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Article

# The Response of Macroeconomic Variables to Government Spending Shocks in the Sudanese Economy 1989-2019: Comparing the Structural Shocks (DSGE Approach) and Impulse Response (SVAR Model)

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**Abstract:** The importance that different (approaches and models) to modeling the macroeconomy place on theoretical coherence compared to their capacity to match the data and the quality of the econometric model description varies. Dynamic stochastic general equilibrium (DSGE) models are more theoretical, whereas vector autoregression (SVAR) models provide a better match to the data. For developed economies, there are well-established publications on measuring the response of economic indicators to government spending shocks and aggregate macroeconomic activity. In addition, such empirical studies in emerging nations are scarce. This research seeks to fill this void by utilizing the DSGE model and the SVAR approach to investigate the influence of the response of macroeconomic variables to government spending shocks in the Sudanese economy from 1989 to 2019. The findings indicate that the influence of government expenditure shocks on the Sudanese economy is inconsistent with Keynesian principles, as some selected macroeconomic indicators do not respond positively to government expenditure shocks. The non-responsiveness of the inflation rate and exchange rate to government expenditure shocks is demonstrated; this finding may indicate the monetary authority's weakness in managing monetary variables in the Sudanese economy. In most situations, fiscal and monetary policies were in sync, and "double expansionary" and "double contractionary" policy coordination may be the proper approach; and also create tools that fit the Sudanese economy's structure.

**Keywords:** Government Spending Shocks; macroeconomic variables; Sudanese economy; structural vector-autoregressive model; DSGE model

## 1. Introduction

Sudan is located on the Red Sea, at the crossroads of Sub-Saharan Africa and the Middle East. Its neighbors include Libya, Egypt, Chad, the Central African Republic, South Sudan, Ethiopia, and Eritrea. The White and Blue Niles join in Khartoum, the country's capital, to form the Nile River, which flows to the Mediterranean via Egypt. Sudan features a Sahelian belt with desert in the extreme north, lush territory in the Nile valleys and the Gezira region, and farming and cattle land throughout the rest of the nation, from Darfur to Kassala via the states of Blue Nile and Kordofan. For the majority of its independent history, the country has endured significant internal conflict, undermining its capacity to play a leadership role in the region. This includes two of Africa's

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longest-running civil wars, as well as hostilities in Darfur, South Kordofan, and the Blue Nile. South Sudan seceded from Sudan in 2011 under the terms of the Comprehensive Peace Agreement signed in 2005, becoming Africa's 54th independent state. The independence of South Sudan resulted in a number of economic shocks, including the loss of oil money, which had previously accounted for more than half of Sudan's revenue and 95% of its exports. This has slowed economic growth and resulted in double-digit consumer price inflation, which, along with higher fuel prices, sparked violent protests in December 2019.

Sudan began producing oil in the late 1990s, with oil exports fast growing to a peak of US$ 11.1 billion in 2008, accounting for 95.1 percent of total exports. As a result, the Sudanese economy saw a decade of tremendous growth, with GDP increasing from US$ 10 billion in 1998 to more than US$ 60 billion in 2008. Then, in 2011, South Sudan seceded, removing 75% of the oil reserves. This caused a significant irreversible fiscal and external shock to an economy whose spending patterns had been modeled after a 10-year oil boom. The GDP shrank by a total of 20% from 2011 and 2012. Sudan's economy recovered in the mid-2010s, but declined again in 2018-2020 before increasing by 0.5 percent in 2021 [1].

The macroeconomic impacts of changes in government expenditure shocks have gotten a lot of attention in the economics profession, especially since the Great Recession began in 2007. Following in the footsteps of Blanchard and Perotti, a large body of literature has used Structural Vector Autoregressive (SVAR) models to characterize the empirical effects of government spending shocks on GDP, inflation, and a variety of other macroeconomic variables [2–4]. Fiscal policy must strike a balance between the requirement to enhance capital formation and the marginal propensity to save by lowering consumption levels and the need to reallocate resources through transfer payments in order to achieve an equitable income and wealth distribution system. The second need may be met at the expense of the former [5].

The main findings show that an unexpected government spending shock has an immediate expansionary effect on real GDP and a sudden positive effect on inflation (WPI) and exchange rate stability, and that the impact is permanent and away from zero in both the small VAR and 'augmented' SVAR models. The findings suggest that pro-cyclical policies targeted at increasing the tax base during periods of recession and stagflation may assist overcome the situation by achieving stability and balance in specific macroeconomic variables. A government spending shock increases real GDP in the short term but stabilizes along the negative axis in the long run, showing that the government must ensure that its spending improves the economy's productive capacity and is channeled in the appropriate direction. The responsiveness of the inflation rate to a government expenditure shock suggests that the government should design fiscal consolidation initiatives to address the rising fiscal imbalance and high inflation.

Sudan exhibited an over-reliance on oil earnings during the Sudanese National Congress Party's second term of administration from 2000 to 2011 [6]. The enormous contribution of oil export profits to overall export receipts, which peaked at 95% in 2008, demonstrates the country's reliance on oil revenues. The goal of this study is to quantify the reaction of macroeconomic variables to government spending shocks in the Sudanese economy from 1989 to 2019 using the DSGE model and the SVAR technique. The rest of this study will go as follows. Section 2 examines and contrasts theoretical frameworks and research approaches in this subfield of macroeconomics to identify the DSGE model and SVAR methodology as superior while reviewing the literature on the interaction between macroeconomic variables and government spending shocks. Section 3 describes how the SVAR method and DSGE models are employed in this study, including a description of the sample selection procedure and the determination of essential variables. Section 4 discusses the empirical analysis's main findings. Section 5 calculates the impact and reaction multipliers. Finally, section 6 provides conclusions.

## 2. Theoretical Framework

According to Keynesian theory, which emphasizes the demand side, the economy may not spontaneously recover to full employment during a recession and that the government must intervene and use government expenditure to boost economic growth. In the short run, the aggregate supply schedule is upward-sloping under the Keynesian model of sticky wages, and hence an expansionary fiscal policy would cause real GDP to rise [7]. Macroeconomists are still divided about the quantitative effects of fiscal policy. This uncertainty stems not just

from standard errors in empirical estimation, but also from differing perspectives on the appropriate theoretical framework and econometric approach [8]. There is no agreement on how macroeconomic variables - real GDP, consumption, exchange rate, and inflation rate—react to macroeconomics. The behavior is primarily determined by the econometrics model used. Thus, the dispute over the reaction of macroeconomic variables to government spending shocks in light of growing foreign indebtedness is about more than just the amount of the effect, and there is significant disagreement concerning the underlying direction of the effects [9].

## 3. Literature Survey

### *3.1. Effects of Government Spending Shocks: What Do We know?*

The empirical literature frequently yields highly disparate results when it comes to the responses of specific variables to government spending shocks, and the estimated multipliers vary in size between nations and time periods. Existing empirical research are mostly classified into two categories: the Structural Vector Autoregression (SVAR) technique and the narrative approach. The estimated response changes between the two procedures and is critical to the identifying method used.

### *3.2. Macroeconomic Variables Management in Sudan*

A detailed examination of the Sudanese economy during the last three decades (the period of leadership of the Sudanese National Congress regime) reveals that it has altered significantly, transitioning from comparatively prosperous times in the 1980s and 1990s to significant volatility in subsequent decades. Overall, Sudan's macroeconomic performance has been weak and unstable, with low or negative growth, severe budgetary imbalances, a volatile and unpredictable exchange rate, a high and unpredictable inflation rate, high unemployment, severe poverty, and underlying external adjustment problems [10,11].

## 4. Data and Econometrics Methods

### *4.1. Data Sources and Description*

The analysis made use of annual data from 1989 to 2019. The information was gathered from a variety of sources, including the IMF's International Financial Statistics (IFS), the Government Financial Statistics (GFS), and the Central Bank of Sudan. World Development Indicators and the Ministry of Finance and National Economy's Department of Statistics webpage. All variables were converted to a log format. Figures 1 – 4 demonstrate that the Sudanese economy, as well as the macroeconomic indicators included in the study, are unstable. (Government spending) (GEX) and RGDP, (inflation rate) (INF), and (exchange rate) (EXE) are all mentioned. Figures 1–4 show this. Government spending remained high since 2000 until it fell due to the south's secession in 2011, and then steadied between 2014 and 2019. The inflation rate was constant from the start of the study period until 2010, and it rose after 2011 due to the transfer of the government's share of oil revenues to the state of South Sudan, and it rose insanely during the popular movement until the study's time series ended in 2019. The data clearly shows that overall consumer spending is increasing till it approaches the conclusion of the time series at very high rates. Similarly, the real GDP variable increased following South Sudan's independence from Sudan. The exchange rate variable was nearly steady throughout the period when Sudan implemented its economic liberalization strategy in 1992. Following South Sudan's secession, the exchange rate variable rose significantly to levels that were difficult for the Sudanese economy to control.

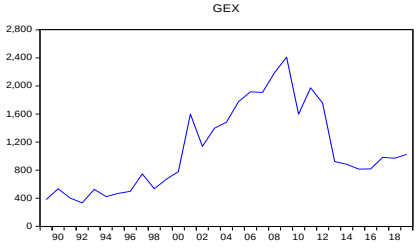


**Figure1.** GEX.

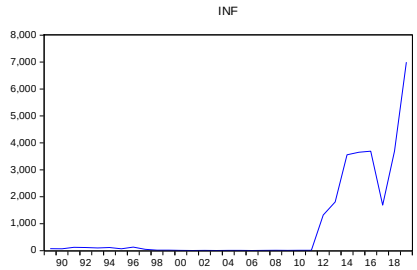


**Figure2.** INF.

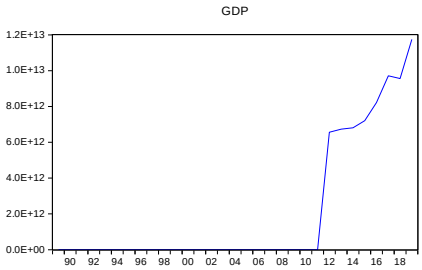


**Figure3.** RGDP.

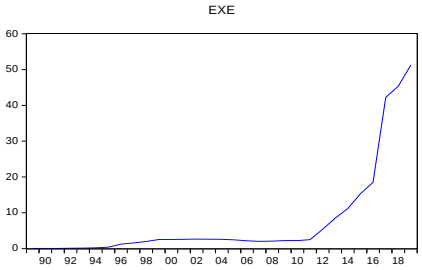


**Figure4.** EXE.

*4.2. Key Variables and Descriptive Statistics*

The variables in this study are limited by the SVAR model. An SVAR model with two equations integrating three key variables is articulated in that study: government expenditure shocks (GEXt) and RGDPt, inflation rate (INFt), and exchange rate (EXEt) of the shocks on the economy directly.

*4.3. Empirical Methodology*

Two empirical SVAR models are estimated by using a non-recursive, unbiased identification technique to identify government spending shocks in the Sudanese economy. I evaluate two identification approaches based on macroeconomic variable simultaneity to investigate if the RGDPt, inflation rate, and exchange rate provide information relevant for identifying government spending shocks. First, I present the estimating approach, and then I describe the identification strategy and results. Choosing the best policy for those outcomes.

4.3.1. Identification in SVAR Models

The identification strategy in SVAR models is intended to circumvent the challenges encountered in dynamic simultaneous equation models, which frequently result in 'extraordinary' identifying constraints, as Sims puts it [12]. The difficulty of obtaining really exogenous variables that may be utilized as instruments is one of the primary challenges with the traditional approach to identification. This is especially true in monetary economics, where virtually every variable in the monetary/financial sector is endogenously determined given well-established financial markets and rational expectations. Furthermore, for the same reasons, it is difficult to justify a priori that one variable does not influence another. That is, there are few compelling identifying constraints.

To address these issues, SVAR models assume all variables as endogenous. VAR models are used to model

the sampling information in the data, which models each variable as a function of all other variables. In terms of defining constraints, SVAR models first deconstruct all variables into expected and unexpected components. The identifying constraints are therefore imposed only on the unexpected segment, where credible identifying constraints are more easily found. In terms of monetary policy, the SVAR method recognizes that the policy instrument is mostly endogenously driven, preventing it from being treated as an exogenous variable. After modeling the model's reduced form with a VAR system, the SVAR analysis proceeds to identify the model. A'reaction function in surprises' is modeled to represent unexpected changes in the policy instrument as a function of unexpected changes in the non-policy variable and monetary policy shocks.

4.3.2. Baseline (VAR) Identification Scheme

A VAR is a n equation, n variable linear model in which each variable is explained by its own lagged value as well as the present and previous values of the remaining n-1 variable. The approach is used to alter the structural form of a n variable-VAR model [2]. SVAR's major goal is to produce non-recursive orthogonalization of error terms for impulse response analysis. This necessitates imposing sufficient theoretically based constraints to determine the orthogonal (structural) components of the error terms. Taking a look at a simple vector autoregression (VAR) specification:

$$Y_t = A_0 + B\left(L, q\right) Y_{t-1} + U_t$$

Where Yt is the K-dimensional vector of endogenous variables at time t (government spending, GDP, inflation rate, consumption, and exchange rate). Yt-1 is a (K) dimensional vector of lagged endogenous variables; A0 is a K dimensional vector of constants; and B(L, q) is a polynomial lag operator L of order q that permits the coefficients at each lag to rely on the quarter q that indexes the dependent variable. Ut is a vector of innovations that may be contemporaneously linked with their own lagged values while being uncorrelated with all right-hand side variables.

Because only lag values of the endogenous variables appear on the right side of the equations, simultaneity is not a concern, and the ordinary least squares OLS approach can produce consistent estimates. Furthermore, even if the innovations Ut are contemporaneously correlated, the OLS approach is efficient and equal to GLS because all equations have the same regressors [13]. Based on this, the OLS model for the simplified form VAR model stated below can be computed.

$$Z_t = a + D(L, q)Z_{t-1} + u_t$$

where $a = A^{-1}A_0$, $D(L,q) = A^{-1}D(L,q)$ and $u_t = A^{-1}U_t$

Because the structure cannot be obtained from the reduced form, the impulse response function (IRF), that is, the dynamic responses of endogenous variables to unit shocks of some of the variables in the system, has no meaningful economic interpretation because reduced form innovations have no direct economic context because they are linear combinations of structural innovations. Furthermore, knowing that u Ik (unit matrix of order k) is frequently correlated in time t complicates the understanding of the reduced form of shocks [14]. Exogenous (nonsample) constraints must be imposed to extract the structure from the reduced form. Rafael and Ivan explored the influence of fiscal policy shocks on GDP, interest rates, and inflation using pattern matrices to specify the constraints defining limits [15].

4.3.3. DSGE Model and SVAR Approach

1) DSGE-SVAR: The Idea

The structural shocks and impulse-response functions obtained by estimation-calibration of the DSGE with those obtained in a Structural Vector Autoregressions (SVAR) identified using some of the DSGE restrictions is a popular validation procedure for Dynamic Stochastic General Equilibrium (DSGE) models [16]. Del Negro and Schorfheide propose a weighted average of a reduced-form VAR and a fully structured DSGE model in their DSGE-SVAR approach [17]. This approach is beneficial for estimating SVAR because it permits eliciting priors for many reduced-form SVAR parameters from priors for a small number of structural parameters in a DSGE model. Because structural parameters often have an obvious interpretation, eliciting priors in the DSGE model is

simpler. The DSGE-SVAR can also be used to determine whether the structural DSGE model adequately describes the economy. Based on the reduced-form statistical features of VARs, comparing the DSGE model fit to that of the SVAR offers a relevant metric of misspecification. Formally, the more the weight placed on the DSGE model by the best-fitting DSGE-VAR, the smaller the risk about misspecification [18].

2) The mapping between the DSGE and VAR model

It is useful to investigate the mapping between form SVAR and DSGE models in order to see the connections between the two. To be more specific, we will look at the class of structural models known as DSGE models, which are often based on an agent's optimization behavior and rational expectation construction. In general, the following state-space description [19, 20] can summarize the solution of a linearized DSGE model:

$$X_t = B(\theta) X_{t-1} + \Gamma(\theta) \eta_t$$
$$Y_t = A(\theta) X_t$$

Where Xt denotes a n 1 vector of state variables, Yt denotes a m 1 vector of variables observed by an econometrician, and t denotes a k 1 vector of economic shocks such that E(t) = 0 and E(t tr) = I.5 The matrices A (), B(), and () are all functions of the underlying structural equation.

Uhlig proposes an alternate strategy employing the 'penalty function' in addition to the pure sign limitation approach. The procedure's goal is to discover a set of orthogonal shocks that minimizes a given penalty function. However, the choice of the penalty function remains arbitrary and difficult to justify economically. The identification procedure discussed here essentially takes the 'penalty-function' approach and applies it to a more formal framework. To construct the penalty function, we use the previously established mapping between the DSGE and the VAR model. This is appealing because it gives a theoretically consistent method of identifying structural VAR shocks, and the identifying assumptions are motivated by DSGE model constraints. Furthermore, the process can aid in the integration of the two separate approaches to macroeconomic modeling.

