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Extension and Revision of Monetary Policy Transmission Mechanisms and Their Impact on Domestic Real Investment in Nigeria: A Time Series Study from 1981 to 2015 by Lucky Anyike and Uzah Cheta Kingsley

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Abstract

The study by Lucky Anyike and Uzah Cheta Kingsley examines the impact of monetary policy on domestic real investment in Nigeria, using the Gross Fixed Capital Formation to Gross Domestic Product ratio as a proxy for domestic real investment. The study uses various independent variables, including the maximum lending rate, credit to the private sector as a percentage of GDP, the naira to US dollar exchange rate, the savings rate, the monetary policy rate, the prime lending rate, and the Treasury bill rate. The authors conclude that monetary policy has a significant effect on the domestic real investment rate. The extension of this paper includes an examination of the impact of fiscal policy on domestic real investment in Nigeria, while also considering the influence of political biases and the fact that a significant portion of fiscal policy spending may be allocated to current expenditures rather than capital expenditures. While mainstream economic theory suggests that fiscal policy should have a positive effect on the real investment rate, this theory may be challenged in Nigeria due to the specific context and allocation of fiscal resources. We also examine the effect of monetary policy on the domestic real investment rate in Nigeria by incorporating additional variables in our analysis.

I. Introduction

Since the release of John Maynard Keynes's magnum opus, The General Theory of Employment, Interest and Money, Western economies have made use of Fiscal and Monetary policies to promote economic stability and steady economic growth. He explained that the government can influence the outcome of the economy through tools such as spending and taxes, while central banks could play their part by influencing the money supply and interest rates. It can be argued that the impact of the Great Depression influenced the formation of Keynes ideas and by the late 1930s western economies began using these policies to promote economic growth and stabilize economic outcomes. The ideas posited by Keynes have faced criticisms over the years, notably the argument put forward by monetarists during the 1970s after the theories provided little solution to the rising inflation and recession, a phenomenon called stagflation, faced by many western

economies at the time. Although, Fiscal and Monetary policy was very popular and used by many countries in the aftermath of the 2007-2008 financial crisis.

Investment is a component of GDP and is the most volatile component of aggregate demand. Real Investment as opposed to financial investment is the is the purchase of tangible assets such as machinery, building, infrastructures that are used to produce economic value (Anyike, L., & Kingsley, U. C., 2017). The paper of interest explores Monetary policy transmission mechanism in detail and how money supply and interest rates affect macroeconomic variables. This mechanism includes the interest rate channel, asset price channel and the exchange rate channel.

Gregory E. Givens, Robert R. Reed (2018) found the impact of monetary policy seems to be substantial on the allocation of fixed-capital formation and the distribution of relative investment prices and interpreted this as evidence of asymmetrical monetary transmission mechanism, while Abdur R. Chowdhury, James S. Fackler and W. Douglas McMillin (1986) using VAR found that M1 Granger-causes investment expenditures.

The impact of fiscal policy on economic outcomes is subject to differing perspectives. One viewpoint suggests that government funding for productive investments, research and development, and provision of public goods and services can foster growth in both the short and long term. On the other hand, an opposing perspective posits that government bureaucracy and inefficiency can stifle growth when they intervene in productive sectors of the economy (Easterly and Rebelo, 1993; Mauro, 1995; Folster and Henrekson, 2001). M Kofi Ocran (2011) found that fiscal policy via government spending, consumer outlay, and tax income moderately but consistently affects real output, with tax revenue and budget deficit producing positive effects, while government expenditure produced negative ones. A. Afonso & JT Jalles (2015), in their study of how fiscal policy impacts investment, discovered that taxes on income, profits, and capital gains, as well as social security contributions, had a significant positive impact on public investment for emerging economies, but not for OECD countries. Aschauer (1989) suggests that considerable importance should be assigned to public investment choices like building highways, streets, and water systems when evaluating the government's impact on economic growth and productivity through fiscal policy. This supports our position that fiscal policy does not always have a direct impact on real investment growth. It is therefore important to consider the appropriate factors when channeling fiscal spending to maximize its impact on investment growth.

In Nigeria, the Central Bank of Nigeria is charged with the responsibility of implementing monetary policy activities, while the government controls fiscal policy. The 1969 Act empowered the CBN to make monetary policy decisions under the supervision of the Ministry of Finance. Nigeria's macroeconomic policies have not consistently yielded optimal outcomes, primarily because of the government's unrestrained access to central bank financing and extensive reliance on quasi-fiscal activities. These practices have hindered necessary fiscal consolidation, resulting in the accumulation of fiscal vulnerabilities that may lead to negative macroeconomic consequences in the present and future (Olumuyiwa Adedeji, 2022). In this paper, we explore if and how these policies have had a significant impact on domestic real investment.

II. Literature Review

In this section, we delve into the intricacies of how monetary and fiscal policies impact economic output by examining their underlying mechanisms.

Monetary policy transmission mechanisms

To begin with, we examine the interest rate mechanism.The three channels through which changes in interest rates affect economic outcomes are market rates, asset prices, and expectations. The relationship between central bank and market rates is quite direct. When the official interest rates increase, they affect the cost of borrowing for consumers and businesses from commercial banks and other lending agents. Moreover, a rise in official rates leads to an increase in the interest on government bonds issued. Changes in the official interest rates can significantly affect the expectations and subsequent economic actions of speculators, investors, and businesses. An increase in interest rates signals a higher cost of capital for individuals and private agents, which could incentivize them to reduce investment or spending activities. Changes in current interest rates can also impact expectations of future interest rates. For example, a change in the rate of interest rate hikes could signal the stance taken by the central bank, whether hawkish or dovish, and inform investors' expectations about the direction of future rates, which could subsequently influence their investment decisions.

The impact of interest rates on asset prices is indirect but nevertheless significant. For instance, the recent collapse of Silicon Valley Bank could be attributed to a significant reduction in the value of the long-term bonds held by the bank, caused by the continued interest rate hikes by the Federal Reserve in 2022. The inverse relationship between interest rates and off-the-run bonds resulted in significant book losses for the bank as it attempted to sell off these assets. Interest rates also have an impact on equity prices by influencing the expectations of economic agents. For example, expectations of interest rate cuts will improve stock market performance due to the expectation of a lower cost of borrowing, which will enable firms and companies to expand their investment activities, leading to economic growth. Expectations of restrictive monetary policy will restrict investment activities and curb short-term growth, ceteris paribus.

