Indian Journal of Applied Business and Economi Research
Vol. 4, No. 2, 2023, pp. 197-219
https://DOI:10.47509/IJABER.2023.v04i02.06

ARF INDIA
Academic Open Access Publishing
www.arfjournals.com

THE NEXUX BETWEEN MONETARY POLICY AND SUSTAINABLE DEVELOPMENT GOALS NUMBER TEN IN NIGERIA

Ja'afar, Yusuf[1*] and Adamu, Abubakar Manu[2]

[1]Department of Accounting, Faculty of Management Sciences, Federal University of Kashere (FUK), Gombe-Nigeria. E-mail: jaafaryusuf2015@gmail.com
[2]Department of Economics, Faculty of Management Sciences, Federal University Lokoja, Kogi-State, Nigeria. E-mail: abubakar.manu@fulokoja.edu
[***]Corresponding Author

Received: 06 November 2023; Revised: 10 December 2023; Accepted 14 December 2023; Publication: 29 December 2023

Abstract: The lingering menace of income disparities amongst citizens in Nigeria have become rampant and a serios challenge to policy makers amidst era of continuous monetary policy crises, as well as the increasing pressure from the global community vis-a-vis the attainment of Sustainable Development Goals number ten (SDG-10). This study examines the nexus between monetary policy and sustainable development goals number ten in Nigeria from (1987 to 2022). The data for this study were collected from secondary sources which includes; World Bank and World Development Indicator online data base, previous research and government documents as well as journals articles. The estimation techniques used for this study is econometrics tools to run the regression, unit root test, ARDL, Bound Test and granger causality tests. The result of the unit root test revealed that there is combination of I(1) and I(0) among the variables, ARDL test result shows that there is existing of long relationship through the bound test, of F-statistics 5.633258 at 10 and 5 per cent respectively. The granger causality test indicates the unidirectional causality, bidirectional causality and no causality relationship among the variables. The result of the short-run and long run indicates that the monetary policy have both positive and negative impact on SDG-10 in Nigeria. What remains to be done is for the government to consider the inflationary and exchange rates in Nigeria in order to tackle the level of inequality amongst the citizens. This can be

To cite this paper:
Ja'afar, Yusuf & Adamu, Abubakar Manu (2023). The Nexus between Monetary Policy and Sustainable Development Goals Number Ten in Nigeria. *Indian Journal of Applied Business and Economic Research*. 4(2), 197-219. *https://DOI:10.47509/IJABER.2023.v04i02.06*

effectively carried out through a stringent price control for goods and services as well as implementing a fixed exchange rate policy that would restrict the ever-declining value of naira relative to dollar exchange rate. If effectively articulated, it will ensure equitable distribution of income and wealth amongst the citizens in the country.

Keywords: Monetary Policy, Reduced Inequality, Sustainable Development Goals, Nigeria

INTRODUCTION

There is a growing body of literature on the causes of income inequality both in developed and developing countries. Several factors have been considered to be responsible for increasing disparity in the level of income. Such factors range from technological progress, demographics, globalization, structure of the labour market, and structure of the economy (Furceri *et al.*, 2016). Recently, monetary policy has also been identified as one of the causes of inequality. It has been argued that the distributional effect of monetary policy also affects income inequality, however, the net effect of this policy on income inequality is not clear (Bernanke, 2015).

In an attempt to examine the impact of monetary policy on sustainable development goals number ten (SDG-10), Coibion *et al.* (2012) found that expansionary monetary policy shocks reduce inequality in the U.S. After this pioneering study, Saiki and Frost (2014) found a contradicting result in the case of Japan. The study reported a positive relationship between expansionary monetary policy shocks and inequality. These two contradicting results set the stage for further investigation of the subject matter. The results of further research could be grouped into four different categories. The first set found out that contractionary monetary policy increases inequality (Furceri *et al.*, 2017; Aye *et al.*, 2018; Feldkircher and Kakamu, 2018). The second set found out that contractionary monetary policy decreases income inequality (Davtyan, 2016; Siami-Namini *et al.*, 2020). The third set discovered that expansionary monetary policy increases income inequality (Inui *et al.*, 2017; Taghizadeh-Hesary *et al.*, 2018; Herradi and Leroy, 2019) while the fourth set found out that expansionary monetary policy reduces income inequality (Hohberger *et al.*, 2019).

Furthermore, Davtyan (2016) argues that many authors commit the error of using measures of income inequality that do not capture the income distribution of the entire population. Such measures use household data that do not represent the income of the top few that controls the economy,

especially in developing countries. In such a case, the results of the effect of monetary policy shocks on inequality from such data might be misleading. He suggests the use of an income inequality index that covers the whole income distribution of the entire population.

This study therefore, contributes to the extant literature in three areas. First, it confirms the validity or otherwise of policy ineffectiveness proposition in Nigeria. Second, it examines the effects of anticipated and unanticipated conventional monetary policy shocks on income inequality in Nigeria. Anticipated and unanticipated monetary policies are generated from the monetary policy function. The implementation of monetary policy in Nigeria follows the Taylor-type reaction function as proposed by Taylor (1993) where the short-term interest rate is the policy instrument. The predictive component of the policy function represents anticipated monetary policy and the residual represents the unanticipated. finally, the study uses the Gini coefficient as a measure of income inequality as suggested by Davtyan (2016). This measure of income inequality captures the income distribution from the spectrum of its three basic layers viz; upper, middle, and lower of the entire citizens in Nigeria.

It is also imperative to state that, considering there are other measures of monetary policy like the income per capita, wages, salaries among others. This study relies mainly on the Gini coefficient in measuring inequality. This is because it provides a reliable explanation on the different measures of inequality especially in the Nigerian context.

Over the past decades, prominence in ensuring stability of the entire monetary policy has received attention due to several episodes of economic and financial crisis/instability and the severe consequences it has on monetary policy, inequality, economic growth and performance at large. To maintain stability in the monetary policy, financial authorities across the world in collaboration with IMF, ESCB and WB introduced an initiative focused on a single methodology for the compilation of Financial Soundness Indicators (FSI) as a measure of the stability of an economy's monitary policy. The IMF's FSI aims to provide reliable and dependable financial indicators that are pre-emptive towards unanticipated monitary policy crisis and shocks emanating within or outside the economy.