According to the work of Fernandez-Villaverde, Rubio-Ramirez, Sargent, and Watson, Christiano et al, and Ravenna, the state-space representation of the DSGE model described above has an infinite order VAR process representation, VAR(), if and only if the eigenvalues of the following matrix are equal to one [21–23].

$$M = (In - \Gamma(A\Gamma)^{-1} A) B$$

In absolute terms, are less than one, and the number of shocks corresponds to the number of observable variables, ie: m = k. This is referred to as the 'Poor Man's invertibility condition' or simply the 'invertibility condition' by Fernandez-Villaverde et al [21].

## 5. Empirical Results and Discussion

In the first, we look at how macroeconomic variables react to changes in government spending. To do this, the effects and responses of changes in aggregate, current, and capital expenditures, as well as economic stability, are examined. However, two distinct SVAR models are developed to verify that all of the models estimated are stable. The findings are detailed below. Pay note here: the SVAR shocks are not "made of" the relevant structural shocks plus measurement and description mistakes.

### *5.1. Preliminary Analysis*

Table 1 displays a variety of descriptive statistics. It is worth noticing that there is a considerable link between the log of real GDP and the log of government spending for all variables.1 Source: shows a time series plot of the four variables, and the graph shows that, with the exception of EXE, the variables have a long-run relationship.

**Table 1.** Descriptive statistics.

| | $GEX_t$ | $RGDP_t$ | $INF_t$ | $EXE_t$ |
|---|---|---|---|---|
| **Mean** | 1092.037 | 7346.584 | 884.3227 | 7.572665 |
| **Median** | 921.9192 | 9057.000 | 67.40000 | 2.435800 |

Cont.

| | | | | |
|---|---|---|---|---|
| Maximum | 2409.554 | 17335.00 | 6996.754 | 51.25000 |
| Minimum | 333.5026 | -196.772 | 4.900000 | 0.045000 |
| Std. Dev. | 607.6726 | 5839.770 | 1692.745 | 13.63368 |
| Skewness | 0.565209 | -0.10456 | 2.100037 | 2.344171 |
| Kurtosis | 2.073439 | 1.659643 | 6.892949 | 7.148401 |
| Jarque–Bera | 2.759467 | 2.377046 | 42.36108 | 50.62013 |
| Probability | 0.251646 | 0.304671 | 0.000000 | 0.000000 |
| Observations | 31 | 31 | 31 | 31 |

Source: Prepared by the researcher from the outputs of the E-views[13] package.

*5.2. Unit root and cointegration tests*

Verifying the stationarity of the econometric series as a preparatory step before modeling is critical to ensure relevance and validity criteria. The response of Sudanese economic activity to budgetary shocks is illuminated using structural vector autoregression modeling, which provides insight into how these shocks spread through the economy. As a result of the impact and response on Sudanese macroeconomic factors. Visual inspection indicates that the levels of all four series considered in the analysis are non-stationary. The results of the standard augmented Dicky Fuller and Phillips-Perron unit-root tests are shown in Table 2. The test included both an intercept and a linear trend. The results reveal the existence of unit roots in taxes, but they are substantial, implying the rejection of a null hypothesis of a unit root at a 5% level for spending and RGDP. When series are represented by initial differences, the null hypothesis of a unit root can be disproved using ADF, PP, and KPSS tests. This is not the case with GDP, which appears to have a unit root. However, when the Phillips-Perron test is performed, the exchange rate and RGDP have a unit root in levels, although the hypothesis of a unit root in initial differences can be rejected at 1% significance.

**Table 2.** Unit-root test.

| **Variables** | **ADF Test *HO*: Variable Has a Unit RootLevel** | | **P.P Test *HO*: Variable Has a Unit RootLevel** | | **KPSS Test *HO*: Variable Is StationaryLevel** | |
|---|---|---|---|---|---|---|
| | **Intercept** | **Intercept and Trend** | **Intercept** | **Intercept and Trend** | **Intercept** | **Intercept and Trend** |
| $GEX_t$ | 1.92 (0.99) | −0.18(0.92) | 3.27 (0.99) | 3.49 (0.98) | −4.15**(0.00) | −4.15**(0.00) |
| $INF_t$ | −0.66 (0.83) | −1.402192 (0.8388) | 4.88 (0.99) | 1.12 (0.99) | 4.61($p < 0.01$) | −8.18 *** ($p < 0.01$) |
| $RGDP_t$ | −0.77 (0.81) | −5.54* (0.00) | −5.41*** (0.00) | −5.83*** (0.00) | 0.81*** ($p < 0.01$) | 0.27***($p < 0.01$) |
| $EXE_t$ | −1.69 (0.42) | −6.69* (0.00) | −01.36 (0.20) | −4. 05* (0.01) | 1.06*** ($p < 0.01$) | 0.17**(0.04) |

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. *p*-values are shown in parentheses.Source: Prepared by the researcher from the outputs of the E-views[13] package.

Because unit root tests reveal the presence of a unit root in our time series, the next step in testing for time series attributes was a co-integration test. Table 3 summarizes the findings. The Johansen co-integration test results indicate a single long-run relationship between the variables. As a result, a structural vector error correction model that takes the cointegration relationship into account might be estimated. However, this is

outside the scope of this work. Blanchard and Perotti [2] also find no significant variation in findings when the cointegration relationship among the variables is imposed. As a result, the SVAR model and DSGE technique used in this analysis are stated in terms of levels and rank.

**Table 3.** Co-integration test.

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.984138 | 214.6437 | 69.81889 | 0.0000 |
| At most 1 * | 0.887123 | 94.47323 | 47.85613 | 0.0000 |
| At most 2 * | 0.494483 | 31.21098 | 29.79707 | 0.0342 |
| At most 3 | 0.314824 | 11.42794 | 15.49471 | 0.1865 |
| At most 4 | 0.015860 | 0.463621 | 3.841466 | 0.4959 |

Source: Prepared by the researcher from the outputs of the E-views[13] package.

Table 3 shows the results of a co-integration test that suggests two co-integration vectors. The estimated coefficients of the two co-integration vectors are largely significant in the system, implying that deviations from the long-run relationship have an effect on government expenditure shocks. The elasticities of government expenditure shocks to inflation and exchange rates based on impulse responses based on the projected VEC system are 0.32 and -0.57 for two years, 0.43 and -0.98 for three years, and 0.49 and -0.99 for four years, respectively. These findings are consistent with those in Table 4 based on the structural VAR with three delays.

**Table 4.** Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC).

| Lag | AIC | SC |
|---|---|---|
| 0 | 110.4389 | 110.6869 |
| 1 | 103.4584 | 104.9462 |
| 2 | 95.42835 | 98.15595 |
| 3 | 92.29624* | 96.26367* |

Source: Prepared by the researcher from the outputs of the E-views[13] package.

The lag duration is determined using the Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SIC) (Table 4). The computed structural VAR provides the impulse responses of Government expenditure shocks to RGDPt and the inflation rate (INFt), as well as the exchange rate (EXEt). The first stage in model estimation is to explain the long-term features of the data series (that is, to confirm the presence of cointegration relationships between model variables). According to the Akaike parameter (AIC), the time series utilized in this study was unstable for all variables except government expenditure. This suggests that non-stationary level variables should be shifted to the first difference. The tests show that three lags are the optimal amount of delays for our model, which differs from the literature, where lags ranged from four to five periods. However, the Schwarz indicator (SC) indicates that a lag of zero is ideal.

*5.3. Empirical Approach Selection and Construction to Measure Impact and Response*

According to the Akaike parameter (AIC), the time series utilized in this study was unstable for all variables except government expenditure. This means that non-stationary variations exist. The autocorrelation of macrovariable time series data is high. The vector autoregressive model (VAR model) and the structural vector autoregressive model (SVAR model) can handle time series of macroeconomic data more effectively. In comparison to the VAR model, SVAR identified the relationship that was previously buried in the random disturbance term of the VAR model by introducing the synchronization relationship matrix A. The five variables

have a clear contemporaneous link. As a result, this paper abandons the VAR model in favor of building the SVAR model [24–28].

5.3.1. Effect of Aggregate Government Expenditure

Figure 5 depicts the responses of macroeconomic variables to government expenditure shocks. Initially, there was no response to government spending shocks in Sudan's exchange rate variable during the time, and the figure shows that the response is close to zero. Following this phase, the exchange rate begins to display a good bullish trend that will last until the fourth quarter. The results reveal that aggregate expenditure shocks have a nearly three-quarter lag before their influence on the currency rate. In general, aggregate expenditure shocks have long-term impacts, although their impact on the Sudanese exchange rate is limited. The same is true for the inflation rate's reaction to government spending shocks. We can see from the graph that inflation rates in Sudan did not respond to government spending shocks during the time due to the weakness of monetary policy and its adaptability to the requirements of economic policies. The indication is stable and does not move, as we can see. In the second and third quarters, RGDP responded positively to aggregate expenditure shocks; in the first quarter, the response was weak or non-existent. The level of reaction remained constant in the fourth quarter. This is because the Sudanese economy was unstable throughout the first time of the ruling regime (the National Conference), and the shocks to government spending were obvious during the period when oil was exploited. This discovery contradicts the Furthermore, it contradicts studies such as Blanchard and Perotti, Perotti, Rafael and Ivan, Rosoiu, and Hussain and Liu [2, 15, 29, 30]. This finding contradicts Keynes' argument about the effectiveness of increased aggregate expenditure as an expansionary policy; it also contradicts studies such as Blanchard and Perotti, Hussain and Liu, Rafael and Ivan, Rosoiu, and Perotti [2,15,29–31].

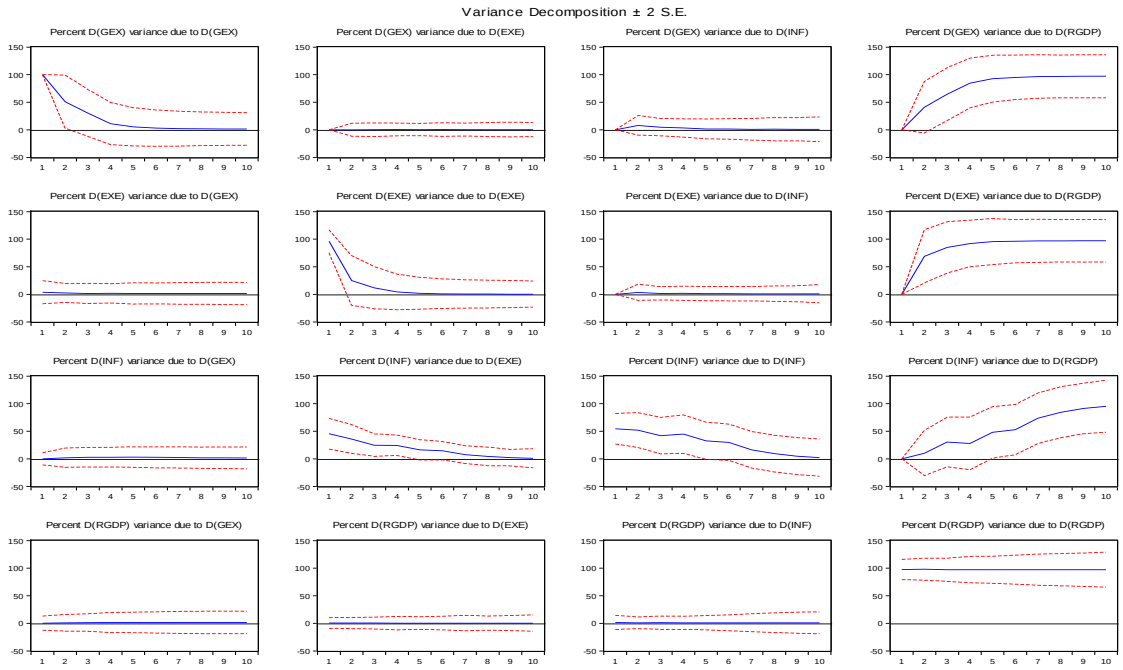


**Figure 5.** Impulse Responses to Aggregate Government Expenditure.

5.3.2. Effects of Economic Stability (Stability of the Exchange Rate of the Sudanese pound)

A change in the exchange rate of the US dollar versus the Sudanese pound will have an immediate and long-term impact on the balance of the state's general budget and government spending. This is mostly owing to the Sudanese economy's close link to gasoline sales income during the study period. The central bank's expansionary monetary policy has been in place since One of the studied years 2010–2014, which had a more than 16% rise in the money supply, higher inflation, and a high and volatile exchange rate for the Sudanese pound. Thus, coordination of fiscal and monetary policy could pave the road for Sudan to reduce exchange rate volatility. Controlling government spending, increasing savings, and lowering trade barriers could all benefit the

currency. Similarly, gold purchases by the Central Bank of Sudan should be undertaken at the current market exchange rate, not at a higher rate.

The constant degradation and fluctuation of the exchange rate across the study period suggests that the exchange rate system used has no effect on the exchange rate's stability. The central bank's many interventions and swings between alternative monetary and fiscal policies, which aim, among other things, to stabilize the currency rate, have failed. To reduce exchange rate volatility, central banks must intervene in exchange rate-determining variables.

The model of impulse responses Figure 6 depicts large inflation responses to simultaneous changes in the exchange rate. When the exchange rate rises by one percentage point, the Sudanese inflation rate rises by 0.39 percentage point. Although the impulse response to an exchange rate shock is usually minor, the lagged cumulative effect is significant in all study periods and thereafter becomes trivial. Despite the fact that the impulse response to an exchange rate shock is small most of the time across all study periods.

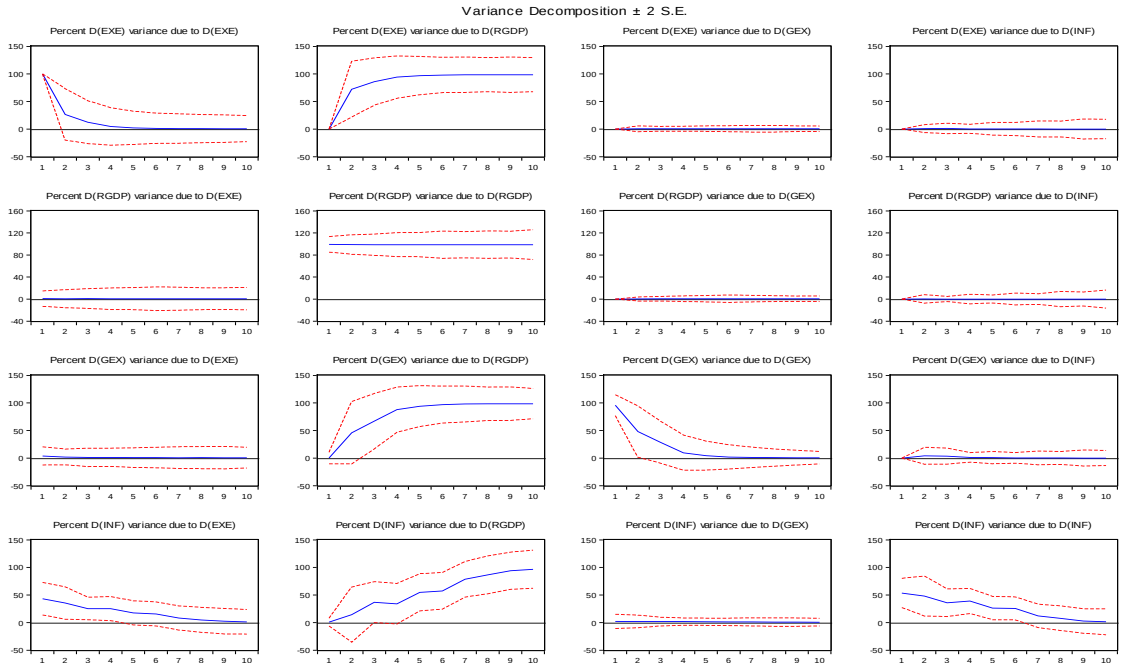


**Figure 6.** Impulse Responses to Economic Stability (Stability of the exchange rate of the Sudanese pound).

**Table 5.** Accumulated bias for misspecified models (DSGE) and the SVAR model.

| Mu | DSGE | Period 1 SVAR Lag one | Ratio | DSGE | Periods 2 SVAR Lage two | Ratio | DSGE | Periods 3 SVAR Lage three |
|---|---|---|---|---|---|---|---|---|
| $M_0$ | 0.5 | 0.6 | 0.9 | 2.5 | 3.7 | 0.7 | 18.2 | 12.4 |
| $M_1$ | 1.1 | 0.9 | 1.0 | 4.3 | 7.5 | 1.1 | 12.9 | 17.8 |
| $M_2$ | 2.1 | 1.9 | 1.1 | 4.3 | 4.4 | 1.4 | 17.1 | 21.7 |
| $M_3$ | 3.2 | 2.0 | 1.8 | 5.8 | 7.9 | 1.2 | 21.2 | 23.4 |
| $M_4$ | 3.7 | 2.4 | 2.0 | 7.3 | 6.3 | 1.2 | 22.7 | 25.9 |

Source: Prepared by the researcher from the outputs of the E-views[13] package.- The accumulated bias is calculated as the sum (across different numbers of periods) of the absolute percentage difference between the estimated DSGE model or the SVAR impulse responses with the DSGE.- The ratio measure is simply the bias of the estimated DSGE model relative to that of the SVAR model.