Campbell (1982) discussed the Keynesian perspective on monetary transmission that centers around the influence of changes in the money supply on the cost of capital through adjustments to short-term interest rates. For instance, an increase in the money supply can boost liquidity in the interbank system, leading to a decrease in overnight interbank rates and, eventually, a reduction in long-term interest rates. This decrease in long-term interest rates can serve as a major stimulus for investment, resulting in an increase in income. According to Tobin (1978), an increase in the money supply can lead to substitution implications between assets such as corporate bonds, equities, and commercial papers, ultimately impacting the rates on these short-term instruments as well as other assets. In addition to these effects, Tobin also discussed other factors that could impact the transmission process, such as increased uncertainties and low retained earnings, which can affect the cost of capital.

Administration of interest rates in Nigeria is divided into two periods. The pre-1986 period saw interest rates administered through the direct monetary management scheme such that interest rates were the primary factor influencing the money market and the variability of credit extended to borrowers. In 1986, Nigeria initiated the Structural Adjustment Program (SAP), which employed inter-bank and emerging rates as a means of transmitting monetary policy. However, the

effectiveness of the interbank market rate declined in the 1990s due to distressed borrowing by insolvent banks, which influenced interest rate changes. In 1993, Open Market Operations (OMO) became the main monetary policy tool in Nigeria. However, Nigeria's OMO method of transmission of monetary policy is unusual since the Central Bank of Nigeria (CBN) engages in a one-way sale of securities to authorized dealers. Additionally, some aspects of this mode of transmission of monetary policy have been considered inadequate compared to developed countries because of the limited participation of the public and non-banking sector, the flexible rediscount policy, and the unappealing interest rates. Consequently, it is to be expected that interest rates in the emerging market will not have an impact on the actual interest rate or cost of funds in the money market.

The credit channel mechanism examines how fluctuations in interest rates impact the availability of credit to the private sector. When the central bank implements restrictive monetary policy by raising reserve requirements for commercial banks, their ability to lend to businesses decreases. Furthermore, when the central bank decreases the money supply, the deposits held by individuals in banks shrink, leading to a reduction in the capacity of banks to extend loans to businesses. In Nigeria, banks tend to give preference to larger firms in terms of sales revenue over medium and smaller businesses; therefore, any alteration in bank reserve policy would disproportionately impact the operations of smaller firms compared to larger ones. For instance, during a credit crunch environment, smaller businesses would only receive minimal funds after loans have been granted to much larger firms (O.A Uchendu 1996).

The exchange rate channel mechanism in Nigeria is unique because changes in the dollar-naira rate have significant implications for economic activities in the country. In the case where the interest rate rises, it can increase capital investment inflows, leading to currency appreciation. However, the changes in the dollar-naira rate are a key determinant of economic activity in Nigeria, as they significantly impact inflation and capital flows. Many manufacturers and retailers, even if their inputs are not dollar-denominated, adjust their prices when the dollar appreciates against the naira. This example and other instances illustrate why the exchange rate mechanism of monetary policy might not play a significant role in determining economic outcomes in the country.

Fiscal Policy

In Nigeria, the government influences economic outcomes through fiscal tools such as taxes, government spending, and corporate taxes. According to Anyanwu's (1996) research on urban unemployment in Nigeria, all fiscal variables were found to significantly decrease unemployment rates in the country. However, one fiscal variable was found to be more effective in reducing unemployment levels in Nigeria compared to monetary policy measures. Ekpo (1994) conducted research examining the influence of government spending on the economic growth of Nigeria from 1960 to 1992. The study results showed that government expenditure on infrastructure can lead to an increase in private investment, supporting the idea of growth through fiscal policy. Our study aims to determine whether fiscal policy variables, including government spending and the corporate tax rate, have had a significant impact on real investment in Nigeria over the period of our analysis.

III. Research Methodology

Our further analysis of how fiscal and monetary policy mechanisms impact domestic real investment in Nigeria has resulted in the adoption of two econometric equations. The contrast of these econometric models provides a window into the effects and limitations of fiscal intervention by the government of Nigeria. The pertinent dependent and independent variables outlined in our assessment include the respective statistics going back over 30 years.

Econometric **Model A**: Monetary Policy

OLS – Ordinary Least Squares Multiple Regression Technique:

Variable Definitions:

Dependent Variable- Time Series (Annual): 1981-2015

DINVT: A homegrown measure of real investment, defined as Gross Fixed Capital Formation relative to Gross Domestic Product. Gross Fixed Capital Formation includes improvements to land, factories, machinery (equipment purchase), and the construction of roads, railways, schools, offices, hospitals, private homes, as well as commercial and industrial buildings (World Bank 2023).

Independent Variables- Time Series (Annual): 1981-2015

MPR: Monetary Policy Rate proxy for interest rate channel. The Monetary Policy Committee (MPC) of Nigeria deploys recommendations for money policy rate changes as a tool to influence cash reserves, short- term money markets, and other interest rates (Central Bank of Nigeria 2023). Composed as the current rate as of December of the specified year.

MLR: Maximum Lending Rate proxy for interest rate channel. The maximum lending rate is an economic tool in which the highest lending rates charged by deposit money banks within Nigeria are set to influence the rates local banks charge on loans to customers (This Day Nigeria 2023). Input as monthly average in year terms.

SR: Savings Rate Proxy for interest rate channel. Gross domestic Savings (% of GDP). Calculated as GDP less total consumption. (World Bank 2023).

FDI: Foreign Direct Investment. With respect to inflow, FDI is based upon a lasting interest in an enterprise; comprised of stock capital, reinvestment of earnings, different forms of long-term capital, and short-term capital (World Bank 2023).

EXR: Official Exchange Rate (per US$). Official exchange rate is determined by Nigerian authorities or an exchange market (World Bank 2023). This data was specifically sourced by the World Bank from the IMF and international financial statistics. Input as monthly average in year terms.