The Nigerian economy, having experienced several periods of financial instability, financial authorities, have taken considerable steps and embarked on several reforms towards ensuring a much stable, robust and viable monitary policy. Some of these were; in the 1990's, capital base requirement in the

banking industry was increased, close supervision on non-performing loans among banks was intensified and regulation on structure and ownership of commercial banks was strengthened. Furthermore, steps towards achieving total independence of the CBN from Federal Ministry of Finance (FMF) was advanced and expediting legal proceedings in convicting illicit and fraudulent acts in financial institutions like the Decree No.18 of 1994 on failed banks and recovery of debts particularly on insider abuse in which key officials were alleged to have partook in. In 2005, the CBN increased the minimum capital base to N25 billion, consolidation of banking institutions through mergers and acquisitions, closer collaboration with the EFCC, establishment of the Financial Intelligence Unit (FIU) and accelerated completion of the Electronic Financial Analysis Surveillance System (e-FASS). It also established the Monitary Policy Stability Committee (MPSC) in August of 2009. The committee is saddled with the responsibility of publishing a detailed Monetary Stability Report (MSR) bi-annually.

In spite of the laudable reforms embarked upon to ensure financial stability, while available data suggest relative stability in the monitary policy, the economy still lacks the desired economic growth anticipated by economists and financial authorities (Gidigbi, 2017). While the CBN in its Monetary Stability Report for the past 5 years have recorded considerable improvement and stability on inequality in Nigeria (CBN, 2016; Umoru & Osemwegie, 2016). A plethora of researchers like Drambi *et al.*, (2015); Eta & Anabori, (2015); Ochei, (2013); Ogwumike & Salisu, (2008); Omolara & John, (2016); Omoruyi & Ede, (2014); Udom *et al.*, (2018); Udude, (2014); Ugwuanyi & Odo, (2015) argue that while there may be relative stability in the sector, the policy reforms are yet to achieve significant contribution to sustained economic growth.

Furthermore, a study by Obienusi, (2015) shows that the ability of the monetary policy to stimulate economic growth and development depends on the health, soundness and stability of the inequality level in Nigeria. Hence, this study hopes to add to the lingering debate and take an informed position on the subject. To this end, this study attempt to analyze the nexus between monetary policy and SDG-10 in Nigeria and investigate why despite stability reforms, the Nigerian economy is not able to achieve stable and sustained income inequality in the country. Based on the earlier points highlighted, it is pertinent to ask what is the impact of monetary policy on sustaianble development goals number ten in Nigeria?

The broad objective of this study is to ascertain the empirical relationship between monetary policy and inequality in Nigeria. The specific objectives are to:

(i) Find out the nature of causality between monetary policy and SDG-10 in Nigeria;
(ii) Examine whether there is a long-run significant relationship between monetary policy and SDG-10 in Nigeria;
(iii) Ascertain the impact of monetary policy on SDG-10 in Nigeria.

Consistent with the research objectives, the following null hypotheses were fomulated:

H_{01}: There is no causality between monetary policy and SDG-10 in Nigeria;
H_{02}: There is no significant long-run relationship between monetary policy and SDG-10 in Nigeria;
H_{03}: Monetary policy has no significant impact on SDG-10 in Nigeria.

This study will serve as a morale booster to the government especially in tailoring its monetary policy agenda towards achieving a vibrant, strong and stable financial system capable of contributing to economic growth, absorbing shocks, efficient allocation of scarce resources, even distribution of income, reducing income disparity (inequality), creating a financial mechanism and framework capable of warning and detecting a possible disruption in the function of the financial system from forces within or outside the economy.

This study is arranged into five sections. The first section deals with the introduction and contains the background issues of the study and finally, significance of the study. Section two captures the conceptual framework of key ideas embedded in the study and reviews empirical literatures as well as the theoretical framework underpinning the variables of the study. Section three presents the methodology of the study including the techniques used for data analysis. Section four deals with the presentation of data, analysis of empirical results and discussion of findings. Section five is a highlights of the summary, conclusion and recommendations of the study.

REVIEW OF EMPIRICAL STUDIES

Accordingly, extant studies have examined the effects of the types and nature of monetary policy shocks on income inequality. Types of monetary policy shock are expansionary and contractionary shocks. Likewise, monetary policy could either be anticipated or unanticipated. The pioneering study, Coibion *et*

al. (2012), investigated the effects of the types of monetary policy shocks on consumption and income inequality in the United State. The results showed that contractionary monetary policy shocks increase income inequality. This result is supported by the findings of Furceri *et al*. (2017) using a panel of 32 advanced and emerging market countries between 1990 and 2013 and Feldkircher and Kakamu (2018) in Japan between 2002:1 and 2016:4. In the same vein, Aye, Clance, and Gupta (2019) examined the effectiveness of monetary and fiscal policy shocks on inequality in the face of uncertainty in the United State between 1980:1 and 2008:4. The results also support the fact that contractionary monetary policy shock increases income inequality in the country.

Siami-Namini *et al*. (2020) found out that contractionary monetary policy shock decreases income inequality in the U.S. Another strand of the empirical literature (Inui *et al*., 2017; Taghizadeh-Hesary *et al*., 2018; Herradi and Leroy, 2019) reported that expansionary monetary policy shock increases income inequality in Japan and 12 advanced economies respectively. Contrary to this finding is Hohberger *et al*. (2019). The study found an inverse relationship between expansionary monetary policy shock and income inequality in the euro area. Furthermore, Furceri *et al*. (2017) studied the effects of the nature of monetary policy shock on inequality using a panel of 32 advanced and emerging market countries. The study concentrated only on the effect of unanticipated shock on inequality, neglecting the anticipated shock. Results showed that unanticipated shock increases inequality over the period under study. Aside from Furceri *et al*. (2017), the empirical literature on the effects of the nature of monetary policy shocks on income inequality is sparse. This, therefore, calls for further research.