These findings emphasize a significant distinction between the two models (as shown in Table 5): the SVAR suggests that real shocks, such as inflation rate and RGDP shocks, are more important than nominal shocks (government spending shocks and exchange rate stability) for real economic variables. The aggregate of real shocks is responsible for 23% of RGDP, 7% of inflation, and 3.9% of the exchange rate. The DSGE model, on the other hand, suggests that both real and nominal shocks are equally important. However, it is extremely vulnerable to shocks. Another intriguing finding is that the DSGE model identifies inflation rate mark-up shocks as the primary contributor to the unconditional variation of the exchange rate, RGDP, and government spending, whereas.

### *5.4. Robustness Check of the SVAR Approach*

To test the robustness of the results, we used several variable orderings. The results are identical to the prior order, with no discernible difference. To boost our confidence in our findings, we ran four tests to validate the SVAR approach: serial correlation, heteroskedasticity, stability, and normalcy testing. The results show that there is no serial correlation, no heteroskedasticity, and SVAR meets the stability criteria. The VAR model, however, fails the normalcy test using the Jarque-Bera test. According to ThadEwald and Buning, the Jarque-Bera test has poor power when applied to small sample size, as was the case in this investigation [32,33].

1) Robustness Checking

In this study, different approaches for robustness checking were investigated, such as the use of a model without monetary policy.

2) Model without Monetary Policy and Fiscal Policy

The monetary policy variable was employed in the baseline model. Because the primary goal of this research is to examine the impact of macroeconomic variables' responses to government spending shocks, it is assumed that the model does not include a monetary policy variable. According to the findings of the analysis, the impulse response function of the influence of fiscal policy in the baseline model is nearly identical. Overall, the impulse response function was found to be resilient with baseline constraints.

## 6. Concoction

To improve budgetary balance, the government must gradually reduce oil subsidies. In terms of policy recommendations, it is implied that government spending shock convergence can be achieved by rationalizing spending and developing monetary and financial policy tools that are compatible with the structure of the Sudanese economy, though the latter is more effective in terms of magnitude. As government spending shock convergence across countries is a sign of welfare enhancement, and establishing economic stability and full employment of resources through these policies, the results in this article demonstrate that it is possible. In general, the newly estimated models' results did not differ much from those reported in the preceding part or theoretical section, and they did not agree with the theoretical model's conclusions. In other words, a shock to macroeconomic variables resulted in rising inflation, an unstabilized exchange rate, labor accumulation, and, lastly, a low growth rate.

It is critical to stress that the primary contributions of this work to public finances can be stated in two complimentary elements. For starters, by developing an indicator of government spending shocks, it gives inputs for decision-making in both the current and future scenarios. Second, by investigating and highlighting the effects of increased inflation rate and exchange rate on the real and fiscal variables of the economy in a structural model, it is demonstrated that increased government spending shocks negatively affect both economic activity and public accounts, and that the adoption of a fiscal rule can mitigate the adverse effects of increased government spending shocks on public accounts and all macroeconomic variables. Taken as a whole, this conversation can have a positive impact by promoting better fiscal policy planning and consolidation during times of increased government spending shocks. According to the policy, model, and strategy implications, the government should carefully study and identify the sectors or components that have better potential, capacity, and importance in generating sustainable economic growth and rationalizing public spending. The findings shed

light on the potential and specific future issues confronting the Sudanese economy.

Sudan faces numerous problems, including urgent humanitarian and economic needs, guaranteeing security, justice, and respect for human rights, peacekeeping, and advancing the democratic transition. Fiscal reforms to increase domestic revenue mobilization, reduce subsidies, and strengthen the social safety net; solidifying the transition to a flexible exchange rate and reserve money targeting regime; strengthening the financial sector by transitioning to a dual banking system and reforming the resolution regime; strengthening governance and transparency, particularly in the SOE sector; and creating a more enabling environment for private sector growth.

## 7. Disclaimer

The author's views, results, opinions, and conclusions or recommendations in this scholarly Paper are solely his or her own. They do not necessarily represent the Sudanese government's viewpoint. The Sudanese government accepts no responsibility for any errors or omissions in these scientific publications or for the accuracy of the material included within them.

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The author declares no conflict of interest.

## References

1 African Development Bank. *African Economic Outlook, Supporting Climate Resilience and a Just Energy Transition in Africa*; African Development Bank Group: Abidjan, Côte d'Ivoire, 2022.

2 Blanchard O, Perotti R. An Empirical Characterisation of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics* 2002; **117**(**4**): 1329–1368.

3 Galí J, López-Salido D, Vallés J. Understanding the Effects of Government Spending on Consumption. *J Eur Econom Assoc* 2007; **5**: 227–270.

4 Ramey VA. Identifying Government Spending Shocks: It's All in the Timing. *Q J Econ* 2011; **126**(**2011**): 1 –50.

5 Alami Y, El Idrissi I, Bousselhami A, Raouf R, Boujettou H. Macroeconomic Impacts of Fiscal Shocks on the Moroccan Economy: a Disaggregated SVAR Analysis. *Journal of Business and Socio-economic Development* 2022; **2**(**2**): 137–152.

6 World Bank. Sudan: the Road Toward Sustainable and Broad-Based Growth. Available online: http://www.worldbank.org (accessed on 5 January 2024).

7 Sobti R. The Macroeconomic Impact of Fiscal Policy Shocks: What do the Indian Data Say?. *Margin: The Journal of Applied Economic Research* 2022; **16**(**1**): 7–27.

8 Cogan JF, Cwik T, Taylor JB, Wieland V. New Keynesian Versus Old Keynesian Government Spending

Multipliers. *Journal of Economic Dynamics and Control* 2010; (**3**): 81–295.

9 Yadav S, Upadhyay V, Sharma S. Impact of Fiscal Policy Shocks on the Indian Economy. *Margin: The Journal of Applied Economic Research* 2012; **6**(**4**): 415–444.

10 Ali AG, Elbadawi I. Explaining Sudan's Economic Growth Performance, AERC Collaborative Research Project on Explaining Africa's Growth Performance. *Working paper No 9* 2004.

11 Abdalla SZ. Sources and Impacts of Macroeconomic Fluctuations in Sudan: Empirical Evidence from Structural Vector Autoregressive (SVAR) Framework. *Visiting Research Fellow Series No*. 495, Institute of Developing Economies, Japan, 2016.

12 Sims CA. Macroeconomics and Reality. *Econometrica* 1980; **48** (**1**): 1–48.

13 EViews 9 User's Guide II. Available online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cdn1.eviews.com/EViews%2012%20Users%20Guide%20II.pdf (accessed on 5 January 2024).

14 Bahovec V, Erjavec N. *Uvod U Ekonometrijsku Analizu*; Element: Zagreb, Croatia, 2009.

15 Rafael R, Ivan Z. The Use of SVAR Analysis in Determining the Effects of Fiscal Shocks in Croatia. *Financial Theory and Practice* 2011; **35**(**1**): 25–58.

16 Lippi M. Validating Dsge Models with Svars and High-Dimensional Dynamic Factor Models. *Econometric Theory* 2023; **39**(**6**): 1273–1291.

17 Del Negro M, F Schorfheide. Priors from General Equilibrium Models for Vars. *International Economic Review* 2004; **45**(**2**): 643–673.

18 Drautzburg T. A Narrative Approach to a Fiscal DSGE Model. *Quantitative Economics* 2020; **11**(**2**): 801–837.

19 Blanchard OJ, Kahn CM. The Solution of Linear Difference Models Under Rational Expectations. *Econometrica* 1980; **48**(**5**): 1305–1311.

20 Sims C. Solving Linear Rational Expectations Models. *Computational Economics* 2002; **20**(**1**): 1–20.

21 Fernandez-Villaverde J, Rubio-Ramirez J, Sargent T, Watson M. ABCs (and Ds) of Understanding VARs. *American Economic Review* 2007; **97**: 1021–26.

22 Christiano LJ, Eichenbaum M, Vigfusson R. *Assessing Structural VARs'*; National Bureau of Economic Research: Cambridge, MA, USA, 2006.

23 Ravenna F. Vector Autoregressions and Reduced Form Representations of DSGE Models. *Journal of Monetary Economics* 2007; **54**: 2048–2064.

24 Pfaff B. VAR, SVAR and SVEC Models: Implementation within R Package Vars. *J Stat Softw* 2008; 27; 1–32.

25 Adenomon MO, Oyejola BA. Impact of Agriculture and Industrialization on GDP in Nigeria: Evidence from VAR and SVAR Models. *Int J Anal Appl* 2013; **1**: 40–78.

26 Zhang S, Han G, Yu R, Wen Z, Xu M, Yang Y. The Sustainable Development Path of the Gold Exploration and Mining of the Sanshan Island-Jiaojia Belt in Laizhou Bay: A DID-SVAR Approach. *Sustainability* 2021; **13**: 11648.

27 Ahmed HJA, Wadud IM. Role of Oil Price Shocks on Macroeconomic Activities: An SVAR Approach to the Malaysian Economy and Monetary Responses. *Energy Policy* 2011; **39**: 8062–8069.

28 Beard E, Marsden J, Brown J, Tombor I, Stapleton J, Michie S, West R. Understanding and Using Time Series Analyses in Addiction Research. *Addiction* 2019; **114**: 1866–1884.

29 Rosoiu J. The Impact of the Government Revenues and Expenditures on the Economic Growth. *Procedia Economics and Finance* 2015; **32**: 526–533.

30 Hussain SM, Liu L. Macroeconomic Effects of Government Spending Shocks: New Narrative Evidence from Canada. *Journal of Macroeconomics* 2023; **75**: 103483.

31 Perotti R. Estimating the Effects of Fiscal Policy in OECD Countries. Available online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www. frbsf. org/wp-content/uploads/fpoecd. pdf (accessed on 5 January 2024).

32 Thadewald T, Bunning H. Jargue-Bera Test and Its Competitors for Testing Normality: A Power Comparison. Available online: http://www.econstor.eu. (accessed on 5 January 2024).

33 Nour S. Assessment of the Impact of Oil: Opportunities and Challenges for Economic Development in Sudan. *African Review of Economics and Finance* 2011; **2**(**2**): 122–148.

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Article

# Emergence Procurement, Issues and its Pandemics: A case of Selected Public and Private Procuring Entities of Materials in Mbeya City-Tanzania

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**Abstract:** The study aimed at investigating the emergence procurement issues and pandemics. This investigation came following a number of cases (>80%) over the procured materials found not to meet the requirements. The study was carried out in Mbeya City where 97 respondents from 2 public (30 respondents) and 3 private (67 respondents) procuring entities were involved. This sample frame was obtained by applying the systematic sampling technique. Indeed, data from this sample frame were primarily collected using questionnaire and secondarily by reviewing journals and reading books. The collected and processed data were analyzed using incremental and absolute fit indices. From the analysis it was found that emergence procurement is the result of being not effectively plan for procurement of materials (RMSEA>0.07). It is from ineffective planning for materials to be procured that found to cause the revealed splitting of orders (RMR<0.08; $X^2$>0.05), inefficient use of scarce resources (GFI>0.90; $X^2$>0.05) and non retention of customers (NNFI>0.95; $X^2$ >0.05). It is from this discrepancy found, thus this study recommends that the procuring entities should be used to procurement planning.

**Keywords:** emergence procurement; splitting of orders; in-efficient use of resources; loss of customers; private and public procuring entities; materials; Mbeya City

## 1. Introduction

Efficient procurement has been the debatable issue by most of procuring and supply firms. Meeting to this excellent and efficiency in procurement and supply then strategic planning cannot be avoided. The strategic planning dictated has to state what to procure, how much to procure, when to procure and from whom to procure [1]. Thus procurement planning is a vital task towards achieving efficiency in procurement [2]. This is to say, unplanned procurement called emergence procurement can-not meet to the said efficiency and excellence in procurement.

Emergence procurement is un-planned procurement in which the five fundamental questions, the procuring entities should consider are not addressed. The said five fundamental questions that are not addressed in the adopted emergence procurement are what to procure, how much to procure, from where to procure, when to procure and for whom to procure [3]. Thus if these questions are well addressed under emergence procurement, this is then a source of splitting of orders. It is with emergence procurement in which ordering is not confined to the listed five fundamental questions [4]. The results of this is that emergence procurement leading into increase

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in number of orders, inventory cycle time, thus piling up the total inventory cost.

Emergence procurement is the result of inefficient use of organization resources. It is with this then that is why it is said that emergence procurement lead into inefficient use of resources, of which therefore the philosophy total cost minimization is not met [5]. Due to unplanned purchases undertaking might be executed when price is high aiming to meet the demand that fall due. Acquiring materials at high price utilizes more and unplanned financial resources [6]. Moreover with emergence procurement the materials to be procured might be more than what is the actual need of the market at a particular time [7]. This has then revealed to create wastes, redundant and dead stocks [8]. It is with emergence procurement in which materials are overstocked or even under-stocked. Under-stocking is the result of a firm running out of stock [9].

Emergence procurement is the root cause of the withdrawals of the customers from the procuring and supplying firm. As it has noted above, since emergence procurement is normally not confined to specifications then a discrepancy of supplying unnecessary and non-right materials is obvious [10]. Supplying of unnecessary and non-right materials is the result of dissatisfaction of customers [11]. This either withdrawal customers from transacting with procuring /supplying firm. Moreover since emergence procurement is not confined to how much to procure indemptedness towards sustaining a market demand at a given time period called forecasted demand, then the cause of overstocking and/or under-stocking are obvious which then disrupt customer service level. Procuring and supplying little than the market need because the firm incur the stock out cost in which the firm run out of stock for customers not accessed to the materials at the time when needed. This then a major cause of these customers withdrawals. Low quality materials held in a store or procured none planned and supplied to the market is another reason for customers withdrawal from the transacting.

The emergence procurement has revealed to be not confined to optimal ordering [12]. Un-optimal ordering has therefore being a cause of increase in total ordering cost [13]. This is then has caused the philosophy of maximization of total inventory cost being violated.

Gheibi and Fay reported that emergence procurement is not confined to specifications [14]. This either means that the questions of what and how much is to be procured is not confined under emergence procurement. The mergence procurement has found procuring firms not able to meet the market demand that fall due at a particular time [15].

Emergence procurement has found to be the cause of overstocking and under-stocking [16]. Non forecasted materials procurement has been the root cause of double material handling discrepancies [17]. Emergence procurement has been a cause of the firm running out of stocks [18].

From above it has stipulated that emergence procurement lead into negligence of the philosophy minimization of total cost of ownership indeed the inventory total cost. This study underhand has explicitly addressed the impacts of emergence procurement to be the cause of splitting of orders. The spllited order has revealed has revealed to be the cause of increase in ordering cost thus marginalized total inventory cost, increase in cycle time, number of orders and average inventory. Moreover while other authors has stipulated on emergence procurement to be the cause of procured materials not being confined to specifications, this study underhand has stipulated on multiplier effects of the procured and supplied materials not being confined to specifications such that over creation of dead stocks, creation of slow and non moving stocks, uneconomical use of store space, more use of financial resources and procurement of materials more than the actual need of the market.

The overstocking and under-stocking discrepancies revealed by other authors has not uncovered in-terms of its multiplier effects. The said multiplier effects have therefore put down by this study underhand. Thus the contextual gap uncovered by this study under discussion different from other studies was loss of customers being the said multiplier effects of under-stocking and overstocking. The concepts revealed leading to loss (withdrawals) of customers resulted due to under-stocking and overstocking were un-time delivery, non right quantity, non-quality and non-right priced materials.

To reveal the facts, this study employed three specific research objectives. These objectives were: - to investigate the effects of emergence procurement on splitting of orders; to examine the effects of emergence procurement on inefficient use of resources; and analyze the effects of emergence procurement on loss of

customers. The general research objective defining the three specific objectives was to investigate the effects of being used to emergence procurement.

## 2. Literature Review

### *2.1. Theoretical Literature Review*

The study was guided by Strategic Process Model supplemented by the Hybrid Linear Cyclic Process Models [19]. Strategic process model proposes procurement undertaking to be strategic in a manner that whatever what need to be procured need to be planned. The model suggests on the importance of being adhered to five fundamental questions before actual deliveries which are what, how much, when, where and for whom to procure. That means the materials to be procured should be confined to specifications. Specifications reveal the problem, the society face, the issue which was not put down by linear process model [20]. The Linear Process Model which came before cyclic and hybrid Linear-cyclic Process Model proposed that before actual delivery, then the procuring and supplying should first determine the problem (the actual need) of the market of which the need of the market of which the need is defined by preparing procurement plan sometimes called annual procurement. With cyclic process model by [20]. is that whatever should first determine the problem (the actual need) of the market of which the need is defined by preparing procurement plan, sometimes called annual procurement. With cyclic process is that whatever what is to be adhered to the market, still there should a feedback executed by performing evaluation to determine whether what has delivered is the material actually demanded by the society (customers). Thus aggregation of linear and cyclic process Model which emerged to hybrid linear-and-cyclic process model had a concepts stipulated by both linear and cyclic models.