CPS: Monetary sector credit to private sector (% of GDP). This variable includes financial resources allocated to the private sector in the form of loans, security purchases (non-stock), trade credits, and assuming accounts receivable credit (World Bank 2023).

Econometric **Model B**: Fiscal Policy

OLS – Ordinary Least Squares Multiple Regression Technique:

$$DINVT_t = a_{10} + a_{11}MPR + a_{12}MLR + a_{13}SR + a_{14}FDI + a_{15}EXR + a_{16}CPS + u_{1t}$$

Variable Definitions:

Dependent Variable- Time Series (Annual): 1981-2015

DINVT: A homegrown measure of real investment, defined as Gross Fixed Capital Formation relative to Gross Domestic Product. Gross Fixed Capital Formation includes improvements to land, factories, machinery (equipment purchase), and the construction of roads, railways, schools, offices, hospitals, private homes, as well as commercial and industrial buildings (World Bank 2023).

Independent Variables- Time Series (Annual): 1981-2015

GSPEND: General Government Final Consumption Expenditure (% of GDP). This iteration of government spending includes current purchases of goods and services, employee wages, national defense, and security (World Bank 2023).

CORPTR: Corporate Tax Rate. While corporate tax rates are a source of income for countries, policy makers must also create situations that incentivize business to take up operations in the region. Average statutory corporate tax rates are weighted by GDP for the mentioned dataset (Tax Foundation 2023).

FDI: Foreign Direct Investment. With respect to inflow, FDI is based upon a lasting interest in an enterprise; comprised of stock capital, reinvestment of earnings, different long-term capital, and short-term capital (World Bank 2023).

PSEE: School Enrollment Gross- Primary. The education system of Nigeria has a certain capacity for enrollment, in this case, high ratios may indicate overage children who are also enrolled due to possibly being held back or getting a late start (World Bank 2023).

LRGDP: Log of GDP (Current US$)- Nigeria. This figure is comprised of the gross value created by resident producers, adding taxes while subtracting government subsidies (World Bank 2023). GDP is a statistic that takes the local currency and converts it to U.S. dollars using yearly exchange rates (World Bank 2023).

Data Sources

As our additional fiscal and monetary analysis is an extension and revision of Lucky and Kingsley's original contention, we began with a similar data structure in an attempt to understand the previous authors' vision and data collection method. This process opened with our group recreating a rudimentary mock model similar to the equation at the forefront of Monetary Policy Transmission Mechanisms and Domestic Real Investment in Nigeria: A Time Series Study 1981-2015. This was just a reference as we steered completely to our own data collection method and subsequent variable implementation. Our intensive sourcing procedure led us to international banking statistics and citation, as well as an in-

depth understanding of the economic practices of the government of Nigeria.

The Central Bank of Nigeria (CBN) was a valuable resource in terms of the entities' commitment to historical data and strong description of respective rate meanings. Our first econometric equation was greatly enhanced by the confidence we felt in the data sourced from the organization. A 2007 CBN Act bestowed complete control of monetary and financial policy procedures upon the federal bank (Central Bank of Nigeria 2023). Some of the organization's responsibilities are to ensure price stability, print legal tender in the country, and promote a sound financial system to exhibit financial control in Nigeria (Central Bank of Nigeria 2023). The Central Bank of Nigeria publishes charted materials defined as money market indicators that allow researchers to visualize the year-on-year changes in relevant rates (lending, savings, money policy, etc.). The merits of data collection from a reputable source, especially one with the best interests of the country at large, further solidified our vision regarding the true impact of monetary policy on real investment.

The World Bank has undertaken an initiative to include a data arm in its portfolio of services. The bank itself is committed to sustainability and implementing practices to reduce poverty around the world. In assessing the country of Nigeria, we sourced a myriad of materials that assisted us in augmenting the initial monetary policy equation and creating a stand-alone fiscal policy equation. The World Bank data allowed said research to include some overlap variables in both equations. The thought here is that we successfully contrived a comparison that shows the true effect of real investment regressed on data such as foreign direct investment, real GDP, primary school enrollment, etc. Once again, the backing of a strong source with what we believe is a respectable motive adds additional value to our analysis. The DataBank analysis visualization tool from the World Bank is a time series mechanism that assisted our sourcing going back to the early 1980s (World Bank).

In revising and extending the original paper, one of our main focuses was to keep the integrity of the past research in mind when adding our own viewpoint. The Central Bank of Nigeria's data collection process allowed us to truly understand our predecessors' sourcing and direction. We were in turn able to keep the requisite variables (with first-person time-series data sourcing) over the same period while implementing trusted sources from the World Bank to enhance our respective econometric equations.

Special Problems

When implementing a multiple regression model, many econometricians take further steps to strengthen the model by adjusting the variables based on the type of data collected. Our sourced data was continually rate- or percentage-specific, which might indicate a need for a log procedure. This issue can be further analyzed in a more extensive residual analysis. Please see below for log econometric equations in further assessing all angles of research. Due to our analysis being an extension of a previous paper, the original level-level (level-log for DINVT-real GDP only) econometric equations were the only models deployed in our report.

$$\log DINVT_t = a_{10} + a_{11}\log MPR + a_{12}\log MLR + a_{13}\log SR + a_{14}\log FDI + a_{15}\log EXR + a_{16}\log CPS + u_{1t}$$

$$\log DINVT_t = a_{20} + a_{21}\log GSPEND + a_{22}\log CRPTR + a_{23}\log FDI + a_{24}\log PSEE + a_{25}\log RGDP + u_{2t}$$

At one juncture of our research, we were using an annual population growth variable in the fiscal policy econometric equation. This specific variable proved to exhibit an issue with stationarity in the first difference. Due to the fact that Lucky and Kingsley ran stationary analyses in the first difference as well, we decided to omit this variable from our model from that point forward.