Another important issue raised in the literature is about the measurement of income inequality. Several studies (Inui *et al*., 2017; Feldkircher & Kakamu, 2018; Saiki and Frost, 2019; Aye *et al*., 2017) used Gini coefficient generated from micro-level data. Davtyan (2016) cast doubt on the estimates generated from such data because they might not represent the whole population, especially the top one percent that are controlling the economy. This study, therefore, contributes to the extant literature by investigating the impact of anticipated and unanticipated monetary policy in generating income inequality in Nigeria, using the Dynamic Stochastic General Equilibrium approach. This is because income inequality is prominent in developing countries and understanding the impact of these shocks will help policy makers in curbing its spread. Besides, the study uses the Gini index, generated by World Development Indicator,

to measure income inequality in the country. The index measures the extent to which distribution of income among individuals or households within an economy deviates from a perfectly equal distribution.

In particular, expansionary monetary policy tends to provide a larger benefit to households who have negative unhedged interest rate exposure i.e. households whose maturing liabilities exceed their maturing assets. Opposite effects have been also documented: Expansionary monetary policies and low interest rates favour borrowers who may be low income households while savers and lenders are adversely affected (Dopeke & Schneider, 2006). Hence monetary policy can have an ambiguous effect on inequality. The relationship complicates further by considering the sources of income of households. If monitory policy affects wages and labour income, then households for which wage is the most important source of income will be strongly affected. If monetary policy substantially alters asset prices, high income households which hold financial wealth will be highly affected.

Furthermore, Coibion *et al.* (2012) investigate whether the US monetary policy has contributed to changes in consumption and income inequality. The authors use household level data from the Consumer Expenditures Survey (CEX) since 1980 at quarterly frequency to construct their different measures of inequality and to see how these measures respond to monetary policy shocks as identified by Romer and Romer (2004). Their findings suggest that contractionary monetary policy shocks significantly increase income, consumption and wage inequality among US households. In the present study we investigate whether monetary policy shocks have affected earnings, income and consumption inequality in Nigeria.

While this study is closely related to Coibion *et al.* (2012), there are a number of important distinguishing features. First, the study uses a substantially longer quarterly time series for the inequality measures - from 1969 to 2012. This period includes a number of recessions and expansions where the Bank of England used a variety of policies, with this variation providing a stronger identification of policy shocks. Second, in addition to investigating the impact of standard monetary policy, it also examines the impact of unconventional monetary policy on inequality. Most importantly, annual data on the Gini coefficient in a mixed frequency VAR to investigate the level of inequality in Nigeria have been employed. See Mumtaz and Theophilous (2015).

Over the past year, additional studies have applied similar methods to investigate this issue for various sets of countries. This includes Guerello (2016)

for the Euro Area and Furceri et.al (2016) for developed and emerging countries found that monetary contraction raises inequality and Inui et.al (2017) for Japan who report an unstable relationship between inequality measures and monetary policy changes. Using a Structural Vector Autoregression (SVAR), it was found that contractionary monetary policy shocks lead to an increase in earnings, income and consumption inequality. These results remain invariant to alternative specifications of the VAR, the monetary policy shock makes important contributions to historical fluctuations in the inequality measures. In order to investigate the possible factors behind the increase in inequality we estimate the SVAR using data for households at different percentiles of the distribution.

THEORETICAL FRAMEWORK

The classical economists' view of monetary policy is based on the quantity theory of money. The quantity theory of money is usually discussed in term of fisherian equation of exchange, which is given by the expression **MV = PY**. In the expression, M denotes the supply of money over which the Federal Government has some control; V denotes the velocity of circulation which is the average number of times a currency is spent on final goods and services over the course of a year; P denotes the price level. Hence PY represents current nominal GDP. The equation of exchange is an identity which states that the current market value of all final goods and services (nominal GDP) must equal the supply of money multiplied by the average number of times a currency is used in transaction in a given year.

The classical economist believes that the economy is always at or near the natural level of real GDP. Thus, they assume that in the short run, the Y in the equation of exchange is fixed. They further argue that the velocity of circulation of money tends to remain constant. So that V can also be regarded as Fixed. Given that both Y and V are fixed, it follows that if the Central Bank of Nigeria (CBN) were to engage in expansionary (or contractionary) monetary policy, it will lead to an increase (or decrease) in money supply (M), the only effect would be to increase (or decrease) the price level P, in direct proportion for the change in money supply (M). In other words, expansionary monetary policy can only lead to inflation, and contractionary monetary policy can only lead to deflation of the price level.

The quantity theory of money (QTM) refers to the proposition that changes in the quantity of money lead to, other factors remaining constant,

approximately equal changes in the price level. Usually, the QTM is written as $MV = PY$, where M is the supply of money; V is the velocity of the circulation of money, that is, the average number of transactions that a unit of money performs within a specified interval of time; P is the price level; and Y is the final output. The quantity theory is derived from an accounting identity according to which the total expenditures in the economy (MV) are identical to total receipts from the sale of final goods and services (PY). This identity is transformed into a behavioural relation once V and Y are assumed as given or known variables.

METHODOLOGY AND MODEL SPECIFICATION

The study adopts the New Keynesian model with standard Calvo sticky price and no capital, as considered by Clarida, Gali and Gertler (1999), Woodford (2003), Liu and Zhang (2010), Ireland (2005), Adebiyi and Mordi (2011), Mordi *et al.* (2013), Akinlo and Apanisile (2019), and Apanisile and Osinubi (2020). The key assumptions of the model are imperfect competition which is based on the fact that firms produce heterogeneous goods and sticky prices which make it difficult for all firms to reset their prices at the same time. Key players in the model are household, firm, and government.