Using strategic process model supplemented by hybrid linear – cyclic model has shown that problem identification (determination of market need) is a vital juncture before actual replenishment of the materials. Indeed it has shown that the problem identification is defined by uncovered five important questions which are what to procure; how much to procure; when to procure; where to procure and for whom to procure confined by preparing annual procurement plan.

Despite of the innovations put forward by strategic process model but the opposite side say if the specifications and if the problem is not clearly defined what will happen has not stipulated. The opposite side what has stipulated by this study under discussion is unplanned procurement and its pandemics. As what has stipulated by this study, unplanned procurement called emergence procurement revealed to be the causal of splitting of orders, inefficient use of resources and loss of customers.

### *2.2. Empirical Literature Review*

Kweka associated the emergence procurement and use of more cost in procurement undertakings in India [21]. With this study by it was revealed that because emergence procurement is a ghost unplanned procurement dealings then during acquisition, the price of materials might happen to be very high [21]. This then demand a procuring entity to use more financial resources to adequately acquire the intended materials. With a slight difference is that the study by [21] was specifically correlating the emergence procurement and the marginal cost incurring.

Moreover, according to in Romania it was revealed that it is by 84% cases reported over supplies is that pertaining stock-outs due to opting for emergence procurement [22]. It was moreover revealed that emergence procurement is unplanned procurement from which the procurement method is not known. This was further revealed to be the cause of a firm realize to have zero inventory when a fresh ordering for delivery is done but only to realize that the firm is running out of stock. What innovative has therefore brought by this study is that it is from the stock out discrepancy what has revealed to be the cause over loss (withdrawal) of customers. It was explicitly said that nothing efficient and optimally will be obtained if more financial resources was to utilized. This study under discussion has been broad by dictating on the more resources use and not when only emergence procurement is made part and parcel of the routine activity of the procuring firm. More resources does not only implies more cost to be incurred when acquiring materials but also more materials bought than the

actual demand of the market, more human and physical resources un-optimally utilized. Thus this study under discussion revealed the pandemics of emergence procurement and the dilemma of not meeting the optimality over use of resources in general.

Marshall et al. in Tanzania reported on increase in average inventory due to emergence procurement practices [23]. From the study by it was revealed that the sometimes it happen that the inventory ordered become overstocked and thus creating slow moving average stock [23]. It was furthermore revealed that the more average inventory was due to high non-moving stocks/wastes once realized dead stocks. This study under discussion has stipulated on the root cause of high average stock held in a store caused by splitting of orders. More other issues that this study underhand addressed to be rooted at splitting of orders were increase in ordering cost, holding cost, number of orders, number of deliveries and inventory cycle time which has revealed to disrupt optimal replenishment.

### *2.3. Conceptual Framework*

The association of variables, concepts from the above hypothesis analysis and reviews of literature, the conceptual framework was drawn as shown in Figure 1 below.

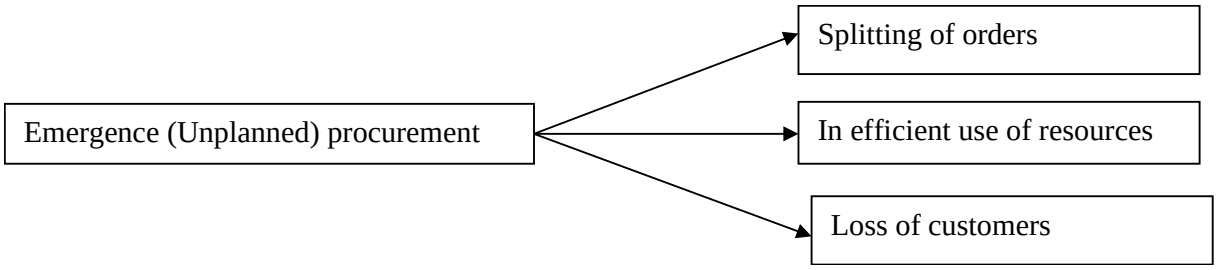


**Figure 1.** Conceptual framework of the issues and pandemics of emergence procurement.

## 3. Materials and Methods

The study used the cross sectional survey design and positivistic philosophy. Moreover the study was conducted in Mbeya City Council. This area was chosen as Mbeya City is one of the outgrowing cities with many traders popping in. Through a pilot study it was found that despite of large number of traders popping in especially in the city centre and the area of Mwanjelwa but most of business runners (procuring and supplying firms) lacked managerial skills pertaining effective planning. Through piloting it was found that about 80% of procuring and supply firms do not plan for procurement undertakings. Though the study included a large number of private procuring firms but public procuring firms were not left aside. This was one of the criterion that used to differentiate this study and other studies which found to be concrete and much over private procuring firms. The study included 2 public and 3 private procuring entities. It is from this sample frame in which 30 respondents from public and 67 respondents from public procuring entities/firms. Indeed the 30 out of 67 respondents from private procuring firms were from the large ones and 37 respondents were from micro, small and medium procuring firms. The targeted population was the procuring and supplying firms involved in procurement of materials (goods).

To derive to 67 respondents from 2910 total population for only registered and licensed procuring firms, the study employed systematic sampling. Using systematic sampling technique the $30^{th}$ interval was deduced from the formula n= N/n where N= total population =2910 and n = sample size = 97. This means that the $1^{st}$ 30 interval was for 30 respondents from public procuring firms, the $2^{nd}$ 30 interval of respondents was for large private procuring firms and the other 30 (+7) was for micro, small and medium procuring firms.

The primary data from the sample obtained were obtained by employing questionnaire and secondary data were obtained by reviewing journal articles , Wikipedia and reading books. These documentary reviews enabled to back up the study by revealing or associating the concepts said by other authors in relation to the study underhand for validity and reliability proof of primary data obtained from the field.

The data collected were from four variables which were splitting of orders, inefficient use f resources, loss

of customers and emergence procurement. The variables were measured using likert scales of the form '5' = strongly agree; 4= agree; 3= undecided; 2= disagree and; 1= strongly disagree. The collected data were coded, edited, checked for missing values and cleaned and then subjected for analysis. The analysis employed inferential statistics tools including absolute and incremental fit indices which were RMSEA, RMR, GFI and NNFI.

## 4. Findings and Discussion

### *4.1. Emergence Procurement and Splitting of Orders*

With this title, the study aimed at revealing the effects of emergence procurement and the way orders are split. None planning over procurement of materials as it is to other assignments lead into of orders. As it was reported by [24], splitting of orders pile up materials ordering cost, and thus increasing the numbers of orders. The results from the field were regarding title head were presented as shown in Table 1 pertaining the Root Mean Residual (RMR) testing.

**Table 1.** Root Mean Residual Analysis Testing results.

| S/N | Constructs (N=97) | Value | d.f | $\chi 2$ | Pro |
|---|---|---|---|---|---|
| 1. | Marginalized ordering cost | 0.06 | (1, 96) | 0.07 | 0.001 |
| 2. | Increase in number of orders | 0.05 | (1, 96) | 0.09 | 0.002 |
| 3. | Increase in average inventory | 0.07 | (1, 96) | 0.20 | 0.000 |
| 4. | Increase in inventory cycle time | 0.04 | (1, 96) | 0.30 | 0.003 |

**Source:** Researchers' Own Computations (2020)

It is from the results shown in Table 1 which indicates that emergence procurement is a contributory start for the organization not able to minimize the inventory total cost. This either is due to the proof over marginalized inventory ordering cost with RMR value =0.06<0.08, the recommended value. High ordering cost including the purchase price, shipping cost, suppliers searching cost has a multiplier effect over increase in material holding cost. Emergence procurement ignores the principles of optimism as it is to economic order quantity model (EOQ).

Moreover the same results over splitting of orders and emergence procurement was shown with RMR results =0.05, $\chi 2$ >0.05 regarding increase in number of orders (n=D/Q =d/Q) as it is to other constructs. Normally with increase in number of orders, then more ordering cost is to be incurred. Moreover if the buffering system is not properly executed then the organization might be creating wastes = $\underline{\text{(Average waste)/½}}$

(Average inventory)/$1/_{12}$

Indeed splitting of orders due to adoption of emergence procurement is a result of increase in average inventory (Q/2), RMR =0.07. Increase in average inventory results into increase in slow /non-moving stocks where inventory turnover rate is negligible. Non moving stocks where inventory turnover rate is negligible. Non moving materials are dead stocks which end up with loss to the firm if it is no causing uneconomical use of store space. This either was the same reported by [25] that more average inventory creates obsolete, dead and inadequate stocks.

Splitting of orders due to adoption of emergence procurement found to prolong the inventory cycle time shown by RMR = 0.04. It was revealed that splitting of orders happen to prolong the process of procurement in which the problem of running out of stock is there obvious. Emergence procurement does neither offer optimal ordering as it is with EOQ nor buffer stocking zero inventory ordering system [25].

The statistical significance between emergence procurement and splitting of orders was proven from the found cases over increase in inventory ordering cost 4 times (represented by increase in inventory cycle time, Chi-square =0.4 at p=0.05) different from the procuring firm used to procurement planning. As it has noted above the major cause of piling of ordering cost was the replenishment being subjected to high purchase price

when demand fall due. The problem of splitting of orders by most of procuring and supplying firm was indeed with private, micro and small ones.

*4.2. Emergence Procurement and In-Efficient Use of Resources*

With this subtitle, the study motivated to express the effects of emergence procurement towards inefficient use of resources. In any business optimization over use of resources is a priority [26]. Optimization entails efficient/proper use of scarce resources purporting to maximize outputs or outcomes. Optimality in the use of resources details over proper use of store space, ordering the optimal quantity of materials that sustain market demand at a given periodic time. More other information found from the field was shown in Table 2.

**Table 2.** Goodness of fit index analysis testing.

| Constructs | Value | $\chi 2$ | Sig. |
|---|---|---|---|
| Materials ordered | 0.91 | 0.20 | 0.000 |
| Financial resources | 0.92 | 0.10 | 0.001 |
| Store space | 0.94 | 0.30 | 0.002 |

**Source**: Researchers' Own Computations (2020)

With GFI = 0.91 pertaining perception of the quantity of materials order shows the problem of overstocking or/and under-stocking to persist. It is obvious that non- planning and forecasting of materials needed is the results of either materials being ordered more than what is required called overstocking or being ordered in less quantity than the required one called under-stocking. This was also said by Njualem that since emergence procurement is not planned and forecasted then what is procured normally does not meet the demand of the market [27]. On other hand it was reported that unplanned procurement of materials gives rise to ordering of larger quantity of materials than what is the actual demand [28]. The pandemics with more materials ordering is the incur rage of more holding cost [29]. Excess holding of materials is the cause of creation of wastes, redundant (dead) stocks, obsolete and obsolescent stocks [29]. Excess materials holding implicate inefficient use of store space [29].

The GFI =0.92, $\chi 2>0.05$ as it was with constructs number 1 and 3 indicates that emergence procurement is the source of non-efficient use of financial resources. Thus optimality over use of firms' resources being not attained. Non planned procurement undertakings is (are) procurement acting which are not used to budget schedule, thus the risks of ordering large amount of materials at unplanned budget is there obvious. It is with emergence procurement in which more cost might be incurred at the time materials are needed while its price is very high [30]. Thus either is the result of acquisition of materials which are of low quality due to the specified ones being offered at a very high price unaffordable. The low quality, non-specified materials end up being dead stocks.

It is from the discrepancy of splitting of orders, in which more materials ordering lead into "double handling". This was found to be acute over perception un-proper use of store space, GFI =0.94, given $\chi 2>0.05$. Overstocking usually bring in materials of which some are of low quality not demanded by the market at that particular time. This either creates excess materials which give rise to an un-optimal use of store space [31]. This means that while say materials of class A (high quality ones) where to be handled in a store in a given time period but now even the so called slow moving or class C materials (non demanded materials) were found held in a store which is now counted as un-economical use of store space. Moreover, emergence procurement was revealed to be a causal of the loss of customers' satisfaction the fact found and presented in Table 3.

It was furthermore revealed that the total cost of inventory found to increase twice more for unplanned procurement as compared to the planned one. That means more cost found to be incurred with the firm not used to inventory planning and forecasting. It was moreover reported over reported statistical significance equal to Chi2 square = 0.3 at p=0.05, cases over dead stocks creation due to use of emergence procurement. Double material handling cases were mostly reported given un-optimal use of store space given chi square>0.05 (Refer

Table 4)

*4.3. Emergence Procurement and Loss of Customers*

The subtitle emergence procurement and loss of customers aimed at investigating the extent to which opting for unplanned (emergence) procurement give rise to loss of customers. As it was indeed said by Stark that since emergence procurement is conducted out of specification, out of time of delivery, out of budget and time schedule then the risks of buying non-specified (i.e. materials of low quality, less quantity) has been common [32]. Emergence procurement is non-smart procurement undertakings of acquiring new materials when they have just finished in the store [33]. Emergence procurement is a traditional way of procuring materials of which the fundamental questions what a procuring firm should consider are not fostered such as what to procure; how much to procure; for whom to procure; where to procure; and when to procure.

**Table 3.** Non Normalized Fit Index.

| Constructs | Value | $\chi 2$ | Sig. |
|---|---|---|---|
| 1. Time delivery | 0.94 | 0.06 | 0.000 |
| 2. Right quantity | 0.92 | 0.07 | 0.000 |
| 3. Right quality | 0.93 | 0.08 | 0.000 |
| 4. Right pricing | 0.91 | 0.05 | 0.000 |

**Source**: Researchers' Own Computations (2020).

With time delivery of materials, NNF=0.94 which is less than 0.95 shows that emergence procurement has negative association with customer retention. That means one of the cause of customers withdrawals is the late deliveries. This is the fact because with emergence procurement, materials needed of such quality and/or quantity might be not found in the store at that time, which might satisfy the need of the customer. The time of placing order until replenishment called lead time become in dilemma, thus even the on-time delivery o materials cause the needy group in reverse not able to meet the demand of the market on time. It is with this discrepancy what causes the needy group/buyer/customer withdrawal from supplying firm and another firm committed to on-time delivery of materials.

The results over right quantity deliveries, NNFI =0.92 is contrarily from the contention over customer or market capturing to the causal of less or more than what is needed deliveries. That means emergence procurement give rise to overstocked/excess material holding which creates wastes in a store. The wastes are obsolete and obsolescent materials of low value not able to sustain customer need [34]. The less quantity of materials ordering is also a dilemma that a procuring and supplying firm can-not retain customers. Ordering less than what is required by the market result into incur rage of stock out cost. With this then customers won't be accessed to materials at the time when they are needed. This either draws trust of customers/purchases from the supplying firm [35].

The results over right quality deliveries, NNFI =0.93 is the indication that most of procuring entities indeed the private supplying firms were not quality embedded ones. This dilemma was mostly found to be caused by opting for emergence procurement. Quality materials are specified inventories what customers demand for, thus it is through emergence procurement in which ingredient 'quality' is not much considered but 'quantity'. This is then a reason why most of organization opting for unplanned procurement ends up buying low quality quality-dead materials. The low quality valued materials deliveries deprive customers from the business transactional relationship. This is the fact that customers/buyers are interested with quality materials, opposite to that they normally withdrawal from such business relationship.

From Table 3 given the NNFI =0.91 for right pricing shows controversial that exist between the two variables i. e. emergence procurement and retention of customers. That means the NNFI<0.95, being the recommended level shows that emergence procurement is normally subjected to high priced materials. The

highly priced ordered materials are associated with the same high selling price. The high selling price has mostly found to be not friend to customers/buyers for the procuring firms not retain customers. According to [36], the high the price the low the demand and the opposite given that other factors affecting demand are kept constant called ceteris paribus.

The statistical significance found between the variable emergence procurement and loss of customers equals to Chi-square =0.4 at p=0.05 (See Table 4) was a proven fact over number of cases reported indeed with private procuring firms over being not able to retain customers. It was reported that at the time of introduction the firm hold large customers but sooner after sometimes of launching a business or introducing the supplies, customers start to withdrawal from the business and establish new business relationship. As it has noted above indeed regarding a negative relationship between emergence procurement and retention of customers smear the proof that emergence procurement is the cause of Chi-square>0.05 statistical significance in relation to off-time deliveries (NNFI=0.94); deliveries of wrong materials (NNFI =0.92) and high price underpinned (NNFI =0.91).

**Table 4.** Hypothesis Testing.

| **Null Hypothesis ($H_0$): EP= $S_O$; EP=IUR; EP=LC** | | | | |
|---|---|---|---|---|
| | | **Value** | **d.f** | **Pro.** |
| Chi-square test | So | 1.6 | (4, 93) | 0.045 |
| | IUR | 1.2 | (3, 94) | 0.050 |
| | LC | 1.6 | (4, 93) | 0.050 |

**So=**splitting of orders**, IUR =** inefficient use of resources**; LC=**loss of customers**.**
**Source**: Researchers' own computations (2020).

## 5. Conclusion and Recommendations

Emergence procurement is unplanned and non forecasted acquisition of good services or works [37]. From the field it was revealed that opting for emergence procurement has positive influence on splitting of orders, inefficient use of resources and loss of customers. It was indeed found that emergence procurement was the result of un optimal ordering which pile up ordering cost and thus inventory holding cost. It is from the discrepancy revealed what this study suggest the following, the policy makers, through PPD, should emphasize public procuring entities used to procurement planning and other efficient adherence procurement. Also through PPRA, the government should insist and publish principles on attaining to efficient procurement in which procurement planning cannot be avoided. Indeed, through PSPTB, the government should continue conducting CPD programs, certifying qualified candidates who would efficiently act in procurement discipline.