IV. Empirical Results

In this section, we present an econometric analysis of the long-run relationship between monetary and fiscal policy variables and domestic real investment in Nigeria. The study by Lucky and Uzah found a positive long-run relationship between several monetary policy variables, including credit to the private sector of the economy (CPS/GDP), maximum lending rate (MLR), monetary policy rate (MPR), net domestic credit (NDC), and savings rate (SR). However, they found a negative long-run relationship between the naira exchange rate per US dollar, prime lending rate (PLR), treasury bill rate (TBR), and domestic real investment. To build on this work, we include some of the same variables, such as MPR, lending rate (LR), and SR, to examine the effects of the monetary policy transmission mechanism on domestic real investment. We also include foreign direct investment (FDI) to capture its effect on domestic real investment. Additionally, we expand the analysis to investigate the impact of fiscal policy on domestic real investment in Nigeria by including fiscal policy variables such as government spending as a percentage of GDP and corporate tax rate, along with the education and FDI variables used in the first analysis.

Stationary Testing

Stationary tests are performed using the software Eviews, with results in Appendix B below. The most appropriate procedure for this brand of research is Model 2. Model 2 involves an intercept function without a trend. An Augmented Dickey-Fuller (ADF) test statistic is the best way to observe stationary or unit root results. Our study is conducted at the level and first difference levels using the following equation:

$$\Delta Yt = a_0 + \Sigma Y_{yt-i} \dots + u_t$$

This stationary review process is defined by observing the regression of ΔYt on yt-1. The null hypothesis is described as the dependent variable, and respective independent variables have a unit root. The crux of this analysis comes down to comparing the Augmented Dickey-Fuller test statistic versus the critical value of the empirical cumulative distribution of τ_μ. Our research and sample size deploy a critical value of 0.05 significance level at the first difference and 0.01 at the level. If the test statistic is less than the critical value, we reject the null hypothesis, and our variable of interest exhibits stationarity. If the ADF test statistic is greater than the critical value, we fail to reject the null hypothesis that Yt has a unit root.

Our stationarity results are defined in the first difference. For the monetary policy equation analysis, we found that the

Augmented Dickey Fuller test statistics for all variables were less than the critical value and therefore stationary. This result allowed our group to proceed with further research (additional testing below). We found similar stationary results for our fiscal model as well. Our ADF analysis showed that the requisite test statistics for respective variables were less than the critical values in the first difference. The overall results were positive as both models exhibited stationarity. Please also see level stationary data in Appendix B for comparison.

Johansen Cointegration Testing

We used the Johansen co-integration test to test the existence of a long-run equilibrium relationship among our variables. Examining the trace test results from our first model, shown in Appendix C, we reject the null hypothesis of no co-integrating relationship as we see the existence of four co-integrating vectors between the monetary variables. The results of the Max-Eigen test show the existence of 4 cointegrating vectors between the monetary variables, supporting the trace test results.

Looking at the test results for the fiscal policy model, we reject the null hypothesis of no co-integrating relationship as we see the existence of 5 co-integrating vectors between the fiscal variables. The results of the Max-Eigen test also showed the existence of 5 cointegrating relationships, supporting the trace test results. The results obtained from the Johansen co-integration test allow us to conduct a Vector Error Correction Model (VECM) analysis.

Granger Causality Testing

A Granger Causality Test was then administered to determine the causal relationship between the dependent variable, domestic real investment, and the respective independent variables in the fiscal and monetary models. The results are shown in the table in Appendix D. The hypothesis tests are as follows:

H_0: Independent Variable does **not** Granger cause Dependent Variable
H_1: Independent Variable does Granger cause Dependent Variable

H_0: Dependent Variable does **not** Granger cause Independent Variable
H_1: Dependent Variable does Granger cause Independent Variable

The results of the Granger Causality Test showed a mix of causal linkages. Regarding monetary variables, the test concluded that there was a causal relationship (rejecting the null) among DINVT (dependent), CPS, EXR, and SR. On the contrary, we found no causal relationship (accepting the null) for MPR, MLR, and FDI.

Our fiscal policy model results concluded that there was a causal relationship among variables DINVT, CORPTR, and the log of Real GDP. In this case, the remaining variables GSPEND, FDI, and PSEE exhibited no causal relationship. The above results were similar to Anyike and Lucky's interpretation in that there was no overarching relationship for a large

majority of the variables either way.

Optimal Lag Criterion

This procedure is used to investigate the optimal lag length in the VAR model, further solidifying the Johansen Cointegration Test parameters as well. Our cointegration lag definition was 1 2 (monetary) and 1 3 (fiscal). We began by estimating a standard VAR using the endogenous inputs, totaling all variables in our econometric equations. We then checked the lag structure and lag length criteria to ascertain that the AIC statistics are the lowest compared to SIC and HQ, respectively. We used AIC figures to inform our final decision regarding the lag. Please see Appendix E.

VAR- Vector Error Correction Model (VECM)

The next step involves estimating a VAR model that is specific to a Vector Error Correction (VECM) type. For this purpose, a cointegration form is selected as option 3: Intercept (no trend) in CE and VAR. The results are available in Appendix F. The original paper utilized an autoregressive distributed lag technique up to a maximum lag of 1. This resulted in an over-parameterized outcome, which was simplified using a general to specific approach to obtain a parsimonious error correction result.

The VECM estimation output of the monetary policy model reveals that all the monetary policy variables are significant in estimating the long-run relationship in the model. All coefficients are negatively signed, except for the Maximum lending rate. Using a critical value of 2.04 at the 5% significance level, all monetary policy variables were found to be significant in determining the long-run equation for our main variable of interest, DINVT. One way our result differs from the original paper is that CPS/GDP was found to be statistically insignificant and thereby dropped from the parsimonious correction model. In our estimation, we see that the Credit to private sector variable is in fact significant in the long-run model, with a coefficient of –1.137.

Looking at the second part of the output, we examine the speed of adjustment of each variable to the long-run equilibrium. The coefficient for DINVT is 0.828, indicating a divergence from the long-term equilibrium. For FDI and SR, we observe coefficients of 0.248 and 1.0263, also indicating a divergence from the long-run equilibrium as the coefficients are positively signed. The error correction term for all other variables appears to be statistically insignificant. Examining further, we see that the two lags of DINVT are significant in explaining the short-run equation of DINVT. We also find that only the first lag of the exchange rate variable and the savings rate variable is significant in the short-run model where DINVT is expressed as a dependent variable. All other variables and their associated lags appear to be statistically insignificant in capturing the short-run dynamics of DINVT.