Household

The model presumes a set of identical and infinitely lived households that make consumption and labour supply decisions, demand, money and bonds, and seek to maximize:

$$Maxc_t \frac{MtEo}{P_t} \sum_{t=0}^{\infty} B^t U(C_t, N_t \frac{M_t}{P_t} \tag{1}$$

Where E_0 denotes expectation operator condition on time 0 information, β is the discount factor, $M_t P_t$ is the real money holding; subject to the budget constraint:

$$P_t C_t + Q_t B_t + M_t \leq + M_{t-1} B_{t-1} + W_t N_t + J_t \tag{2}$$

Where $C_t(i)$ represents the quantity of good i consumed by the household in period t, for $i \in [0,1]$ for $t = 0, 1, 2, \ldots$, $Pt(i)$ is the price of good i, Nt denotes hours of work, W_t is the nominal wage, Bt represents purchases of one-period bonds at a price Qt, B_{t-1} is the number of bonds purchased last year, M_t is money holding and J_t is a lump-sum component of income. ∈ measures the inter temporal elasticity of substitution between the differentiated goods, which

is equal to the price elasticity of demand. Using the Kuhn-Tucker approach to obtain FOC conditions of equations (1) and (2) and re-arrange, we have:

$$1 - B(1 + i_t) E_t \left(\frac{U_c(t-1)}{U_c(t)} \frac{P_t}{P_t} \right) \tag{3}$$

Equations (3), (4) and (5) determine the inter temporal consumption allocation (the Euler equation), the labour- leisure choice, and the money demand respectively. The equations determine the rational forward-looking household's allocation decision.

$$\frac{U_N(t)}{U_C(t)} = \frac{W_t}{P_t} \tag{4}$$

$$\frac{U_M(t)}{U_C(t)} = \frac{i_t}{1 + i_t} \tag{5}$$

$$U(C_t, N_t M_t) = \frac{C_t^i - \sigma}{1 - \sigma} - \frac{N_t^i + \varnothing}{1 + \varnothing} + \left(\frac{\frac{M_t}{P_t}}{1 - V} \right) \tag{6}$$

This study uses secondary data which were obtained from the World Bank Data Indicators (WDI) online data base, 2022, Central Bank of Nigeria (CBN) statistical Bulletin (2022). The data obtained include; Gross Domestic Product (GDP), Nominal Interest Rate (NINT), Nominal Exchange Rate (NEXR), Domestic Inflation Rate (DINR), Trade Openness (TOP) and Gini Index (GID). The methodology used in this study is described in other to give a clear understanding of the steps involved in arriving at the parsimonous model of the study forthe period of thirty six (36) years spanning from (1987-2022). The model is specified as follows;

$$GDP - f(RINR, OEXR, DIFR, TOT, GDI) \tag{1}$$

$$\text{GDPt} - \beta_0 + \beta_1 RINR_t + \beta_2 OEXR_t + \beta_3 DINF_t + \beta_4 TOT_t + \beta_5 GDI_t + \mu_t \tag{2}$$

Where:

GDP = Gross Domestic Product; RINR = Real Interest Rate; OEXR = Official Exchange Rate; DINF = Domestic Inflation; TOT = Term of Trade; GDI = Gini Index; β_0, β_1, β_2, β_3, β_4, β_5= Slopes of the regressions; μ_t = Error term

A prior Expectation

$$\beta_1 > 0, \beta_2 < 0, \beta_3 < 0, \beta_4 > 0, \beta_5 > 0$$

Variables Measurement

Variables	*Description*	*Sources*	*A priori Sign*
Gross Domestic Product (GDP)	This indicator provides values for gross domestic product (GDP) expressed in current international dollars, converted by purchasing power parity (PPP) conversion factor. GDP is the sum of gross value added by all resident producers in the country plus any product taxes and minus any subsidies not included in the value of the products. PPP conversion factor is a spatial price deflator and currency converter that eliminates the effects of the differences in price levels between countries. From April 2020, "GDP: linked series (current LCU)" is used as underlying GDP in local currency unit so that it's in line with time series of PPP conversion factors for GDP, which are extrapolated with linked GDP deflators.	World Bank Development Indicator (WDI) online data base 2021.	
Real Interest Rate (RINR)	Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. The terms and conditions attached to lending rates differ by country, however, limiting their comparability.	World Bank Development Indicator (WDI) 2021.	+
Official Exchange Rate (OEXR)	Official exchange rate refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).	World Bank Development Indicator (WDI) 2021.	+
Domestic Inflation Rate (DIFR)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.	World Bank Development Indicator (WDI) 2021.	+
Term of Trade (TOT)	The terms of trade effect equals capacity to import less exports of goods and services in constant prices. Data are in constant local currency.	World Bank Development Indicator (WDI) 2021.	+

Variables	*Description*	*Sources*	*A priori Sign*
Gini Index (GDI)	Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	World Bank Development Indicator (WDI) 2021.	+

Source: Author Compilation

Unit Root Test

The Unit root test procedure employed for this study is the Augmented Dickey-Fuller (ADF) test developed by Dickey Fuller (1997,1981). The ADF test requires rejecting null hypotheses of unit root, that is the series are non-stationary in favour of the alternative hypothesis of stationary (Omoke, 2010). The tests were conducted without a deterministic trend for each of the series. The general form of the ADF test is stated as:

$$\Delta Y_t = \alpha_1 t + \alpha Y_{t-1} + \Sigma_{i=1}^{m} \alpha_i Y_{t-i} + \varepsilon_t \quad (3)$$

Where: y is a time series, t is a linear time trend, Δ is the difference operator, β_o is a constant, n is the optimum number of lags in the dependent variable and ε_t is the error time t.

Autoregressive Distributed Lag (ARDL)

This model is an ordinary least square (OLS) based model which can be used for both non-stationary data as well as for data with mixed order of integration. This technique used sufficient numbers of lags to capture the data generating process in a general to specific modeling framework (Shrestha & Bhatta, 2018). The dynamic error correction model (ECM) can be obtained from the ARDL model through a simple linear transformation. Similarly, the ECM combines both the short run dynamics with the long run equilibrium relationship.

According to Akpan and Akpan (2012), the statistic underlying this test is the Wald or F-statistic in a generalized Dickey-Fuller type regression, which is used to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium correction model (UECM). The general form of the Autoregressive Distributed Lag (ARDL) bounds testing model is presented as follow:

$$y_t = \alpha + \beta x_t + \delta z_t + e_t \tag{4}$$

The error correction version of the Autoregressive Distributed Lag (ARDL) bounds testing model is expressed as:

$$\Delta y_t = \alpha_0 + \Sigma_{i=1}^{p} \beta_1 \Delta y_{t-1} + \Sigma_{i=1}^{p} \delta_i \Delta x_{t-1} + \Sigma_{i=1}^{p} \varepsilon_i \Delta z_{t-1} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + \lambda_3 z_{t-1} + \mu t \tag{5}$$

The first part of equation (v) with β, δ and ϵ denotes short run dynamics of the model while the second part with λs represents long run relationship. The null hypothesis that guides the ARDL approach is $\lambda_1 + \lambda_2 + \lambda_3 = 0$, which implies non-existence of long run relationship.