Moreover, the firms should be used to inventory planning and forecasting; the firms should define requirements (i. e. what and how much to procure); the firms should be used to framework contracts in procurement from which the method of procurement is also to be define and the firms should be used to budget schedule. To wound up, the firms should be used to specifications (defining Bill of Materials) as well as the firms should be used to time schedule (work plan).

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**References**


1 Aemireddy N, Yuan X. Root Cause Analysis and Impact of Unplanned Procurement on Truckload Transportation Costs. Available online: chrome – extension://efaidnbmnnnibpcajpcglclefindmkaj/https://dspace. mit. edu/bitstream/handle/1721.1/121317/Aemireddy_Yuan_2019. pdf? sequence=1&isAllowed=y (accessed on 26 May 2023).

2 Barraket J. The Role of Intermediaries in Social Innovation: the Case of Social Procurement in Australia. *Journal of Social Entrepreneurship* 2020; **11**(**2**): 194–214.

3 Bhandari M, Mody K, Rao B, Shivaram M, More M. *U.S. Patent No. 10,296,963*; Patent and Trademark Office: Washington, DC, USA, 2019.

4 Caranta R, Cravero C. Sustainability and Public Procurement. In *Public Procurement and Aid Effectiveness*; Hart Publishing: Oxford, UK, 2019.

5 Cawthorne WR, Famouri P, Chen J, Clark NN, McDaniel TI, Atkinson RJ, Nandkumar S, Atkinson CM, Petreanu S. Development of a Linear Alternator – Engine for Hybrid Electric Vehicle Applications. *IEEE Transactions on Vehicular Technology* 1999; **48**(**6**): 1797–1802.

6 Changalima IA, Mushi GO, Mwaiseje SS. Procurement Planning as a Strategic Tool for Public Procurement Effectiveness: Experience from Selected Public Procuring Entities in Dodoma City, Tanzania. *Journal of Public Procurement* 2021; **21**(**1**): 37–52.

7 Cheng W, Appolloni A, D'Amato A, Zhu Q. Green Public Procurement, Missing Concepts and Future Trends –A Critical Review. *Journal of Cleaner Production* 2018; **176**: 770–784.

8 Christopher E. Assessment of The Factors Influencing Implementation of Annual Procurement Plan in Tanzania: A Case of Selected Public Agencies. Ph. D. Thesis, Mzumbe University, Morogoro, Tanzania, 2020.

9 Crafoord K, Dalhammar C, Milios L. The Use of Public Procurement to Incentivize Longer Lifetime and Remanufacturing of Computers. *Procedia CIRP* 2018; **73**: 137–141.

10 de Souza Dutra CT, Rohan U, Branco RR, Chinelli CK, de Araujo AJVB, Soares CAP. Barriers and Challenges to the Sustainability Requirements Implementation in Public Procurement of Engineering Works and Services. *Open Journal of Civil Engineering* 2017; **7**(**1**): 1–13.

11 Erickson VJ, Halford A. Seed Planning, Sourcing and Procurement. *Restoration Ecology* 2020; **28**: S219 – S227.

12 Fatorachian H, Kazemi H. Impact of Industry 4.0 on Supply Chain Performance. *Production Planning & Control* 2021; **32**(**1**): 63–81.

13 Gaur J, Amini M, Rao AK. The Impact of Supply Chain Disruption on the Closed – Loop Supply Chain Configuration Profit: a Study of Sourcing Policies. *International Journal of Production Research* 2020; **58** (**17**): 5380–5400.

14 Gheibi S, Fay S. The Impact of Supply Disruption Risk on a Retailer'S Pricing and Procurement Strategies in the Presence of a Substitute Product. *Journal of Retailing* 2021; **97**(**3**): 359–376.

15 Ghisetti C. Demand – Pull and Environmental Innovations: Estimating the Effects of Innovative Public Procurement. *Technological Forecasting and Social Change* 2017; **125**: 178–187.

16 Hackl J, Krause D, Otto K, Windheim M, Moon SK, Bursac N, Lachmayer R. Impact of Modularity Decisions on a Firm'S Economic Objectives. *Journal of Mechanical Design* 2020; **142**(**4**): 041403.

17 Handayani DI. Risk Management of Supplier – Buyer in Procurement of Raw Materials for Improving Supply Chain Performance. *Jurnal Manajemen* 2018; **22**(**3**): 293–309.

18 Herz B, Varela – Irimia XL. Border Effects in European Public Procurement. *Journal of Economic Geography* 2020; **20**(**6**): 1359–1405.

19 Kanani R, Buvik A. The Effects of the Degree of Produce Perishability and the Choice of Procurement Channel on Supplier Opportunism: Empirical Evidence from the Food Processing Industry. *International Journal of Procurement Management* 2018; **11**(**1**): 113–133.

20 Križić I. Regulating Public Procurement in Brazil, India, and China: Toward the Regulatory-Developmental State. *Regulation & Governance* 2021; **15**(**3**): 561–580.

21 Kweka EE. Challenges in Public Procurement: An Examination of Legal Implications of Non Compliance with Procurement Rules in Selected Institutions in Morogoro. Ph.D. Thesis, Mzumbe University, Morogoro, Tanzania, 2019.

22 Lee H, Kim K. Traditional Procurement Versus Public–Private Partnership: A Comparison of Procurement Modalities Focusing on Bundling Contract Effects. Asian Development Bank Economics Working Paper Series No. 560. Available online: https://ssrn. com/abstract=3339138 or http://dx. doi. org/10.2139/ssrn. 3339138 (accessed on 26 May 2023).

23 Marshall D, McCarthy L, Claudy M, McGrath P. Piggy in the Middle: How Direct Customer Power Affects First–Tier Suppliers' Adoption of Socially Responsible Procurement Practices and Performance. *Journal of Business Ethics* 2019; **154**(**4**): 1081–1102.

24 Mrope NP. Determinants of Performance of Procurement Departments in Public Entities in Tanzania. Ph.D. Thesis, JKUAT–COHRED, Juja, Kenya, 2018.

25 Mtonga C. Addressing the Effects of Procurement Procedure Breaches in Higher Learning Institutions: a Case of the Lusaka Apex Medical University in Zambia. Ph. D. Thesis, University of Zambia, Lusaka, Zambia, 2020.

26 Munubi KZ, Kinanga R, Ondiba KP. Effects of Electronic Procurement on Organizational Performance: a Case Study of Major Supermarkets in Nairobi County. *International Academic Journal of Procurement and Supply Chain Management* 2017; **2**(**3**): 92–105.

27 Njualem LA. Exploring the Effects of Enterprise Resource Planning Systems on Direct Procurement in Upstream Asset–Intensive Industries. Ph.D. Thesis, Texas Tech University, Lubbock, TX, USA, May 2018

28 O'Brien CM, Martin–Ortega O. *Public Procurement and Human Rights: Opportunities, Risks and Dilemmas for the State as Buyer*; Edward Elgar Publishing: London, UK, 2020.

29 Preda I. Challenges in the Management of Emergency Public Procurement Performed in Romania to Combat the COVID–19 Pandemic. *Business Excellence and Management* 2020; **10**(**I1**): 67–87.

30 Raj A, Agrahari A, Srivastava SK. Do Pressures Foster Sustainable Public Procurement? An Empirical Investigation Comparing Developed and Developing Economies. *Journal of Cleaner Production* 2020; **266**: 122055.

31 Ramirez – Mitma M, Rojas – Garcia J, Torres – Sifuentes C, Raymundo C. A Strategic Lean Procurement Model Based on Supplier Approval to Reduce Unplanned Downtime in a Textile Small and Medium–Sized Enterprises. In *Brazilian Technology Symposium*; Springer: Berlin, Germany, 2019

32 Stark RJ. Impact of Material Shortages to Revenue. Ph. D. Thesis, University of Wisconsin – – Stout, Menomonie, WI, USA, 2019.

33 Stoffel T, Cravero C, La Chimia A, Quinot G. Multidimensionality of Sustainable Public Procurement (SPP) –Exploring Concepts and Effects in Sub–Saharan Africa and Europe. *Sustainability* 2019; **11**(**22**): 6352.

34 Tai YM. Web – Enabled Direct Procurement and Competitive Advantage: Mediating Effects of Inter – Organizational Management Capability. *International Journal of Procurement Management* 2017; **10**(**6**): 665–682.

35 Troje D, Gluch P. Populating the Social Realm: New Roles Arising from Social Procurement. *Construction Management and Economics* 2020; **38**(**1**): 55–70.

36 Tumusiime MF. Assessment of the Effects of Procurement Processes on the Performance of Construction Contracts in Local Government in Uganda: a Case Study of Sheema District. *Journal of Civil Construction and Environmental Engineering* 2020; **5**(**6**): 151–160.

37 Yao Y, Dresner M, Zhu KX. Monday Effect on Performance Variations in Supply Chain Fulfillment: How Information Technology–Enabled Procurement May Help. *Information Systems Research* 2019; **30**(**4**): 1402–1423.

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Article

# The Interactive Term of Debt Servicing and Oil Revenue on Capital Formation in Nigeria

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**Abstract:** Excessive debt servicing can strain government budgets, diverting resources away from critical investments and capital formation. Therefore, this study investigates how the concurrent level of debt servicing affects the relationship between oil revenue and capital formation in Nigeria. The study employs fully-modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) estimation techniques and utilizes time series data covering a period from 1981 to 2022. Results indicate a cointegration relationship among the variables in the model, and the findings reveal that debt servicing negatively and significantly moderates the positive effect of oil revenue on capital formation in Nigeria. Based on these findings, the study recommends that policymakers should carefully manage debt servicing obligations. This may involve exploring strategies to reduce the cost of servicing or optimizing debt repayment schedules to minimize the impact on the country's overall debt burden. Similarly, since the findings suggest that oil revenue has a positive impact on capital formation, policymakers should devise strategies to efficiently manage and diversify the use of oil revenues to enhance overall capital formation.

**Keywords:** capital formation; debt servicing; economic growth; gross domestic saving; oil revenue

## 1. Introduction

Capital formation is a cornerstone of a nation's economic development, and crucial for fostering sustained growth. It entails the accumulation of both physical and financial assets, thereby facilitating heightened production and productivity [1]. The significance of this process becomes apparent when a country is grappling with problems associated with debt accumulation and servicing [2]. The issue arises when excessive debt servicing burdens government budgets, redirecting resources away from essential investments. In such a scenario, the very foundation for robust economic development is compromised, posing challenges to the nation's overall growth path [3].

In Nigeria, the accumulation and servicing of excessive debt is creating a strain on government budgets, diverting resources from crucial sectors such as infrastructure, education, healthcare, and capital formation. The country witnessed a consistent growth in external debt, reaching a substantial amount of US$41.11 billion by 2004 (Debt Service Management Office [4].

Consequently, Nigeria encountered challenges in meeting its debt obligations. To tackle this issue, the Paris Club, consisting of 15 creditor nations, initiated a debt relief program in 2005 for heavily indebted countries, including Nigeria. At that time, Nigeria's debt to the Paris Club stood at US$28 billion, constituting a significant

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portion (85.8%) of its overall debt burden [5]. Through this initiative an upfront payment of US$6 billion in debt arrears, a substantial portion of Nigeria's debt, totaling US $16.6 billion, was forgiven. Additionally, the remaining debt of US$8.2 billion qualified for a buyback arrangement, resulting in significant savings of US$2 billion. This strategic approach effectively reduced Nigeria's external debt burden to US$3.7 billion, equivalent to 2.1% of its GDP, by 2006 [6].

However, recent data indicates that Nigeria's external debt has experienced further upsurge, standing at US $42.50 billion as at December ending 2023. These figures reflect a continued upward trend, raising concerns about the sustainability of debt service obligations and introducing a high degree of uncertainty in managing the country's debt [7]. External debt accumulation and servicing in Nigeria might affect various macroeconomic factors that are anticipated to contribute positively to capital formation. In essence, the emphasis is on oil revenue, a crucial aspect of the nation's income. The debt servicing could potentially reduce the anticipated positive influence of oil revenue on capital formation in the country. The allocation of resources to service debt may disrupt the intended beneficial effects of oil revenue on the accumulation of capital.

Analyzing the relationship between debt servicing, oil revenue, and capital formation in Nigeria is crucial for economic management. This study provides insights into debt dynamics and offers policymakers tools to optimize resource allocation and manage risks effectively. Understanding how oil revenue fluctuations impact debt servicing and capital formation can help Nigeria develop more targeted policies for sustainable development and financial stability. Incorporating these insights into development strategies can improve fiscal planning, boost investor confidence, and attract domestic and foreign investment. By aligning debt management with long-term development objectives, Nigeria can enhance inclusive growth, reduce poverty, and build a foundation for lasting economic prosperity.

Therefore, the objective of this study is to empirically examine how the concurrent level of debt servicing affects the relationship between oil revenue and capital formation in Nigeria. After this introduction, the second section deals with the review of related literature. The third section presents the methodology of the study. The fourth part present and discusses the empirical results. The last section summarizes the main findings, conclusion and provides policy recommendations.

## 2. Literature Review

The Harrod-Domar model developed in the mid-20th century represents a theoretical framework that was first designed to elucidate the relationship among saving, economic growth, and capital accumulation within an economy. It postulates that the rate of economic growth is directly tied to the level of savings and the capital stock. In essence, the model contends that an increase in savings can lead to a rise in capital accumulation, consequently fostering economic growth. The Harrod-Domar model thus provides insights into the dynamics that connect savings, capital formation, and the overall expansion of an economy [8].

Guided by Harrod-Domar model, numerous researchers have examined the relationship among savings, capital formation, economic growth and other macroeconomic variables. For instance, Yang and Shafiq investigated the relationship among capital formation, economic growth, foreign direct investment (FDI), inflation, money supply, and trade openness in twenty emerging Asian countries spanning a period from 2007 to 2018 [9]. The study utilized a fixed-effect model with robust standard errors to assess the impact of predictors on the economic growth of these Asian countries. The findings indicated a positive relationship between economic growth and predictors such as FDI, capital formation, money supply, and trade openness, while inflation exhibited a negative association with the economic growth of the Asian countries.

Similarly, Aslan and Altinoz employed the panel vector autoregression (PVAR) approach to investigate the interconnection among natural resources; gross capital formation, globalization, and economic growth in developing countries across Europe, Asia, Africa, and the Americas during the period 1980–2018 [10]. Findings across continents indicate bidirectional causality between globalization and economic growth. Additionally, bidirectional causality is observed between capital formation and growth in Europe and Asia, as well as between natural resources and growth in Asia and America. Moreover, unidirectional causality is identified from GDP to natural resources in Europe, from capital formation to GDP in Africa and America, and from GDP to natural

resources in Europe, with a reverse direction from natural resources to GDP in America.

In a country specific study, Ali investigated the effect of gross fixed capital formation on the economic growth of Pakistan, utilizing annual time series data spanning from 1981 to 2014 [11]. The study employed the Johansen Co-integration and Vector Error Correction Model (VECM). The findings indicated that all variables in the model were statistically significant, displaying the expected signs and establishing a long-run relationship with economic growth. Similarly, Bal, et al. investigated the influence of capital formation on economic growth in India during the period from 1970 to 2012 [12]. The authors employed the ARDL estimation technique and found that capital formation, trade openness, exchange rate, and total factor productivity had positive effects on economic growth in India.

In a specific Nigerian context, Akinola and Omolade conducted a study from 1975 to 2008, investigating the relationship among gross domestic savings (GDS), gross capital formation (GCF), and economic growth (GDP) [13]. Using the vector error correction model (VECM), their results revealed that GDP had a strong positive and statistically significant impact on both GDS and GCF, surpassing the effects of GDS and GCF on GDP. The causality test confirmed bidirectional causality among all the variables. Similarly, Udude et al. [14], employing the VECM estimation technique, explored the impact of oil exports on gross capital formation in Nigeria from 1980 to 2015. Their findings indicated that: oil exports had an inversely significant impact on gross capital formation in Nigeria in both the long run and short run; real gross domestic product impacted gross capital formation in Nigeria in the long run; and a causal relationship existed between the dependent variable and explanatory variables in Nigeria. The study concluded that oil exports did not contribute to the growth in gross capital formation in Nigeria.

Lucky and Uzah examined the determinants of capital formation in Nigeria [15]. The model considered Gross Fixed Capital Formation (GFCG/GDP) as a function of Broad Money Supply (M2/GDP), Credit to the Private Sector (CPS/GDP), Gross National Savings (GNS/GDP), Commercial Banks Lending Rate, Exchange Rate (EXR), Inflation Rate (INFR), External Debt (EXTD/GDP), Public Expenditure (PEX/GDP), Government Revenue (GR/GDP), Terms of Trade (TT/GDP), and Operating Surplus (OPS/GDP). The results indicated that M2/GDP, GNS/GDP, EXR, EXTD/GDP, and TT/GDP had negative and insignificant effects on capital formation, while CPS/GDP, LR, INFR, PEX/GDP, GR/GDP, and OPS/GDP had positive and insignificant effects on capital formation in Nigeria. Similarly, Abdullahi et al. assessed the effect of external debt on capital formation in Nigeria, using time series data from 1980 to 2013 and employing the Autoregressive Distributed Lag (ARDL) modelling [2]. The result shows that external debt has negative effect on capital formation in Nigeria.