From the results, we make the same argument adopted by the original paper, that monetary policy has an impact on domestic real investment through the various monetary policy channels, as all the coefficients in the long-run equation are statistically significant in explaining DINVT. Further details on the different transmission channels of monetary policy can be found in the literature review section.

For the second model, we take our analysis a step further to determine the effect of fiscal policy on domestic real investment in the economy. From the VECM results, we observe that FDI, government spending, and LRGDP variables are statistically significant in explaining the long-run dynamics for domestic real investment, although this is using the 10% significance level, as PSEE and CORPTR turn out to be statistically insignificant at the 5% level. Looking at the short-run estimation output, we find that only the second lag of DINVT and the first lag of the corporate tax rate is statistically significant in explaining the short-run equation for domestic real investment in the economy. Variables such as FDI, government spending, long-run GDP, and primary school enrollment rate turn out to be statistically insignificant. Examination of the equation for real GDP shows that the first and second lags of the primary school enrollment rate are statistically significant in explaining real GDP growth in the economy. Finally, considering the error correction terms, we find that the adjustment process towards the long-run equilibrium is slow or nonexistent, as the error correction terms for all the variables appear to be statistically insignificant.

Focusing on the long-run equilibrium equation, we can conclude that fiscal policy, using government spending and the corporate tax rate, can have an effect on real domestic investment. This is supported by A. Afonso & JT Jalles (2015) in their study of how fiscal policy impacts investment, as they discovered that taxes on income, profits, and capital gains, as well as social security contributions, had a significant positive impact on public investment for emerging economies, of which Nigeria is one.

V. Conclusion

Lucky and Kingsley's paper applied the Johansen Cointegration Test via the max method to surmise that their economic model had four linear combinations of variables that exhibit stationarity in the long run (Lucky, Kingsley 2017). This conclusion was reached as the null hypothesis results were accepted in moving from the fourth cointegrated equation to the fifth. They also deployed the common 5% significance level for the study. By extension, our cointegration procedure used two Johansen Cointegration techniques: the trace test and the max test. In comparing our monetary policy equation with Lucky and Kingsley's, we found that our results mirror the original paper as we too arrived at at most four linear combinations of variables showing stationarity under the max method. Please keep in mind our extension had one extra variable and the overlap in variables administered in both studies was MLR, MPR, and SR. The trace test results for monetary policy in our research also showed at most four cointegrating vectors. Our extension required us to apply the same cointegration testing to the variables in our fiscal policy model as well. Said extension does not allow for comparison with Lucky and Kingsley beyond their monetary economic method. Our stand-alone results for the respective trace and max tests under our fiscal policy model showed five cointegrated relationships. The cointegration test results and comparison between our method and the original paper assist us in concluding that there is a long-run relationship within each of the monetary and fiscal policy transmission mechanisms and domestic real investment.

The Johansen Cointegration test does a good job of showing the existence of a long-run relationship between vectors but does little to describe the nature of this relationship. The VECM results below give a stronger explanation of the positive and negative long-run link between our monetary and fiscal models and gross fixed capital formation relative to gross

domestic product in Nigeria.

The Granger Causality Test is a way to think about multiple time series, specifically if one time series is the cause of another. This method, ultimately, can be a forecasting tool in which we study whether current or past values of a variable help to forecast another (Enders 2015). The original paper and our continued analysis showed a range of causal and non-causal relationships. For example, the monetary policy models in both Lucky and Kingsley's paper and our extension showed a causal link between the dependent variable domestic real investment and the exchange rate. This result makes sense as changes in the price of doing business (positive or negative) would directly influence private investment. Lucky and Kingsley even touch on the idea of volatility of the exchange rate having a negative effect on investment (Lucky and Kingsley 2017).

Our extension showed a few other causal relationships in terms of monetary policy transmission mechanisms and domestic real investment. The significant independent causal variables in this case were the savings rate and credit to the private sector. This conclusion makes sense as credits are designed to encourage private investment in terms of forecasting. The monetary policy variables that are not helpful in forecasting the dependent variable were foreign direct investment, maximum lending rate, and monetary policy rate.

The Granger Causality Test results, when it came to our fiscal policy econometric model, showed causal relationships (and rejection of the null hypothesis) between domestic real investment (DINVT), corporate tax rate, and log real GDP (LRGDP). An important distinction in these results is that the relationship between DINVT and LRGDP is actually bidirectional. In this example, DINVT/LRGDP in current or past form is useful in forecasting LRGDP/DINVT. The remaining fiscal variables that did exhibit a causal relationship were government spending, primary school enrollment rate, and foreign direct investment.

The original paper lacks a detailed discussion of VECM estimation and only focuses on the error correction term for domestic real investment. This paper aims to further investigate whether monetary and fiscal policy variables can explain the long-run equilibrium of domestic real investment in the economy. The results show that all monetary policy variables are statistically significant in explaining domestic real investment growth. Although we found the value for the exchange rate to be weakly exogenous, with a value of –0.03, which is very close to zero, in the short-run equation, only the first lag of the exchange rate and the savings rate variable were statistically significant when expressing DINVT as a dependent variable. The results indicate that monetary policy has had an impact on gross fixed capital formation in the country during the time period of the study. The original paper's results indicate that all monetary policy variables, except CPS, are statistically significant in the model. Our findings corroborate their results with a minor deviation, as our model shows that CPS is also statistically significant. We adopt one of the recommendations made in the original paper, that monetary policy in the economy requires taking into account both interest rate management and the response of domestic real investment. Furthermore, it is crucial to eliminate institutional and policy obstacles that hinder investment for optimal policy formulation and implementation. In essence, the effectiveness of monetary policy in promoting improvements in domestic real investment can be hindered by institutional failures and inefficiencies in the financial environment.

The second model studied the effects of fiscal policy on domestic real investment, using the variables corporate tax rate, government spending, FDI, and school enrollment rate, with the corporate tax rate and government spending as the key fiscal policy variables. Our results indicate that our key variables are significant in determining the long-run equilibrium for DINVT. This suggests that changes in government spending and the corporate tax rate can indeed impact the growth of gross fixed capital accumulation in the economy.