Granger Causality Test

A variable x is said to Granger cause another variable y if past values of x help predict the current level of y given all other appropriate information

The granger causality test in relation to this research work is given as follows:

$$\text{GDP} = \Sigma\beta_1\, GDP_{t-1} \Sigma\beta_2 GDI_{t-1} \Sigma\beta_3 DINF_{t-1} OEXR_{t-1} RINT_{t-1} \Sigma\beta_4 TOT_{t-1} \tag{6}$$

$$GDI = \Sigma\beta_1\, GDP_{t-1} \Sigma\beta_2 GDI_{t-1} \Sigma\beta_3 DINF_{t-1} OEXR_{t-1} RINT_{t-1} \Sigma\beta_4 TOT_{t-1} \tag{7}$$

$$DINF = \Sigma\beta_1\, GDP_{t-1} \Sigma\beta_2 GDI_{t-1} \Sigma\beta_3 DINF_{t-1} OEXR_{t-1} RINT_{t-1} \Sigma\beta_4 TOT_{t-1} \tag{8}$$

$$EXR = \Sigma\beta_1\, GDP_{t-1} \Sigma\beta_2 GDI_{t-1} \Sigma\beta_3 DINF_{t-1} OEXR_{t-1} RINT_{t-1} \Sigma\beta_4 TOT_{t-1} \tag{9}$$

$$INT = \Sigma\beta_1\, GDP_{t-1} \Sigma\beta_2 GDI_{t-1} \Sigma\beta_3 DINF_{t-1} OEXR_{t-1} RINT_{t-1} \Sigma\beta_4 TOT_{t-1} \tag{10}$$

$$TOT = \Sigma\beta_1\, GDP_{t-1} \Sigma\beta_2 GDI_{t-1} \Sigma\beta_3 DINF_{t-1} OEXR_{t-1} RINT_{t-1} \Sigma\beta_4 TOT_{t-1} \tag{11}$$

Decision Rule

The decision rule for the causality model is the test of the null hypothesis that estimated coefficient is zero at the appropriate level of significance where at least four null hypotheses will either be rejected or accepted.

DATA ANALYSIS AND INTERPRETATION

The data analysis and presentation on the impact on monetary policy on inequality in Nigeria in Nigeria from 1985 to 2020, the data are; Gross Domestic Product (GDP), Real Interest Rate (RINR), Official Exchange Rate (OEXR), Domestic Inflation (DINF), Term of Trade (TOT) and Gini Index (GDI).

Unit Root Test

To avoid spurious regression results that characterize non-stationary time series data, Gujarati, *et al*. (2009) proposed that they should be subjected to a stationarity test. The tests of the variables at level and first difference using both Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) unit toot tests. Using the ADF test at levels, the results suggested that some of the variables were stationary at level, while in most cases, PP test suggested non-stationary of the variable at levels. The PP test was preferred to augument the ADF test, due to the validity of its results even when disturbance are serially correlated and heterogeneous, unlike the ADF test, which is non-parametric test. The results obtained are summarized in Table 2

Augmented Dickey Fuller (ADF) Test					
Variables	*At Level*	*Prob.*	*1st Difference*	*Prob.*	*Order of Integration*
GDP	-1.0846	0.7105	-3.0570	0.0396**	1(1)
GDI	-1.4373	0.5529	-5.0948	0.0002***	1(1)
DINF	4.6285	1.0000	-2.0742	0.2557	1(1)
OEXR	1.8132	0.9996	-3.9883	0.0041***	1(1)
RINT	-3.1695	0.0306**	-6.2757	0.0000***	1(0)
TOT	-0.8925	0.7788	-5.9344	0.0000***	1(1)

(*) indicates significant at the 10%, (**) significant at the 5% and (***) significant at the 1%
Source: Computed by the Author using Eviews 10

The unit root results presented in table 2 showed that all the variables are stationary at after first difference except Real interest rate (RINT) that was stationary at level and at 5% level of significance. This implies that the variables are integrated of order I(0) and I(1) using the ADF. This is because the test statistics of all the variables at first difference are greater than their critical values at 5 per cent and 1 per cent levels of significance.

Consequently, ARDL bounds test for Cointegration was deemed appropriate to check for the long-run relationship among the variables in the models used in this study.

VAR Lag Order Selection Criteria

Before testing for the long-run relationship among the variables the study tested for the optimum lags to be used in the ARDL bounds test and its short and long-run estimates using the VAR lag order selection criteria. The result obtained is presented in Table 3.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1949.445	NA	3.63e+42	115.0262	115.2955	115.1180
1	-1724.059	357.9663*	5.47e+37*	103.8858*	105.7713*	104.5288*
2	-1695.210	35.63663	1.03e+38	104.3065	107.8081	105.5006

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

From Table 3, the different criteria suggested different optimum lags that can be used for the specified output. Sequential Modified LR test statistic (LR) choose 2 lags, Final Prediction Error (FPE) and Akaike Information Criterion (AIC) picked 1 lag out of a maximum of 3 lags while Schwarz Information Criterion (SC) choose lag 1 and Hanna-Quinn Information Criterion, out a maximum of 2 lags. If there are limited observations in the ARDL model, it is often advised to use the Akaike Selection Criterion (AIC) in selecting the optimum lag length. Thus, this study used 1 lag to determine the long-run relationship among the variables in the output equation.

ARDL Bounds Test for Cointegration

Having established the order of integration and the maximum lags to be used in the equations adopted for this study, it went further to ascertain if there is the long-run relationship among the variables using autoregressive distributed lag (ARDL) bounds testing approach. The result obtained is presented in Tables 4.

Table 4: ARDL Bounds Test

Test Statistic	**Value**	**K**
F-statistic	5.633258	5
	Critical Value Bounds	
Significance Level	**I(0) Bound**	**I(1) Bound**
10%	2.08	3.2
5%	2.39	3.38

Computed by the Author using Eviews 10

The table 4 showed the result of the ARDL bounds test for cointegration for human capital development, poverty and inequality in Nigeria. The first step in this procedure is to compare the value of the calculated f-statistic and critical value bounds. From the table 4, the estimated f-statistic of 4.456343 calculated at k=3 (number of explanatory variables) and the estimated respectively exceeds the upper critical bounds at 10 and 5 per cent levels of significance respectively. Hence, the null hypotheses of no long-run relationship among the variables is rejected. This implies that there is a long-run association between the variables. The next step is to investigate the short and long-run association of monetary policy on inequality in Nigeria.