In the same vein, Ozuzu and Ewubare employed the autoregressive distributed lag (ARDL) approach to investigate the impact of export earnings on capital formation in Nigeria spanning from 1980 to 2018 [16]. The study included various components of export earnings, such as oil export earnings, agriculture export earnings; solid minerals export earnings, and services exports earnings. Capital formation was assessed using indicators like gross capital formation, foreign reserve build-up, and foreign direct investment. The results from the Bound Test Cointegration indicated a long-run relationship between gross capital formation and the explanatory variables in the model. However, the study found that oil export earnings had a negative effect on capital formation in the long run, while agriculture export and solid mineral export earnings had positive effects on capital formation both in the short and long run.

The gap observed in the literature so far appeared in the fact that, while numerous studies have investigated the impact of different macroeconomic factors on capital accumulation in Nigeria, they have largely overlooked the moderating role of debt servicing in the relationship between oil revenue and capital formation. As a result, this study aims to fill this research gap by investigating how the impact of oil revenue on capital formation is influenced by the level of debt servicing in Nigeria.

## 3. Methodology

This section discusses the methodological approaches employed in order to achieve the objective of this study. It covers model specification, data sources, and estimation techniques.

*3.1. Model Specification and Data Source*

Following Abdullahi et al. [2], the functional form of the model is as specified in Equation (1):

$$GCF_t = f\left(GDS_t,\ GDP_t,\ OIL_t,\ DEBT_t,\ OIL*DEBT_t\right) \quad (1)$$

The variables in Equation (1) are; GCF (gross capital formation in current US $), GDS (gross domestic savings in current US$), GDP (gross domestic product in current US$), OIL (oil revenue in ₦ Billion), DEBT (total debt service on external debt in current US$), and OIL*DEBT (interaction of oil revenue and total debt service). The data for these variables span from 1981 to 2022 and were collected from the World Development Indicators, a World Bank database [17], and the statistical Bulletins of the Central Bank of Nigeria [18]. The natural logarithm of Equation (1) is taken to derive the baseline econometric model of the study, as presented in Equation (2).

$$lnGCF_t = \alpha_0 + \alpha_1 lnGDS_t + \alpha_2 lnGDP_t + \alpha_3 lnOIL_t + \alpha_4 lnDEBT_t + \alpha_5 lnOIL*lnDEBT_t + \varepsilon_t \quad (2)$$

In Equation (2), "*ln*" represents the natural logarithm of the variables; α0 denotes the intercept or constant term; α1, α2, α3, α4, α5 are the parameters or coefficients that signify the magnitude and direction of the impact each variable has on gross capital formation (GCF); and εt is the error term, representing the unobserved factors affecting gross capital formation (GCF) that are not explained by the included independent variables.

*3.2. Estimation Techniques*

The estimation techniques employed in this study encompasses three steps. The first step involves conducting unit root tests to establish the stationarity property of the series, utilizing the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. In the second step, the study tests the existence of a cointegration (long-run) relationship among the variables, employing the Johansen cointegration test [19]. This method is frequently applied in previous studies and is preferred over other cointegration tests due to its ability to simultaneously estimate multiple cointegrating vectors. The third step involves estimating the coefficients of Model (2) using both fully-modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) to enhance the robustness of the results.

Pedroni initially developed the FMOLS estimation technique, a residual-based test that provides efficient results for cointegrated variables [20]. Additionally, FMOLS is considered a reliable estimate, especially when dealing with small sample sizes, and it helps alleviate issues related to endogeneity and serial correlation among the variables [21]. Similarly, Stock and Watson developed the DOLS estimation technique to handle endogeneity (correlation between the independent variables and the error term) and serial correlation (correlation between error terms across time), issues often encountered in time series data [22]. FMOLS and DOLS are both valuable techniques for analyzing time series data with non-stationarity and endogeneity issues. FMOLS is particularly useful for estimating long-run relationships, while DOLS is more focused on dynamic models and efficient estimation of cointegrating vectors.

**4. Results and Discussion**

This section presents and discusses the empirical findings of the study. It includes the results of unit root tests that assess the stationarity status of the series, cointegration tests exploring long-run relationships among the variables, and the results of the estimated coefficients in the model.

*4.1. Results of Unit Root Tests*

Table 1 displays the outcomes of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The results reveal that all the variables exhibit unit roots at their levels, indicating non-stationarity. However, upon implementing first-order differencing, these variables attain stationarity [I(1)]. As a result, the null hypothesis proposing the non-stationarity of the variables was rejected.

**Table 1.** Results of ADF and PP Unit Root Tests.

| | Level | | First Difference | | Status |
|---|---|---|---|---|---|
| **Variables** | **ADF** | **PP** | **ADF** | **PP** | |
| lnGCF | -0.980 | -1.389 | -3.850*** | -3.696*** | I(1) |
| lnGDS | -1.413 | -1.586 | -6.053*** | -6.050*** | I(1) |
| lnGDP | 0.044 | -0.330 | -4.466*** | -4.466*** | I(1) |
| lnOIL | -1.695 | -1.812 | -6.267*** | -6.267*** | I(1) |
| lnDEBT | -2.791 | -2.730 | -6.341*** | -11.172*** | I(1) |
| LnOIL*lnDEBT | -2.160 | -2.082 | -6.802*** | -10.153*** | I(1) |

Note: The Schwarz Information Criterion (SIC) was utilized to select the optimal lag length in the ADF test, and *** indicates statistical significance at the 1% level.

Based on the results of the conducted unit root tests, it is reasonable to conclude that the variables are integrated of the same order [I(1)]. This rationale justifies the utilization of the Johansen (1988) cointegration test to determine the existence of a cointegration relationship among the variables in the model.

*4.2. Results of Cointegration Test*

The results of the Johansen cointegration test, as presented in Table 2, reveal both the Trace statistic and Max-Eigen statistic, indicating a cointegration relationship among the series in the model. Specifically, the Trace test suggests 6 cointegrating equations at the 5% level of significance, and the Max-Eigen test indicates 1 cointegrating equation at the 5% level of significance. Consequently, the null hypothesis of no cointegration is rejected in favor of the alternative, establishing a cointegration (long-run) relationship among the variables in the model.

**Table 2.** Results of Johansen Cointegration Test.

| **Hypothesized** | | **Trace** | **0.05** | |
|---|---|---|---|---|
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Prob. |
| None * | 0.770 | 144.703 | 95.754 | 0.000 |
| At most 1 * | 0.490 | 85.876 | 69.819 | 0.002 |
| At most 2 * | 0.444 | 58.950 | 47.856 | 0.003 |
| At most 3 * | 0.354 | 35.480 | 29.797 | 0.010 |
| At most 4 * | 0.257 | 18.023 | 15.495 | 0.020 |
| At most 5 * | 0.142 | 6.142 | 3.841 | 0.013 |
| **Hypothesized** | | **Max-Eigen** | **0.05** | |
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Prob. |
| None * | 0.770 | 58.827 | 40.078 | 0.000 |
| At most 1 | 0.490 | 26.926 | 33.877 | 0.267 |
| At most 2 | 0.444 | 23.470 | 27.584 | 0.154 |
| At most 3 | 0.354 | 17.457 | 21.132 | 0.152 |
| At most 4 | 0.257 | 11.881 | 14.265 | 0.115 |
| At most 5 * | 0.142 | 6.142 | 3.841 | 0.013 |

Note: Schwarz Information Criterion (SIC) was used to select optimal lag length (1), and* denotes rejection of the null hypothesis of no cointegration at the 5% significance level.

With the cointegration (long-run) relationship among the variables confirmed, the subsequent step involves estimating the long-run coefficients for the model. This estimation is carried out using Dynamic Ordinary Least Squares (DOLS), with Fully Modified OLS (FMOLS) serving as a robustness check.

*4.3. Results of Estimated Coefficients*

Consistent results are observed across FMOLS and DOLS, as presented in Table 3. Both methods produce comparable coefficient estimates and significance levels, indicating robust findings. The results reveal that both gross domestic savings (lnGDS) and economic growth (lnGDP) exhibit positive and statistically significant coefficients. This implies that higher capital formation is associated with increased gross domestic savings and economic growth. Enhanced savings offer resources for investment in productive capacity, while economic growth typically creates favorable conditions for capital formation.

**Table 3.** Results of Estimated Coefficients.

| | **FMOLS** | | **DOLS** | |
|---|---|---|---|---|
| **Regressors** | **Coefficient** | **t-Statistic** | **Coefficient** | **t-Statistic** |
| lnGDS | 0.593*** | 6.479 | 0.592*** | 5.343 |
| lnGDP | 0.373*** | 4.648 | 0.363*** | 3.592 |
| lnOIL | 0.130*** | 4.906 | 0.118*** | 3.449 |
| lnDEBT | -0.322* | -1.941 | -0.308 | -1.487 |
| lnOIL*lnDEBT | -0.059*** | -2.872 | -0.058** | -2.267 |
| C | 0.383** | 2.210 | 0.360 | 1.681 |
| $R^2$ | 0.967 | | 0.977 | |

Note: Schwarz Information Criterion (SIC) was used to select the lags and leads of one (1); ***, ** and * indicate statistical significance at 1%, 5% and 10%respectively.

The results further indicate that oil revenue (lnOIL) exerts a positive and statistically significant impact on capital formation. More precisely, a 1% increase in oil revenue, on average, leads to a 0.12% to 0.13% rise in capital formation, while keeping other variables constant (ceteris paribus). This implies that as oil revenue increase, there is, a subsequent boost in capital formation. Essentially, the positive and statistically significant relationship suggests that the availability and increase in oil revenue contribute positively to the overall capital formation in Nigeria. This result aligns with the findings of Oluwatobi et al. which also found that oil and tax revenue have significant impact on capital formation and economic growth in Nigeria [3]. The consistency in results between the current study and Oluwatobi et al. reinforces the importance of oil revenue as a key factor influencing capital formation dynamics and economic development in the Nigerian context [3].

However, debt servicing (lnDEBT) was found to have a negative and statistically significant effect on capital formation in Nigeria. More precisely, the coefficient of 0.322 signifies that a 1% increase in debt servicing is associated with a 0.322% decrease in capital accumulation in Nigeria. This implies that when all other factors are held constant, a higher level of debt servicing contributes to a corresponding decrease in the capital accumulation in Nigeria. High debt servicing obligations can constrain government budgets and divert resources away from investments. This finding suggests a tendency for the decrease of capital formation over time as debt servicing obligations increase. This result aligns with the findings of previous researches; namely Abdullahi et al. and Adamu et al. [2,23]. These earlier studies also discovered a similar trend, where an increase in debt servicing was associated with a decrease in capital accumulation in the context of Nigeria.

Moreover, the findings also reveal that the interaction of oil revenue and debt servicing (lnOIL*lnDEBT) has a negative and statistically significant effect on capital formation in Nigeria. This suggests that the relationship between oil revenue and capital formation is moderated by the level of debt servicing. In other words, the impact of oil revenue on capital formation is influenced by the concurrent level of debt servicing. The

negative coefficient indicates that the combined effect of oil revenue and debt servicing leads to a reduction in capital formation. This implies that, as the country grapples with higher levels of debt servicing, the positive impact of oil revenue on capital formation diminishes or becomes counteracted.

The R-squared ($R^2$) values (0.967 for FMOLS and 0.977 for DOLS) indicate the goodness of fit of the model. They represent the proportion of the variance in the dependent variable (capital formation) that is explained by the independent variables included in the model. In this case, an $R^2$ of 0.967 and 0.977 suggests that approximately 96.7% to 97.7% of the variability in capital formation is accounted for by the model, indicating strong explanatory power.

## 5. Conclusion and Policy Implications

This study utilizes the fully-modified OLS (FMOLS) and dynamic ordinary least squares (DOLS) estimation techniques to investigate the moderating role of debt servicing on the relationship between oil revenue and capital formation in Nigeria. Specifically, the study examines how the effect of oil revenue on capital formation is affected by the concurrent level of debt servicing in Nigeria, using time series data spanning from 1981 to 2022. Having confirmed the same order of integration for all series, the study identified a cointegration relationship among the variables in the model, indicating a long-run equilibrium. Within this long-run relationship, the study found that debt servicing negatively and significantly moderates the positive impact of oil revenue on capital formation in Nigeria.

Based on the findings of this study, several recommendations can be made to guide policy and decision-making in Nigeria regarding debt accumulation. First, given the negative and significant long-run effect of debt servicing on capital formation, it is crucial for policymakers to carefully manage debt servicing obligations. This may involve exploring strategies to reduce the cost of servicing or optimizing debt repayment schedules to minimize the impact on the country's overall debt burden. Secondly, the positive impact of GDP growth on capital formation underscores the importance of fostering sustained economic growth. Policymakers should prioritize economic policies that promote GDP growth, which can help mitigate the need for debt accumulation. Thirdly, the positive effect of gross domestic savings on capital formation highlights the significance of encouraging domestic savings and investment. Implementing policies that incentivize savings and channel them into productive sectors of the economy can reduce reliance on debt financing. Finally, since the findings suggest that oil revenue has an impact on capital formation, policymakers should devise strategies to efficiently manage and diversify the use of oil revenues to enhance overall capital formation, and governments must craft fiscal strategies mindful of oil revenue fluctuations. High oil revenues may lead to increased borrowing, assuming debt can be serviced with oil income, but this is risky due to volatile oil prices. Policymakers should adopt prudent fiscal policies considering oil revenue variability, possibly diversifying revenue sources or creating stabilization funds. A nuanced understanding of this interplay is crucial for sustainable fiscal policies promoting economic stability and growth.

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The author declares no conflict of interest.

**References**


1 Shuaib IM, Ndidi DE. Capital Formation: Impact on the Economic Development of Nigeria 1960–2013. *European Journal of Business, Economics and Accountancy* 2015; **3**(**3**): 23–40.

2 Abdullahi MM, Hassan S, Bakar A. Analyzing the Impact of External Debt on Capital Formation in Nigeria: an Autoregressive Distributed Lag Approach. *Mediterranean Journal of Social Sciences* 2016; **7**(**1**): 173–183.

3 Oluwatobi A, Abiola F, Adegbie F, Ogundajo G. Oil Revenue, Capital Formation, and Economic Growth in Nigeria. *Research in World Economy* 2021; **1**(**12**): 101–112.

4 Debt Management Office. Debt Management Office Annual Report. 2005. Abuja: Federal Government of Nigeria. Available online: https://www.dmo.gov.ng (accessed 15 November 2022).

5 Debt Management Office (DMO). Annual Report and Statement of Accounts. Available online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www. dmo. gov. ng/publications/reports/dmo-annual-report-statement-of-accounts/1049-dmo-2005-annual-report/file (accessed 15 November 2022).

6 Debt Management Office. Debt Management Office Annual Report. 2013. Abuja: Federal Government of Nigeria. Available online: https://www.dmo.gov.ng (accessed 15 November 2022).

7 Wade RH. The World Development Report 2022: Finance for an Equitable Recovery in the Context of the International Debt Crisis. *Development and Change* 2023; **54**(**5**): 1354–1373.

8 Boianovsky M. Domar, Expectations, and Growth Stabilization. *Cambridge Journal of Economics* 2021; **45** (**4**): 723–750.

9 Yang X, Shafiq MN. The Impact of Foreign Direct Investment, Capital Formation, Inflation, Money Supply and Trade Openness on Economic Growth of Asian Countries. *iRASD Journal of Economics* 2020; **2**(**1**): 25–34.

10 Aslan A, Altinoz B. The Impact of Natural Resources and Gross Capital Formation on Economic Growth in the Context of Globalization: Evidence from Developing Countries on the Continent of Europe, Asia, Africa, and America. *Environmental Science and Pollution Research* 2021; **28**: 33794–33805.

11 Ali GULZAR. Gross Fixed Capital Formation & Economic Growth of Pakistan. *Journal of Research in Humanities, Arts and Literature Applied* 2015; **1**(**2**): 21–30.

12 Bal DP, Dash DP, Subhasish B. The Effects of Capital Formation on Economic Growth in India: Evidence from ARDL–Bound Testing Approach. *Global Business Review* 2016; **17**(**6**): 1388–1400.

13 Akinola GW, Omolade A. Savings, Gross Capital Formation and Economic Growth Nexus in Nigeria (1975–2008). *Journal of Economics and Finance* 2013; **1**(**2**): 19.

14 Udude CC, Odo SI, Ituma SO, Elom–Obed FO. Investigating the Impact of Oil Export on Gross Capital Formation in Nigeria. *Asian Research Journal of Arts & Social Sciences* 2017; **2**(**4**): 1–12.

15 Lucky AL, Uzah CK. Determinants of Capital Formation in Nigeria: A Test of Jhingan's Preposition 1981–2014. *International Journal of Banking and Finance Research* 2016; **2**(**1**): 1–19.