In the study, most of our error correction terms turn out to be statistically insignificant, which may indicate potential estimation errors in the analysis. One possible factor for this is that the sample size used in the study was too small to generate statistically significant results. Inadequate sample size can result in unreliable statistical estimates and may not accurately represent the population. The study was limited by the quality or availability of the data on monetary and fiscal policy variables in Nigeria. This can lead to biased or imprecise results and can reduce the power of the analysis. Lastly, the study may have overlooked important macroeconomic factors that could have influenced the relationship between fiscal and monetary policy and domestic real investment. By carefully considering these factors, future research should be designed to better address these limitations and provide more precise estimations.

Appendix A

Monetary Policy Coefficient Analysis

OLS- Ordinary Least Squares Regression				
VARIABLE	**COEFFICIENT**	**STD ERRORS**	**T STATISTIC**	**P-VALUE**
C	10.05526	9.053038	1.110705	0.2761
MPR	-0.101715	0.448625	-0.226727	0.8223
MLR	-0.294174	0.388817	-0.756588	0.4556
SR	0.827579	0.092685	8.928982	0.0000
FDI	-0.326091	0.5069222	-0.643276	0.5253
EXR	-0.076794	0.026899	-2.854907	0.0080
CPS	0.398742	0.459662	0.867468	0.3931
R_squared	0.943649			
Adj R_squared	0.931574			
F- Statistic	78.14739			
Prob F-Stat	0.00000			
Durbin Watson Stat	1.66808			

Fiscal Policy Coefficient Analysis

OLS- Ordinary Least Squares Regression				
VARIABLE	**COEFFICIENT**	**STD ERRORS**	**T STATISTIC**	**P-VALUE**
C	432.0047	281.0068	1.537346	0.1350
GSPEND	-0.308131	1.250015	-0.246502	0.8070
CORPTR	1.629771	0.630119	2.586450	0.0150
FDI	-0.488906	0.971856	-0.503064	0.6187
PSEE	0.032834	0.265409	0.123711	0.9024
LRGDP	-17.34390	10.46715	-1.656984	0.1083
R_squared	0.814205			
Adj R_squared	0.782171			
F- Statistic	25.41712			
Prob F-Stat	0.00000			
Durbin Watson Stat	0.514977			

Appendix B

Augmented Dickey-Fuller Test

Model 2 (with intercept only, lag selection using SIC, max lag=8)

Monetary Policy Stationary Analysis - LEVEL						
VARIABLE	**ADF T-STATISTIC**	**TEST CRITICAL VALUES 1%**	**5%**	**10%**	**PROB.**	**ORDER OF INTR.**
DINVT	-2.918133	-3.653730	-2.957110	-2.617434	0.0543	I(1)
MPR	-3.030411	-3.639407	-2.951125	-2.614300	0.0420	I(1)
MLR	-2.389902	-3.639407	-2.951125	-2.614300	0.1520	I(1)
SR	-2.064949	-3.639407	-2.951125	-2.614300	0.2594	I(1)
FDI	-3.460885	-3.639407	-2.951125	-2.614300	0.0155	I(1)
EXR	0.328863	-3.639407	-2.951125	-2.614300	0.9765	I(1)
CPS	-2.102640	-3.646342	-2.954021	-2.615817	0.2449	I(1)

Fiscal Policy Stationary Analysis - LEVEL

VARIABLE	ADF T-STATISTIC	TEST CRITICAL VALUES 1%	5%	10%	PROB.	ORDER OF INTR.
DINVT	-2.918133	-3.653730	-2.957110	-2.617434	0.0543	I(1)
GSPEND	-0.984926	-3.639407	-2.951125	-2.614300	0.7475	I(1)
CORPTR	-1.439439	-3.639407	-2.951125	-2.614300	0.5515	I(1)
FDI	-3.460885	-3.639407	-2.951125	-2.614300	0.0155	I(1)
PSEE	-1.489960	-3.639407	-2.951125	-2.614300	0.5265	I(1)
LRGDP	-2.382783	-3.639407	-2.951125	-2.614300	0.9999	I(1)

Monetary Policy Stationary Analysis – FIRST DIFFERENCE

VARIABLE	ADF T-STATISTIC	TEST CRITICAL VALUES 1%	5%	10%	PROB.	ORDER OF INTR.
DINVT	-4.763544	-3.653730	-2.957110	-2.617434	0.0006	I(1)
MPR	-7.981873	-3.646342	-2.954021	-2.615817	0.0000	I(1)
MLR	-5.066863	-3.653730	-2.957110	-2.617434	0.0002	I(1)
SR	-7.343121	-3.646342	-2.954021	-2.615817	0.0000	I(1)
FDI	-7.999069	-3.646342	-2.954021	-2.615817	0.0000	I(1)
EXR	-5.218421	-3.646342	-2.954021	-2.615817	0.0002	I(1)
CPS	-5.593858	-3.661661	-2.960411	-2.619160	0.0001	I(1)

Fiscal Policy Stationary Analysis – FIRST DIFFERENCE

VARIABLE	ADF T-STATISTIC	TEST CRITICAL VALUES 1%	5%	10%	PROB.	ORDER OF INTR.
DINVT	-4.763544	-3.653730	-2.957110	-2.617434	0.0006	I(1)
GSPEND	-5.337084	-3.646342	-2.954021	-2.615817	0.0001	I(1)
CORPTR	-6.155395	-3.646342	-2.954021	-2.615817	0.0000	I(1)
FDI	-7.999069	-3.646342	-2.954021	-2.615817	0.0000	I(1)
PSEE	-4.989881	-3.646342	-2.954021	-2.615817	0.0003	I(1)
LRGDP	-4.192406	-3.653730	-2.957110	-2.617434	0.0026	I(1)

Appendix C

Johansen Cointegration Test

Monetary Policy Model

Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Prob.**	Decision.
None *	0.946585	291.8696	125.6154	0.0000	Reject H0
At most 1 *	0.911417	198.1203	95.75366	0.0000	Reject H0
At most 2 *	0.805569	120.5581	69.81889	0.0000	Reject H0
At most 3 *	0.701030	68.15238	47.85613	0.0002	Reject H0
At most 4	0.476946	29.51519	29.79707	0.0539	Fail to Reject H0
At most 5	0.235571	8.776907	15.49471	0.3864	Fail to Reject H0
At most 6	0.005636	0.180874	3.841465	0.6706	Fail to Reject H0