ARDL Short-Run

Table 5: Results of Estimated Short- run Coefficients Using ARDL Approach ARDL, (1, 0, 0, 1, 0, 0) Selected Based on Akaike Information Criterion

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.**
GDP(-1)	1.07403	0.050113	21.89872	0.0000
GDI	92.9744	474.2252	0.194628	0.8471
DINF	-21.9398	140.1407	-1.797764	0.0834
OEXR	-13.7993	85.95369	-1.323960	0.1966
OEXR(-1)	25.9735	121.5436	2.270571	0.0314
RINT	-23.8713	899.5924	-0.237742	0.8139
TOT	1.92E-10	5.08E-10	0.377819	0.7085
C	-21411.10	21896.24	-0.977844	0.3368

Computed by the Author using Eviews 10

The short-run estimate coefficient in table 5 revealed that negative sign of Domestic inflation (DINF) 1 per cent increase will decrease the Gross Domestic Product (GDP) at 10 per cent level of significance, the positive sign of official exchange rate (OEXR)(-1) 1 per cent increase will increase the Gross

Domestic Product (GDP) and is statistically significance at 5 per cent level of significance in the short-run. This indicates that the two variables play a vital role on the impact of monetary policy on inequality in Nigeria. This study is in line with the study of Karen (2016), Apanisile (2021) and contrary to the study of Kuhelika (2021).

Table 6: Results of Estimated Long- run Coefficients Using ARDL Approach ARDL, (1, 0, 0, 1, 0, 0) Selected Based on Akaike Information Criterion

Conditional Error Correction Regression				
Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	-21411.10	21896.24	-0.977844	0.3368
GDP(-1)*	0.097403	0.050113	1.943687	0.0624
GDI**	92.29744	474.2252	0.194628	0.8471
DINF**	-21.9398	140.1407	-1.797764	0.0834
OEXR(-1)	12.1743	88.27781	1.837090	0.0772
RINT**	-23.8713	899.5924	-0.237742	0.8139
TOT**	1.92E-10	5.08E-10	0.377819	0.7085
D(OEXR)	-13.7993	85.95369	-1.323960	0.1966

Computed by the Author using Eviews 10

Table 6 showed the long-run coefficient of the negative Domestic Inflation (DINF) with (-21.9398) 1 per cent decrease will decrease the Domestic Inflation with -21 per cent and statistically significance at 10 per cent, the positive sign of official exchange rate (OEXR) 1 per cent increase will increase the domestic product (GDP) at 10 per cent and is statistically significance at 10 per cent in the long-run. This indicates that the inflation and exchange rate play a vital role in influencing the impact of monetary policy on inequality in Nigeria. The study is in line with the study of Voinea, Lovin & Cojocan (2017) and contrary to the study of Johnbosco and Christopher (2020).

Table 7: Granger Causality Test

Null Hypothesis:	*Obs*	*F-Statistic*	*Prob.*
DINF does not Granger Cause GDP	34	0.83717	0.4431
GDP does not Granger Cause DINF		6.84761	0.0037
TOT does not Granger Cause GDP	34	3.97225	0.0299
GDP does not Granger Cause TOT		3.92989	0.0309
OEXR does not Granger Cause GDI	34	2.96663	0.0673
GDI does not Granger Cause OEXR		0.43677	0.6503
RINT does not Granger Cause GDI	34	0.10882	0.8973

GDI does not Granger Cause RINT		2.81636	0.0762
OEXR does not Granger Cause DINF	34	2.45631	0.1034
DINF does not Granger Cause OEXR		4.60946	0.0183
TOT does not Granger Cause DINF	34	0.71700	0.4967
DINF does not Granger Cause TOT		3.62161	0.0394
TOT does not Granger Cause OEXR	34	3.47201	0.0445
OEXR does not Granger Cause TOT		1.41946	0.2582
TOT does not Granger Cause RINT	34	0.92372	0.4084
RINT does not Granger Cause TOT		0.13463	0.8746
Computed by the Author using Eviews 10 *Computed by the Author using Eviews 10*			

Source: Authors' computation using E-views 10

The pairwise granger causality reveals that domestic inflation granger cause Gross domestic product. However, Gross domestic product does not granger cause domestic inflation at 5% level of significance as indicated by the probability values 0.0037 and 0.4431. Thus, there is unidirectional causality from gross domestic product to domestic inflation.

Term of Trade granger causes gross domestic product. However, term of trade does not granger cause domestic groduct at 5% level of significance as indicated by the probability values 0.0299 and 0.0309. Thus, there is a bidirectional causal relationship from term of trade and gross domestic product.

Official exchange rate does not granger cause Gini index. Similarly, official Exchange Rate does not granger cause Gini Index at 10% level of significance as indicated by the probability values 0.0673 and 0.6505. Thus, there is bidirectional causality between the official exchange rate to Gini index.

Real interest rate does not granger cause Gini Index. Similarly, Gini index does not granger cause real interest rate at 5% level of significance as indicated by the probability values 0.0762 and 0.8973. Thus, there is unidirectional causality between real interest rate and Gini Index.

Official exchange rate granger causes domestic inflation. However, official exchange rate does not granger cause domestic inflation at 5% level of significance as indicated by the probability values 0.0183 and 0.1034. Thus, there is a unidirectional causality from official exchange rate to domestic inflation.

Official exchange rate granger causes Domestic Inflation. However, official exchange rate does not granger cause domestic inflation at 5% level of significance as indicated by the probability values 0.0183 and 0.1034.

Thus, there is a unidirectional causality from official exchange rate to domestic inflation.

Term of trade granger causes Domestic Inflation. However, term of trade rate does not granger cause domestic inflation at 5% level of significance as indicated by the probability values 0.4967 and 0.0394. Thus, there is a unidirectional causality from domestic inflation to term of trade.