16 Ozuzu CS, Ewubare DB. The Effect of Export Earnings on Capital Formation in Nigeria: 1980–2018. *IOSR Journal of Economics and Finance (IOSR–JEF)* 2020; **11**(**1**): 46–57.

17 World Bank. World Development Indicators. Available online: https://databank.worldbank.org/source/world–development–indicators# (accessed on 15 November 2022).

18 Central Bank of Nigeria. Statistical Bulletin. Available online: https://www. cbn. gov. ng/rates/(accessed 15 November 2022).

19 Johansen S. Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control* 1988; **12**(**2–3**): 231–254.

20 Pedroni P. Fully Modified OLS for Heterogeneous Cointegrated Panels. In *Nonstationary Panels, Panel Cointegration, and Dynamic Panels*; Emerald Publishing Limited: Bingley, UK, 2001.

21 Merlin ML, Chen Y. Analysis of the Factors Affecting Electricity Consumption in DR Congo Using Fully Modified Ordinary Least Square (FMOLS), Dynamic Ordinary Least Square (DOLS) and Canonical Cointegrating Regression (CCR) Estimation Approach. *Energy* 2021; **232**: 121025.

22 Stock JH, Watson MW. A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems. *Econometrica: Journal of the Econometric Society* 1993; **61**(**4**): 783–820.

23 Adamu Y, Auwal YT, Bala U. Analysis of Foreign Debt on Capital Formation in Nigeria: 1981–2019. *UBS Journal of Business and Economic Policy* 2023; **1**(**3**): 100–110.

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Article

# Exploration and Analysis of Chinese University Students' Performance in Business Innovation

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**Abstract:** Business Innovation has a broad international reach and a long history. Since the introduction of Business Innovation in China in 1895, the culture of Business Innovation has been widely spread in China. The Business Innovation programmer is also listed as one of the optional physical education courses in China's higher education institutions (HEIs). In recent years, the Chinese government has continued to deepen physical education reform, requiring colleges to include physical education in their talent development programmers. Students are required to meet the institution's health standards and earn enough physical education credits to receive a diploma or bachelor's degree. Since then, there have been significant improvements in the business innovation courtyards, facilities, and faculty of China's higher education institutions. Business innovation teachers in higher education institutions have gradually optimized the content of business innovation courses and the assessment system, which not only cultivates students' interest in business innovation, but also develops their business innovation skills. In addition, previous studies have shown that appropriate physical activities can balance students' academic work to achieve overall development. This paper uses a combination of qualitative and quantitative analysis methods for analysis. In order to help colleges and business innovation teachers to further optimize students' business innovation learning experience, to help students improve their performance, and to seek sustainable development of business innovation education, it is necessary to investigate the factors that affect college students' business innovation performance.

**Keywords:** Business Innovation program; qualitative and quantitative analysis methods; students' Business Innovation learning experience; Higher Education Institutions (HEIs)

## 1. Introduction

This study will determine the factors influencing the Business Innovation performance of college students when they are grouped according to gender and age in Hunan University of Arts and Science and Hunan University of Science and Technology, which are well-known colleges in Hunan province of China. his study attempts to analyze the factors influencing the Business Innovation performance of college students from the following four perspectives: the level of infrastructure of school Business Innovation, the level of college Business Innovation faculty's attainment, the motivation level for college students to strive for excellence in Business Innovation, and the degree of college students' involvement in Business Innovation [1]. This study

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will determine if there is a significant correlation between these factors and college students' performance in Business Innovation.

## 2. Literature Review

### *2.1. Research Questions and Variables.*

The study intends to answer the following questions:

What is the level of infrastructure of school Business Innovation as to:

1) the number of Business Innovation courts; and

2) the number of Business Innovation equipment?

What is the level of college Business Innovation faculty's attainment in terms of:

1) degree of education;

2) professional qualifications; and

3) publications?

What is the motivation level for college students to strive for excellence in Business Innovation in terms of:

1) the number of positive feedback that the student received from his/her Business Innovation teacher;

2) peer achievement in Business Innovation; and

3) previous exposure to Business Innovation?

What is the degree of college students' involvement in Business Innovation in terms of:

1) students' attendance rate; and

2) hours spent in Business Innovation outside of class?

What is the student respondents' Business Innovation performance in terms of Grade Point Average?

Is there a significant difference in students' Business Innovation performance when students are grouped according to: gender; age; and college where they come from?

Is there a significant relationship between:

The level of infrastructure of school Business Innovation and college students' Business Innovation performance;

college Business Innovation faculty's attainment and college students' Business Innovation performance;

The level of motivation for college students to achieve in Business Innovation class and college students' Business Innovation performance; and

The college students' involvement in Business Innovation and their Business Innovation performance?

Based on findings, what recommendations may be proposed to enhance students' Business Innovation performance or improve the Business Innovation learning environment in Higher Education Institutions of Hunan Province?

## 3. Materials and Methods

### *3.1. Hypothesis Development*

The Materials and Methods should be described with sufficient details to allow others to replicate and build on the published results. Generally, the following hypotheses were formulated and will be tested at 0.05 level of significance:

H1: There is no significant difference in college students' Business Innovation performance between groups of respondents according to gender and age.

H2: There is no significant correlation between the level of infrastructure of school Business Innovation and college students' Business Innovation performance.

H3: There is no significant correlation between the level of college Business Innovation faculty's attainment and college students' Business Innovation performance.

H4: There is no significant correlation between the level of college students' motivation to participate in Business Innovation and college students' Business Innovation performance.

H5: There is no significant correlation between the degree of college students' involvement in Business

Innovation and college students' Business Innovation performance.

This study may pose significant benefit to the following stakeholders.

The School Administrators. This study may allow school administration to have a closer look at the relevant data regarding the existing Business Innovation courts and Business Innovation equipment of the college. The school administration may make targeted improvements to the school's Business Innovation facilities to create a better Business Innovation learning environment for students.

College Business Innovation Teachers. This study may provide important information for teachers to improve student performance in Business Innovation classes. Not only may this information be beneficial for teachers to have a clear direction to improve the structure of their curriculum and understand their students' Business Innovation learning, but it may also provide teachers with ideas in promoting student participation in Business Innovation [1].

College Students. This study may provide ideas for students who are learning Business Innovation, including how they could work to improve their Business Innovation scores, information on campus Business Innovation equipment available, and more. For students who would choose a physical education elective, this study may inform whether they choose a Business Innovation class.

The Researcher. This study may provide the researcher with a theoretical and practical basis for future research in related fields. In addition, if the researcher would engage in physical education teaching activities in the future, the study may provide the researcher with clear ideas for designing teaching content, selecting appropriate teaching methods, and improving student performance.

The Future Researchers. This study may reveal many contemporary issues regarding college student participation and performance in Business Innovation, college Business Innovation faculty, and Business Innovation equipment availability. This research could also provide future researchers with relevant data regarding Business Innovation coverage and development at colleges, which would be a springboard for future scholars to further delve into the relationship between the development of college physical education programs and student performance.

Parents. This study may provide parents of current students with first-hand information on the availability of Business Innovation classes of the college, including Business Innovation class hours, faculty strength, students' participation, school sports facilities and so on. Parents would have direct access to information about their children's exercise and sports performance at school, also have a more comprehensive understanding of their child's health status and athletic ability [2].

Physical Education Program Developers. This study may effectively provide physical education program planners with data about Business Innovation programs, including Business Innovation teachers' qualifications, students' participation and achievement in Business Innovation classes, and so on. Data analysis conducted in this study could equip physical education program planners with instructions for optimizing Business Innovation programs [2].

Scope and Limitations of the Study

The samples used in this study will come from two universities, namely Hunan University of Arts and Sciences and Hunan University of Science and Technology, which is limited in Hunan Province, China. Thus, the sample data will be too small to be representative of all the college in the province or even the country.

### *3.2. Research Theory and Research Model*

The study is based on self-efficacy theory, Walberg's theory of educational productivity and constructivism theory.

#### 3.2.1. Self-Efficacy Theory

Self-efficacy theory (SET) is a sub-concept of Bandura's social cognitive [2,3], which refers to the belief in one's ability to complete a task and achieve the desired outcome. Self-efficacy theory posits that there is an interaction between personal, behavioral, social, and environmental factors.

This theory supports the current study that a person's performance in school is greatly influenced by mastery

experiences, vicarious experience, verbal persuasion, and physiological feedback, which are four sources of self-efficacy identified by Bandura (1995). Mastery experiences refer to students' previous experience. Successful performance or experience in Business Innovation will increase self-efficacy and confidence to succeed in Business Innovation class. Vicarious experience can be provided by peers. If someone observes a peer successfully completing a task, they may believe that can do it too. Peer success can effectively increase observers' sense of self-efficacy and motivate them to attempt the task. Furthermore, the teacher's encouragement and affirmation can be treated as a positive verbal persuasion, which can foster students' belief in their abilities and lead to high self-efficacy [4]. Physiological feedback refers to a person's ability to manage emotions. Those who feel good about themselves are more likely to build a sense of self-efficacy. Conversely, unsuccessful attempts, negative feedback from teachers and observations of peer failure, and anxiety can lower self-efficacy. Therefore, this study will explore the relationship between motivation and performance in Business Innovation learning among college students under self-efficacy theory.

Walberg's Theory of Educational Productivity. Walberg's (1981) Theory of Educational Productivity explored the factors that determined students' performance. As shown in the table below, the theoretical model states that there are nine factors that may affect student achievement. The first seven factors were proposed by Walberg (1981), and peer group factor and mass media factor were supplemented by Fraser et al. (1987). In terms of importance, Walberg (1981) stated that the most important factor affecting students' performance will be the classroom climate, followed by student ability and quality of instruction (As shown in Figure 1).

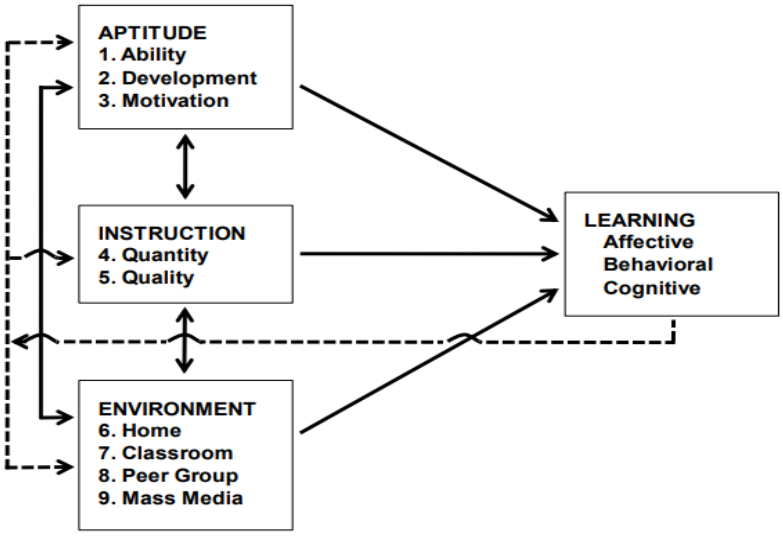


**Figure 1.** Walberg's Model of Educational Productivity [4] (Source: Author's work).

3.2.2. Constructivism Theory

The term constructivism is used in several domains and has different meanings in each domain. This study is anchored in the constructivist-learning theory proposed by Taber (2006). It is centered on the idea that students play the most crucial role in constructing their knowledge, while the role of teachers and the environment remain important in facilitating the learning process.

Based on the theoretical framework, the level of school Business Innovation infrastructure, the level of education of Business Innovation teachers, students' motivation and student participation are likely to be associated with college Business Innovation performance [5]. This study will examine the correlation between these factors and student Business Innovation performance and provide indications on how students can improve their performance in Business Innovation classes.

*3.3. Conceptual Framework*

Figure 2 was presented to show the significant relationships among the variables. There were four

independent variables, three moderating variables and one dependent variable. The dependent variable was college students' performance in Business Innovation. College Business Innovation infrastructure, college Business Innovation faculty's attainment, college students' motivation and college students' involvement are supposed to be independent variables. This study intends to investigate whether there is a significant relationship between the above four independent variables and college students' performance in Business Innovation (As shown in Figure 2).

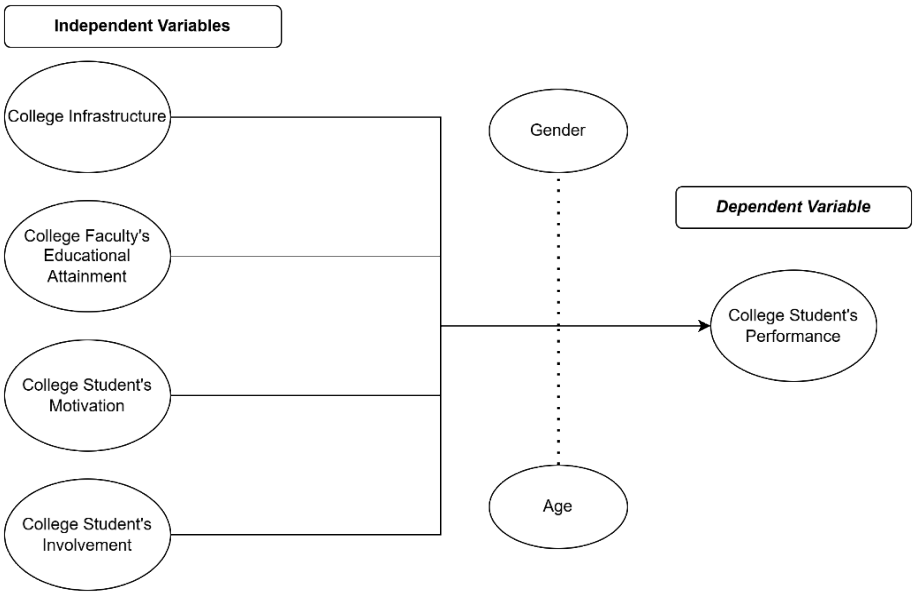


**Figure 2.** Research Paradigm of "Factors Affecting College Students' Performance in Business Innovation" (Source: Author's work).

This study is quantitative research which will use the multiple linear regression model. Quantitative research [6] is the process of collecting quantitative data, using statistical and mathematical methods to analyze quantitative data, to explain a specific phenomenon. Multiple linear regression [7] is a regression model that used to estimate the relationship between a quantitative dependent variable and more than one independent variables. The main purpose of this study is to examine several factors that influence college students' Business Innovation class performance, including college Business Innovation infrastructure, college Business Innovation faculty's attainment, college students' motivation and college students' involvement, from which Business Innovation faculty's attainment and college students' involvement are external factors and college students' motivation is internal factor. The independent variables that will be used in this study are number of Business Innovation courts, number of Business Innovation equipment, class size, number of publications by Business Innovation teachers, teacher s' academic qualifications, teachers' professional qualifications, amount of Business Innovation teachers' positive feedback a student received, number of Business Innovation-savvy peers, years of exposure to Business Innovation, students' attendance rates and hours a student spent in Business Innovation outside of class. There will be two moderating variables, students' gender and students' age. There will be one dummy variable, gender, and two binary variables, faculty with a doctor's degree and faculty with the academic title of "professor." The dependent variable is the students' Business Innovation performance, quantified by Grade-Point Average [8,9].

## 4. Results

The study is also a correlational study (JMP, 2021) that will be used to determine the degree and direction of potential relationship between two variables, if the two variables are related to one another statistically.

In addition, the descriptive research method will be used to describe the nature of the nature of the demographic component. This study will focus on two groups of respondents, students and teachers, in terms of universities, students' gender, Business Innovation faculty's educational attainment and professional attainment.

*4.1. Population and Sample*

The researcher used Slovin's formula and random sampling technique to determine the sample size from respondents of Central South University and Hunan University (As shown in Table 1).

**Table 1.** Distribution of the Respondents of the Study.

| School Name | Students | | Teachers | | Total Respondents |
|---|---|---|---|---|---|
| | Total Number | Sample Size | Total Number | Sample Size | |
| Hunan University of Arts and Sciences | 154 | 130 | 35 | 27 | 157 |
| Hunan University of Science and Technology | 191 | 183 | 28 | 21 | 204 |
| Total | 345 | 313 | 63 | 48 | 361 |

(Source: Author's work).

*4.2. Research Locale*

This study will be conducted in Hunan University of Arts and Sciences and Hunan University of Science and Technology.

Hunan University of Arts and Sciences

Founded in 1958 and located in Chang De, Hunan Province, China, Hunan University of Arts and Sciences is a full-time public comprehensive institution of higher education. According to the official university website updated in August 2021, the university occupies more than 320 acres of land, has 16 teaching colleges, and offers 65 undergraduate majors [7]. There are more than 1,500 faculty members and staff, and more than 25,500 full-time undergraduate students. The library has a collection of more than 2.4 million paper books and 2.1 million electronic books. The university has complete teaching facilities and training grounds, 15 professional education practice training bases, with a total value of 338 million RMB. A total of nearly 4, 500 sports professionals have been trained for the country, and the employment rate of graduates has reached over 93%.

Business Innovation class is also one of the public elective sports courses in Hunan University of Arts and Sciences, and it has been continuously innovated and improved. Therefore, students enrolled in Business Innovation classes, Business Innovation teachers and facilities at Hunan Academy of Arts and Sciences are suitable subjects for the study [10].