Fiscal Policy Model

Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Prob.**	Decision.
None *	0.995336	431.4596	95.75366	0.0000	Reject H0
At most 1 *	0.959909	265.0582	69.81889	0.0000	Reject H0
At most 2 *	0.935591	165.3436	47.85613	0.0000	Reject H0
At most 3 *	0.847574	80.32620	29.79707	0.0000	Reject H0
At most 4 *	0.504105	22.01280	15.49471	0.0045	Reject H0
At most 5	0.008661	0.269648	3.841465	0.6036	Fail to Reject H0

Appendix D

Pairwise Granger Causality Tests

Lags:2

Monetary Policy Model

GRANGER CAUSALITY	OBS	F-STAT	P-VALUE	SIGNIFICANCE	DECISION
MPR does not Granger Cause DINVT	33	0.67265	0.5184	Not Sig.	Accept H0
DINVT does not Granger Cause MPR		0.27113	0.7645	Not Sig.	Accept H0
MLR does not Granger Cause DINVT	33	0.22261	0.8018	Not Sig.	Accept H0
DINVT does not Granger Cause MLR		0.43536	0.6513	Not Sig.	Accept H0
SR does not Granger Cause DINVT	33	0.00237	0.9976	Not Sig.	Accept H0
DINVT does not Granger Cause SR		3.43600	0.0463	Sig.	Reject H0
FDI does not Granger Cause DINVT	33	0.19452	0.8243	Not Sig.	Accept H0
DINVT does not Granger Cause FDI		0.24297	0.7859	Not Sig.	Accept H0
EXR does not Granger Cause DINVT	33	7.51957	0.0024	Sig.	Reject H0
DINVT does not Granger Cause EXR		0.82319	0.4494	Not Sig.	Accept H0
CPS does not Granger Cause DINVT	33	2.06763	0.1454	Not Sig.	Accept H0
DINVT does not Granger Cause CPS		3.86094	0.0330	Sig.	Reject H0

Fiscal Policy Model

GRANGER CAUSALITY	OBS	F-STAT	P-VALUE	SIGNIFICANCE	DECISION
GSPEND does not Granger Cause DINVT	33	1.96207	0.1594	Not Sig.	Accept H0
DINVT does not Granger Cause GSPEND		0.79404	0.4619	Not Sig.	Accept H0
CORPTR does not Granger Cause DINVT	33	5.90035	0.0073	Sig.	Reject H0
DINVT does not Granger Cause CORPTR		0.70760	0.5014	Not Sig.	Accept H0
FDI does not Granger Cause DINVT	33	0.19452	0.8243	Not Sig.	Accept H0
DINVT does not Granger Cause FDI		0.24297	0.7859	Not Sig.	Accept H0
PSEE does not Granger Cause DINVT	33	1.33300	0.2799	Not Sig.	Accept H0
DINVT does not Granger Cause PSEE		0.23236	0.7942	Not Sig.	Accept H0
LRGDP does not Granger Cause DINVT	33	4.61011	0.0186	Sig.	Reject H0
DINVT does not Granger Cause LRGDP	33	6.54499	0.0047	Sig.	Reject H0

Appendix E

VAR Lag Order Selection Criteria

Monetary Policy Lag Review

LAG	LogL	LR	FPE	AIC	SC	HQ
0	-663.8858	NA	3.83e+09	41.93036	42.25099	42.03664
1	-548.5076	173.0674*	65160420	37.78172	40.34676*	38.63196
2	-505.3492	45.85572	1.52e+08	38.14683	42.95627	39.74102
3	-404.9349	62.75899	30956154	34.93343*	41.98728	37.27158*

Fiscal Policy Lag Review						
LAG	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-398.7052	NA	8803.333	26.11001	26.38756	26.20049
1	-243.6084	240.1498	4.248668	18.42635	20.36917	19.05966
2	-186.7614	66.01589	1.469275	17.08138	20.68948	18.25753
3	-113.7176	56.55005	0.323698	14.69146	19.96483	16.41045
4	100.5756	82.95222*	4.05e-05*	3.188668*	10.12732*	5.450495*

Appendix F

VECM Results

Vector Error Correction Estimates
Date: 04/28/23 Time: 15:17
Sample (adjusted): 1984 2015
Included observations: 32 after adjustments
Standard errors in ( ) & t-statistics in [ ]
Lags interval (in first differences): 1 to 2
Endogenous variables: DINVT CPS EXR FDI MLR MPR SR
Deterministic assumptions: Case 2: Cointegrating relationship includes a constant

Cointegrating Eq:	CointEq1
DINVT(-1)	1.000000
CPS(-1)	-1.136770 (0.26061) [-4.36199]
EXR(-1)	-0.032053 (0.01120) [-2.86255]
FDI(-1)	-1.802440 (0.32670) [-5.51712]
MLR(-1)	2.191364 (0.24062) [9.10728]
MPR(-1)	-1.209481 (0.30707) [-3.93874]
SR(-1)	-1.510935 (0.04509) [-33.5056]
C	23.06298 (4.31942) [5.33937]