Term of trade granger causes official exchange rate. However, term of trade rate does not granger cause official exchange rate at 5% level of significance as indicated by the probability values 0.0445 and 0.2582. Thus, there is a unidirectional causality from term of trade to official exchange rate.

Term of trade granger causes real interest rate. However, term of trade rate does not granger cause interest rate at 5% level of significance as indicated by the probability values 0.4084 and 0.8746. Thus, there is a no causality from term of term of trade and real interest rate.

Cumulative Sum of Recursive Residuals of Cusum and Cusum Square

Model stability is necessary for prediction and economic inference. This is regarded as a sufficient condition, hence the study employed stability test for estimated parameters by using the cumulative sum of recursive residual (CUSUM) and cumulative sum of square (CUSUMS Q) tests. The graphical presentation of these tests is presented as follows:

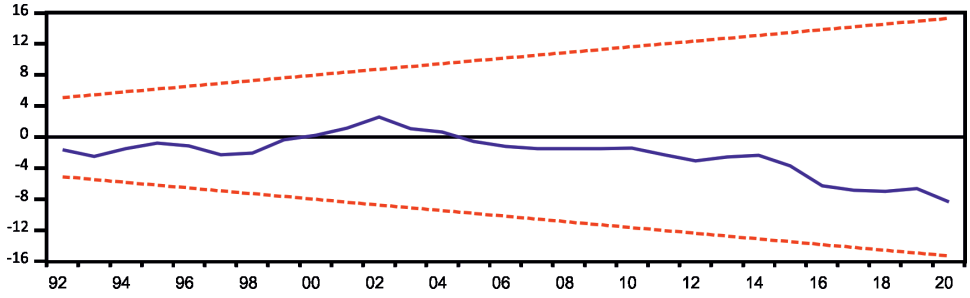
Table 8: Result of Heteroskedasticity and Serial Correlation Test

Heteroskedasticity Test: Breusch-Pegan-Godfrey			
Null Hypothesis: No Heteroskedascitity			
F-Statistic	1.806615	P-value	0.1340
Breusch-Pegan-Godfrey Serial Correlation LM Test			
Null Hypothesis: No Serial Correlation			
F-Statistic	0.271019	P-Value	0.7647

Source: Computed by the Author using Eviews 10

For robustness, therefore, the estimated model was evaluated for presence or absence of serial correlation and Heteroskedasticity with the context of the Breusch-Godfrey Serial Correlation LM test and Breusch-Pegan-Godfrey Heteroskedasticity test, respectively. Both tests were conducted under the null hypotheses of "no autocorrelation" and "no Heteroskedasticity" respectively. The result indicated that the estimated model were free from the econometric problems, as the F-statistics in both tests were statistically insignificant (both

P-value were greater than 0.05), leading to a rejection of the null hypotheses in the test as presented in table 8.



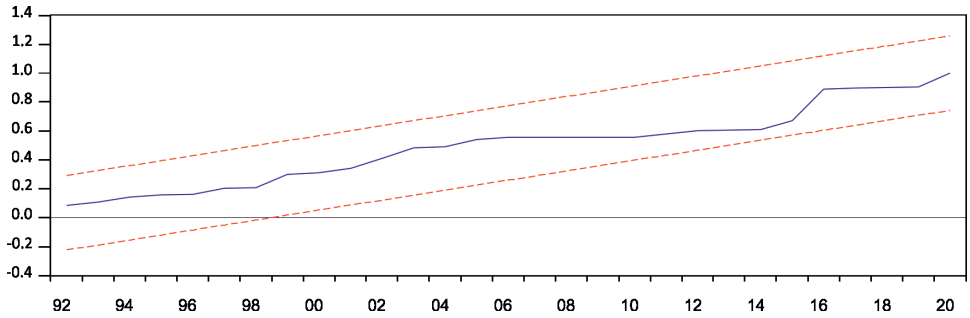
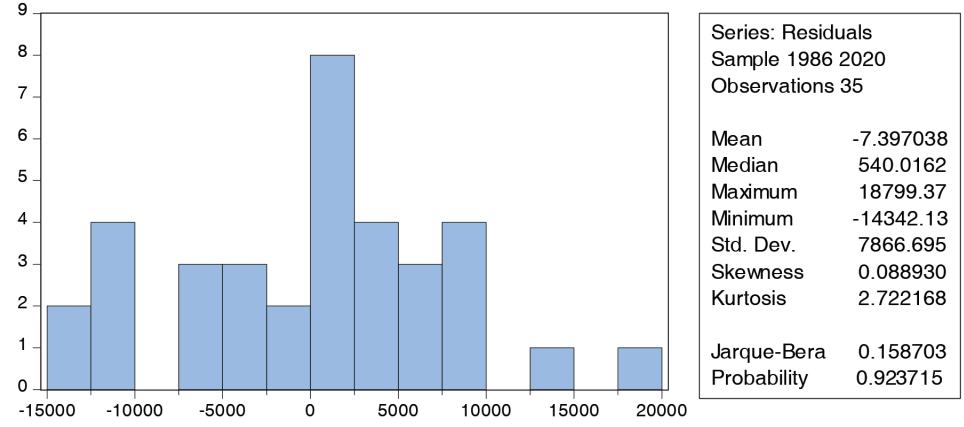


Table 9: Normality Test



The residual from the impact of monetary policy on inequality in Nigeria regression seem to be normally distributed of the Jargue-Bera test shows that the JB statistic is about 0.158703, and the probability of obtaining such a statistic under the normality assumption is about 64 per cent. Therefore, we

do not reject the hypothesis that the error terms are normally distributed in table 9.

CONCLUSION AND RECOMMENDATIONS

The study concludes that in both the short-run and long-run, the domestic inflation decrease the domestic product at 10 per cent level and official exchange rate has positive increase on the gross domestic product in the short-run and in the long-run the domestic inflation also has negative sign in domestic product, the exchange rate increase the domestic product at 10% respectively both in the short-run and long-run coefficient. It is also concluded that monetary policy is significantly related with sustainable development goals number ten in Nigeria.