Error Correction:	D(DINVT)	D(CPS)	D(EXR)	D(FDI)	D(MLR)	D(MPR)	D(SR)
COINTEQ1	0.828797 (0.24343) [3.40463]	-0.006443 (0.11080) [-0.05815]	-0.122701 (0.81677) [-0.15023]	0.248473 (0.09464) [2.62541]	-0.268970 (0.16723) [-1.60842]	-0.118607 (0.18052) [-0.65703]	1.026346 (0.40005) [2.56551]
D(DINVT(-1))	-0.963872 (0.46524) [-2.07179]	-0.133581 (0.21176) [-0.63080]	1.438639 (1.56096) [0.92164]	-0.463325 (0.18087) [-2.56160]	0.233672 (0.31959) [0.73116]	0.104241 (0.34500) [0.30215]	-0.891618 (0.76456) [-1.16618]
D(DINVT(-2))	-0.908804 (0.38120) [-2.38405]	0.071616 (0.17351) [0.41274]	0.813213 (1.27901) [0.63582]	-0.206042 (0.14820) [-1.39027]	0.198503 (0.26187) [0.75803]	0.156697 (0.28268) [0.55432]	-0.958429 (0.62646) [-1.52991]
D(CPS(-1))	1.130679 (0.63576) [1.77846]	0.525745 (0.28938) [1.81678]	1.426702 (2.13311) [0.66884]	0.693281 (0.24717) [2.80486]	0.388674 (0.43674) [0.88995]	0.078815 (0.47145) [0.16718]	0.684132 (1.04481) [0.65479]
D(CPS(-2))	0.512688 (0.76053)	-0.329030 (0.34617)	1.894555 (2.55172)	0.008090 (0.29568)	-0.715725 (0.52244)	-1.194644 (0.56397)	-0.216056 (1.24984)

Monetary policy model

D(EXR(-1))	-0.155915	-0.046426	0.063065	-0.068625	0.019921	-0.023277	0.080830
	(0.06987)	(0.03180)	(0.23444)	(0.02717)	(0.04800)	(0.05182)	(0.11483)
	[-2.23137]	[-1.45970]	[0.26900]	[-2.52618]	[0.41503]	[-0.44923]	[0.70391]
D(EXR(-2))	-0.174312	0.010090	0.483435	-0.026976	0.034889	0.087990	-0.335888
	(0.09719)	(0.04424)	(0.32609)	(0.03779)	(0.06676)	(0.07207)	(0.15972)
	[-1.79351]	[0.22809]	[1.48251]	[-0.71391]	[0.52256]	[1.22087]	[-2.10296]
D(FDI(-1))	0.404533	-0.137900	-2.170341	-0.328090	-0.251868	-0.265454	0.722885
	(0.55716)	(0.25361)	(1.86938)	(0.21661)	(0.38274)	(0.41316)	(0.91563)
	[0.72606]	[-0.54376]	[-1.16099]	[-1.51465]	[-0.65806]	[-0.64249]	[0.78949]
D(FDI(-2))	0.053744	-0.207454	-0.840683	-0.070619	-0.380302	-0.378501	0.222490
	(0.45172)	(0.20561)	(1.51562)	(0.17562)	(0.31031)	(0.33498)	(0.74236)
	[0.11898]	[-1.00895]	[-0.55468]	[-0.40211]	[-1.22555]	[-1.12993]	[0.29971]
D(MLR(-1))	-0.222196	0.133410	-1.497096	0.320064	0.385752	0.944450	-0.477799
	(0.58583)	(0.26666)	(1.96559)	(0.22776)	(0.40244)	(0.43443)	(0.96275)
	[-0.37928]	[0.50030]	[-0.76165]	[1.40527]	[0.95854]	[2.17401]	[-0.49628]
D(MLR(-2))	0.503757	0.160427	-1.408709	0.278817	-0.000788	0.076797	0.865384
	(0.49055)	(0.22329)	(1.64590)	(0.19072)	(0.33698)	(0.36377)	(0.80617)
	[1.02692]	[0.71848]	[-0.85589]	[1.46195]	[-0.00234]	[0.21112]	[1.07346]
D(MPR(-1))	0.174187	-0.042955	2.162094	0.120403	-0.416971	-1.036663	0.164538
	(0.49368)	(0.22471)	(1.65640)	(0.19193)	(0.33914)	(0.36609)	(0.81131)
	[0.35283]	[-0.19115]	[1.30530]	[0.62732]	[-1.22951]	[-2.83170]	[0.20281]
D(MPR(-2))	0.019008	-0.060785	2.121532	-0.082064	-0.331742	-0.469378	-0.263817
	(0.43129)	(0.19631)	(1.44707)	(0.16768)	(0.29628)	(0.31983)	(0.70878)
	[0.04407]	[-0.30963]	[1.46609]	[-0.48941]	[-1.11970]	[-1.46760]	[-0.37221]
D(SR(-1))	1.170337	0.079961	-1.016248	0.351771	-0.178678	-0.143548	0.940845
	(0.40634)	(0.18495)	(1.36335)	(0.15798)	(0.27913)	(0.30132)	(0.66777)
	[2.88020]	[0.43233]	[-0.74541]	[2.22674]	[-0.64012]	[-0.47639]	[1.40893]
D(SR(-2))	0.529942	-0.045265	-0.997852	0.093089	-0.217513	-0.206677	0.597107
	(0.28128)	(0.12803)	(0.94377)	(0.10936)	(0.19323)	(0.20859)	(0.46226)
	[1.88400]	[-0.35354]	[-1.05731]	[0.85124]	[-1.12568]	[-0.99084]	[1.29171]
R-squared	0.447362	0.343027	0.279048	0.666192	0.435026	0.494553	0.522304
Adj. R-squared	-0.007751	-0.198009	-0.314677	0.391291	-0.030247	0.078302	0.128907
Sum sq. resids	411.8691	85.33257	4636.556	62.25341	194.3609	226.4878	1112.345
S.E. equation	4.922153	2.240438	16.51480	1.913626	3.381271	3.650042	8.089009
F-statistic	0.982969	0.634019	0.469995	2.423392	0.934990	1.188113	1.327678
Log likelihood	-86.28555	-61.09916	-125.0219	-56.05367	-74.26973	-76.71731	-102.1819
Akaike AIC	6.330347	4.756197	8.751368	4.440855	5.579358	5.732332	7.323867
Schwarz SC	7.017410	5.443261	9.438432	5.127918	6.266422	6.419396	8.010931
Mean dependent	-1.904042	0.214689	5.991123	-0.011801	0.214766	0.093750	-1.915162
S.D. dependent	4.903188	2.046930	14.40336	2.452745	3.331266	3.801925	8.666887

Determinant resid covariance (dof adj.)	13042428
Determinant resid covariance	155758.2
Log likelihood	-509.1392
Akaike information criterion	38.88370
Schwarz criterion	44.05958
Number of coefficients	113

Fiscal Policy Model

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