In line with the findings of this study, the study profered recommendations as follows:

The Federal Government of Nigeria (FGN) through the Central Bank of Nigeria (CBN) should consider the inflationary trend and fluctuating exchange rate in Nigeria to stabilize inequality. This can be effectively achieved through implementing a monetary policy that focused on the expectations of the citizens and thus, helps drastically reduce the increasing level of inflation and exchange rate fluctuations to the barest minimum if not completely eradicated;

Government should focus on monetary policy instruments which if effectively articulated will reduce the high disparity (inequality) in Nigeria. Hence, it will ensure the attainment of sustainable development goals number ten (SDG-10) by the year 2030 in Nigeria;

The FGN through the Budget Office of the Federation (BOF) should endeavor to implement fiscal stability measures aimed at reducing the wide level of disparity between the rich and the poor increase the level of inequality in Nigeria through improving the basic needs such as equal distribution of income and other scarce resources.

References

Adebiyi, M. A., & Mordi, C. O. (2011). 'Building Dynamic Stochastic General Equilibrium Models for Monetary Policy Analysis', *Economic and Financial Review, 49*(1), 1– 24.

Akpan, G.E., Akpan, U.F. (2012), Electricity consumption, carbon emissions and economic growth in Nigeria. *International Journal of Energy Economics and Policy*, 2(4), 292-306.

Akinlo A. E. & Apanisile O. T. (2019). 'Monetary Policy Shocks and Effectiveness of Channels of Transmission in Nigeria: A Dynamic Stochastic General Equilibrium Approach', *Global Business Review* 20 (2), pp. 1–23.

Apanisile, O. T. and Osinubi, T. T. (2020). 'Financial Development and the Effectiveness of Monetary Policy Channels in Nigeria: A DSGE Approach', *Journal of African Business.* 21(2):193-214.

Aye, C. Goodness, Clance, W. Matthew, and Gupta, R. (2019). 'The Effectiveness of Monetary and Fiscal Policy Shock on U.S. Inequality: The Role of Uncertainty', *Quality & Quantity,* 53(1), pp. 283-295.

Belongia, M. T., and Ireland, P. N. (2014). 'The Barnett Critique after Three Decades: A New Keynesian Analysis', *Journal of Econometrics*, 18(1), pp. 5–21.

Bernanke, B.S. (2015). Monetary Policy and Inequality. Ben Bernanke's Blog, 1 June 2015. https://www.brookings.edu/blog/ben-bernanke/2015/06/01/monetary-policy-andinequality/.

Calvo, G. A. (1983). 'Staggered prices in a utility-maximizing framework', *Journal Monetary Economics*, 12(1), pp. 383–398.

Clarida, R., Gali, J., and Gertler, M. (1999). 'The Science of Monetary Policy: A New Keynesian Perspective', *Journal of Economic Literature, 37*(1), pp. 1661–1707.

Coibion, O., Gorodnichenko, Y., Kueng, L. & Silvia, J. (2012). 'Innocent Bystanders? Monetary Policy and Inequality in the U.S.' NBER Working Paper 18170, *National Bureau of Economic Research*, Inc.

Davtyan Karen (2016). 'Income Inequality and Monetary Policy: An Analysis on the Long Run Relation'. *Research Institute of Applied Economics* Working Paper No2016/04.

Feldkircher, M. & Kakamu, K. (2018). 'How does monetary policy affect income inequality in Japan? Evidence from grouped data'. Working Papers in Regional Science 6215, WU Vienna University of Economics and Business.

Furceri, D., Loungani, P., & Zdzienicka, A. (2016). 'The Effects of Monetary Policy Shocks on Inequality', *Journal of International Money and Finance*, 85(issue c), 168-186.

Herradi, M. E., and Leroy, A. (2019). 'Monetary Policy and the Top One Percent: Evidence from a Century of Modern Economic History'. De Nederlandsche Bank Working Paper Series No. 632.

Hohberger, S., Priftis, R., and Vogel, L. (2019). 'The Distributional Effects of Conventional Monetary Policy and Quantitative Easing: Evidence from an Estimated DSGE Model', Bank of Canada Staff Working Paper 2019-6.

Inui, M., Sudo, N., and Yamada, T. (2017). 'Effects of Monetary Policy Shocks on Inequality in Japan', Bank of Japan Working Paper Series 17-E-3.

Ireland, P. (2005). 'The Monetary Transmission', Federal Reserve Bank of Boston Working Paper 61, Boston.

Karen. D, (2016) Income inequality and monetary policy: An analysis on the long-run relationship, research institution of Applied economics working paper 2016/04, 37.

Kuhelika De & Venoo K, (2021) Effects of Monetary Policy on Food Inequality in India, The Journal of Development Studies, 57:11, 1852-1870, DOI: 10.1080/00220388.2021.1906861

Liu, L., & Zhang, W. (2010). 'A New Keynesian Model for Analyzing Monetary Policy in Mainland China', *Journal of Asian Economics, 21*(6), pp. 540–551.

Mordi, C. N. O., Michael A. Adebiyi, Adeniyi O. Adenuga, Magnus O. Abeng, Adeyemi A. Adeboye, Emmanuel T. Adamgbe *et al.* (2013). *Dynamic Stochastic General Equilibrium Model for Monetary Policy Analysis in Nigeria*. Research Department, Central Bank of Nigeria.

Rotemberg, J. J. (1982). Sticky prices in the United States. *Journal of Political Economy*, 90(1), pp. 1187–1211.

Saiki, A., Frost, J. (2014). 'How does unconventional monetary policy affect inequality? Evidence from Japan'. *DNB Working Paper* 423 (2014).

Siami-Namini, S., Lyford, C., and Trindade, A. A. (2020). The Effects of Monetary Policy Shocks on Income Inequality across U.S. States. *Economic Papers of the Economic Society of Australia*. Doi: 10.1111/1759-3441.12279.

Taghizadeh-Hesary, F., Yoshino, N., and Shimizu, S. (2018). 'The Impact of Monetary and Tax Policy on Income Inequality in Japan', Asian Development Bank Institute Working Paper Series No. 837, Tokyo.

Taylor, J. (1993). 'Discretion versus Policy Rule in Action'. *Carnegie Rochester Conference Series on Public Policy, 39*(1), 195–214.

Woodford, M. (2003). *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton: Princeton University Press.

Voinea, L., & Mihaescu, F. (2017). A contribution to the public-private wage inequality debate: the iconic case of Romania. Economics of Transition, 20(2), 315-337.