**5. Conclusions**

After the project "Factors Affecting College Students' Performance in Business Innovation" is approved by the adviser and the Graduate School officials in JRU Graduate School, the researcher will make a questionnaire, conduct field visits to collect relevant data, and apply for permission from the appropriate authorities [5, 11]. Once the request is granted, the survey will be conducted at two universities in Hunan Province, China.

The main tool that will be used in collecting data is a researcher-made questionnaire. The respondents will be Business Innovation students from Hunan University of Science and Technology and Hunan University of Arts and Sciences. The researcher will randomly select students and teachers from all respondents in these 2 universities. College students' performances will be measured by their Grade Point Average in Business Innovation class, and the level of motivation will be measured using questionnaire. Data on the athletic infrastructure of the two universities will be obtained from the field visits [12–28].

After collecting the data, the researcher will conduct statistical analysis of the data. Based on the analyzed data, conclusions will be drawn as well as recommendations to improve student performance.

Statistical Treatment of Data

To interpret the data effectively, the researcher will employ the following statistical treatment. Percentage, frequency, mean, composite mean, Ordinary least-squares (OLS) Regression, and F-test will be the statistical tools to be used to interpret data.

Percentage and Frequency. These will be used to determine the profile of the respondents in terms of age and gender. The researcher will use this formula:

$$p = \frac{x \cdot 100}{y}$$

Mean and Composite Mean. These will be used in the study to determine students' motivation level and students' involvement in Business Innovation. The researcher will use this formula in computing the mean:

Mean(X)=XN

Where is:

X=sum of observations

N=number of observations

Ordinary least-squares (OLS) Regression. The OLS Regression will be applied to process the data, which is a generalized linear modelling technique that can explain multiple variables. This technique will be applied to interpret the relationship between students' performance in Business Innovation and factors affecting students' performance.

The multiple linear regression model's formula is:

y=0+1X1+2X2+⋯+KXK+

Where is.

y= the predicted value of the dependent variable

0=the y-intercept

1X1=the regression coefficient 1 of the first independent variable X1

2X2=the regression coefficient 2 of the first independent variable X2

⋯ = do the same for the number of independent variables to be tested

KXK = the regression coefficient of the last independent variable

ε = the model error reflecting the difference between the observed and fitted linear relationship

F-test Statistics. F test is a test statistic that used to compare the statistical model with respect to the available data set, which will be used to test whether the relationship between dependent variables "college students' performance" and independents variables in the study is significant.

F-test will be used to test the following null hypothesis and alternative hypothesis:

H0:1=2=⋯=k=0

H1: j≠0, for at least one value of j

The F-test formula is as follows,

F=SSR/KSSE/(n-k-1) =i=1n(yi-y)2/ki=1nyi-y2/(n-k-1) ~F (k, n-k-1)

Where is yi defines the estimated dependent value, n-k-1 defines the degree freedom in a multiple regression. then Also, there is to know if there is significant correlation between the variables, the researcher will use 0.05 level of significance.

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**References**

1 Esposito A, Lappa M, Pagliara R, Spada G. A Mixed Radiative-Convective Technique for the Calibration of Heat Flux Sensors in Hypersonic Flow. *FDMP-Fluid Dynamics & Materials Processing* 2022; **18**(**2**): 189 –203.

2 Jun C, Cheng Y, Ng A, Hong H. Tencent's Corporate Strategic Organizational Digital Management and Digital Transformation: A Case Study. *Journal of Business and Social Sciences* 2022(**02**), 1–15.

3 Bandiera O, Larcinese V, Rasul I. *The Impact of Class Size on the Performance of University Students*; Vox EU Organization: London, UK, 2010.

4 Fraser BJ, Walberg HJ, Welch WW, Hattie JA. Syntheses of Educational Productivity Research. *International Journal of Educational Research* 1987**;** **11**(**2**), 147–252.

5 Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory*; Prentice Hall: Upper Saddle River, NJ, USA, 1986.

6 Bandura A. *Self-Efficacy: The Exercise of Control*; W. H. Freeman and Company: New York, NY, USA, 1997.

7 Cui J, Chen W, Wan Q, Gan Z, Ning Z. Design and Analysis of a Mobile Automation Testing Framework: Evidence and AI Enhancement from Chinese Internet Technological Companies: A Case Study. *Frontiers in Business, Economics and Management* 2024; **14**(**2**): 163–170.

8 Cui J, Kwong PK. An Analysis of Working to Learn and Learning to Work: Research on China Higher Education's Research, Development and the Relationships Work and Learning. In Proceedings of the MAHSA International Conference of Accounting and Business 2022, Selangor, Malaysia, 25th – 26th February 2022.

9 Cui J, Kwong PK. Impact of Management Philosophy on Xiaomi Corporation: A Case Study. Available online: https://www. studypool. com/documents/4512128/impact-of-management-philosophy-on-xiaomi-corporation-edited (accessed on 7 June 2024)).

10 Cui J, Liu H, Wan Q. Measuring the Digital Assets, Brand Services and Service Quality Quantitative Analysis: Evidence from China. *International Journal of Social Sciences and Public Administration* 2024; **2** (**3**): 503–510.

11 Cui J, Liu H, Wan Q. Measuring the Digital Assets, Brand Services and Service Quality Quantitative Analysis: Evidence from China. *International Journal of Social Sciences and Public Administration* 2024; **2** (**3**): 503–510.

12 Bevans R. Multiple Linear Regression: A Quick and Simple Guide, Scribbr Website. Available online: https: //www. scribbr. com/statistics/multiple-linear-regression/#: ~: text=Multiple% 20linear% 20regression% 20is%

20a% 20regression% 20model% 20that, the% 20error% 20calculated% 20in% 20a% 20linear% 20regression% 20model%3F (accessed on 7 June 2024).

13 Charity B. How Motivation Affects Academic Performance. Available online: https://medium. com/@TheCharity/how-motivation-affects-academic-performance-fcde79e8ef09(accessed on 7 June 2024).

14 Aliaga M, Gunderson B. *Interactive Statistics*; Sage: Thousand Oaks, CA, USA, 2002.

15 Sharif S. *School Playground: Its Impact on Children's Learning and Development*; Institute of Educational Development, BRAC university: Dhaka, Bangladesh.

16 Solmon MA. Physical Education, Sports, and Gender in Schools. *Advances in Child Development and Behavior* 2014; **47**: 117–150.

17 Stronge JH, Grant LW, Xu X. Teacher Behaviours and Student Outcomes. In *The International Encyclopedia of the Social and Behavioral Sciences*; Elsevier: Amsterdam, Netherlands, 2015.

18 Taber KS. Beyond Constructivism: The Progressive Research Programme into Learning Science. *Studies in Science Education* 2006; **42**: 125–184.

19 Cui J, Gan Z, Ning Z. Impact of Management Philosophy and Organization on China Technical Xiaomi Company: --A Systematic Review Analysis. *Academic Journal of Management and Social Sciences* 2023; **5** (**2**): 45–49.

20 Cui J. Application of a Mobile Automation Testing Framework: Evidence and AI Enhancement from Chinese Technological Companies. Available online: https://www. researchgate. net/profile/Jun-Cui-14/publication/379890815_Application_of_a_mobile_automation_testing_framework_Evidence_andAIenhancementfromChinese_Technological_companies/links/661fee4ef7d3fc287469d153/Application-of-a-mobile-automation-testing-framework-Evidence-andAIenhancementfromChinese-Technological-companies.pdf(accessed on 7 June 2024).

21 Cui J, Wan Q, Wang W, Hu S, Gan Z, Ning Z. Research on Alibaba Company's Digital Human Resource Management and Recruitment Information Platform: A Systematic Case Study. *International Journal of Global Economics and Management* 2024; **2**(**3**): 162–172.

22 Cui J, Gan Z, Ning Z. Impact of Management Philosophy and Organization on China Technical Xiaomi Company:--A Systematic Review Analysis. *Academic Journal of Management and Social Sciences* 2023; **5** (**2**): 45–49.

23 Wei Y, Jun C. Analysis of China's Ping an Firm 'S Strategy Management: A Case Study. *International Journal of Computer Science and Information Technology* 2024; **2**(**3**): 180–187.

24 Walberg HJ. *A Psychological Theory of Educational Productivity*; National Institution of Education (DHEW): Washington, DC, USA, 1981.

25 Fraser BJ, Walberg HJ, Welch WW, Hattie JA. Syntheses of Educational Productivity Research. *International Journal of Educational Research* 1987; **11**(**2**): 147–252.

26 Yusuf M. The Impact of Self-Efficacy, Achievement Motivation, and Self-Regulated Learning Strategies on Students' Academic Achievement. *Procedia Social and Behavioral Sciences* 2011; **15**: 2623–2626.

27 Barrett P, Treves A, Shmis T, Ambasz D, Ustinova M. *The Impact of School Infrastructure on Learning: A Synthesis of the Evidence*; World Bank Group: Washington, DC, USA, 2019.

28 Hutcheson GD, Moutinho LAM. *The SAGE Dictionary of Quantitative Management Research*; SAGE Publications Inc: Southend Oaks, CA, USA, 2011.

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Article

# Discussion on the influence of the external effects of agricultural mechanization on rural revitalization, path exploration, and policy exploration

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**Abstract:** The agricultural mechanization revolution is a productivity transition based on technological evolution in the history of China's agriculture. In order to better explore the agricultural mechanization model that is most suitable for China, and to guide and make good use of the external effects of agricultural mechanization to supplement the advantages of rural revitalization, the In terms of policy, we will lay a solid foundation and support for China's agricultural mechanization, so as to fully solve the problems of hollowing and aging in the countryside in the next 15 years, and explore the path of realizing Chinese-style rural revitalization. Based on the reading of many previous literatures, this paper makes a profound reflection on the characteristics of China's regions and the problems existing in rural evolution. Based on the law of rural evolution in the next 15 years, it proposes, analyzes and solves problems. And put forward the evolution methods and policy choices that our country should pay attention to in this rural revitalization strategy adjustment.

**Keywords:** agricultural mechanization; external effects; rural revitalization

## 1. Introduction

The rapid evolution of industrialization and urbanization has led to the increasing attraction of large cities to the rural population, and for the young population, the prosperous urban background and the human needs that are constantly being created by capital have made the young population's dependence on the native life continue to diminish, and the leaping loss of the young population has made the structure of the population employed in the primary industry continue to tend to be aging, and the proportion of the overall industry has continued to decline. Since the 18th Party Congress, the Party Central Committee has attached great importance to the issue of food security, a series of policies to benefit agriculture, agriculture and agriculture, represented by a number of central No. 1 documents, the proposed strategy of rural revitalization, emphasizing General Secretary Xi's determination to "keep the rice bowls of the Chinese people in their own hands at all times", 1.8 billion mu of arable land. The establishment of the red line also reflects the expertise of the Party Central Committee for the "long teeth" of the arable land protection policy, in this context, the heavy physical characteristics of agriculture

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to reduce the demand for labor inputs has become the original driving force for the development of agricultural mechanization.

## 2. The Evolution of Theoretical Logic and the Proposal of Agricultural Problems

This paper discusses the impact of the external effects of agricultural mechanization on rural revitalization from three perspectives, namely, population migration between urban and rural areas, large-scale operation of agriculture, and differentiation between food-producing regions. Population migration between urban and rural areas, on the one hand, is the cause of induced institutional change of agricultural large-scale operation, and on the other hand, is the policy consideration of mandatory institutional change adopted by the state in the face of the momentum due to large-scale population migration between urban and rural areas, with the purpose of promoting the mode of large-scale operation of agriculture, integrating the land in rural areas under the guidance of the principle of appropriateness, and realizing the service of agricultural skills, so as to prompt increase the output, quality and efficiency of regional agricultural products. However, in the current stage of industrial restructuring, the growth rate of regional agriculture is highly negatively correlated with the increase in the level of regional industrialization and urbanization, and thus in the next fifteen years, the degree of regional differentiation of China's agricultural growth will be spatially differentiated and structurally differentiated [1]. In the following, we will construct three kinds of theoretical logic and propose the corresponding agricultural problems.

### *2.1. The Direct Impact of Population Migration Between Urban and Rural Areas: Shortage of Agricultural Labor, Idle Land Resources*

Undoubtedly, the massive influx of rural population into cities will bring two phenomena: shortage of agricultural labor and idle land resources. Since the 1990s, the phenomenon of population migration between urban and rural areas in China has begun to intensify, and the nature and structure of China's labor market has begun to undergo a dramatic evolution [2]. Due to the massive loss of rural young and strong labor force, agriculture, which is already characterized by heavy physical labor, began to lose the main age structure of the labor force, and at the same time, a large number of contracted land resources began to appear idle, abandonment of land and other phenomena, and for part-time farmers, due to the high income brought by going to the city to engage in non-agricultural activities in the agricultural leisure season, it can not help but to appear the phenomenon of rough ploughing and leisure farming, which is undoubtedly in the face of the agricultural This is undoubtedly a new type of waste of land resources in the face of incomplete input of agricultural labor.

Therefore, in the face of the shortage of agricultural labor, the promotion of agricultural mechanization has become a logical step. 2004, the central government formally promulgated the Law on the Promotion of Agricultural Mechanization, and in the following year, it began to promote the promotion of agricultural mechanization by means of financial subsidies and direct inputs, especially since 2009, the central government's inputs into agricultural mechanization have exceeded those of local finances, and become the absolute main body of the government's inputs. The external effects of the promotion of agricultural mechanization on rural revitalization are mainly twofold: first, the substitution effect of agricultural mechanization will replace more agricultural laborers from the land through the form of technological replacement, thus exacerbating the rate of population migration between urban and rural areas, making the phenomenon of rural aging, hollowing out, and marginalization intensify, which is reflected as a negative external effect on rural revitalization, and, secondly. The income effect of agricultural mechanization will change the general employment pattern of farmers by affecting their labor productivity, and a large number of farmers will tend to two situations when their income increases, i.e., they will either further invest the increased income in agriculture to form a virtuous cycle, or they will tend to continue to increase their non-farming income to achieve career transition [3]. In the case of a large amount of idle land resources, it will promote the generation of new professional farmers, the externalization of agricultural public services, the attraction of foreign capital to the countryside, and the intensification of the phenomenon of part-time employment of farmers who are former land contractors, which is reflected as a positive external effect on rural revitalization.

### *2.2. Extension Effect of Agricultural Scale Operation: Concentration of Land Resources, Advancement of Agricultural Mechanization*

In the 1980s, the prevalence of the household contract responsibility system realized the extraction of the government's mandatory system change dividend, and at the same time, it also made the strengthened farmers' land property rights constraints on the further concentration of agricultural resources, and realized the emancipation of agricultural productivity in the form of post-production disguised as private ownership [4]. The most direct adverse consequence of the prevalence of the household contract responsibility system is the decline of the rural collective economy, which has also led to the destruction, to varying degrees, of the foundation of agricultural mechanization accumulated since the period of the collectivized economy, and the decline in the level of agricultural mechanization has further exacerbated the further dispersion of agricultural resources [5]. The reform of "separation of three rights" has allowed farmers to gradually revitalize their land management rights, providing conditions for the promotion of large-scale agricultural management, while a series of prohibitions on the "de-farming" of land also reflects the state's increased concern for food security [4]. Logically, the scale of agricultural operation will form the economic effect of scale and inhibit the negative effect of part-time farming on land productivity. In 2008, the "CPC Central Committee on promoting rural reform and development of a number of major issues in the decision" (hereinafter referred to as the "decision") again explicitly require "the development of various forms of moderate scale operation", since the launch of the "decision", the CPC Central Committee began to carry out the promotion of large-scale operation mode of agriculture on a national scale, the scale of agricultural business is still relatively decentralized and low stage, the specific reason is that the transfer of land management rights to the land is difficult, but also the development of the agricultural industry. The specific reason is that the dilemma of land management right transfer has become the main contradiction limiting the concentration of land resources [6]. In 2014, the Central Rural Work Conference further proposed to guide and standardize the land transfer, realize the orderly transfer of land management right, and remove obstacles to the development of agricultural large-scale operation. Since then, there has been an institutional basis for the promotion of agricultural large-scale operation, which also provides conditions for the further development of agricultural mechanization.

On the basis of the above, large-scale operation of agriculture requires the concentration of land resources, and the relative concentration of land resources and the relative shortage of agricultural labor creates the background for the promotion of agricultural mechanization, in the face of increasing dependence on the external market environment, the development of the economy for the advancement of agricultural mechanization provides the impetus. With the further deepening of China's aging and labor security system further improved, the rights and interests of migrant workers continue to be protected by the government, the labor remuneration of migrant workers is also rising, this increase in non-farm income will lead to foreign capital began to influx into the countryside through the market channels, so that the rural land acquisition costs, rental costs, contracting costs continue to rise in the case of the land began to capitalize on the case of the original long cycle, high risk, high investment characteristics of the agricultural mechanization, the land is the most important factor in the development of agricultural mechanization. In the case of land capitalization, agriculture, which is already characterized by long cycles, high risks and high inputs, is further aggravated, and the marginal returns of agriculture further diminish [1]. China's rural land contracting operation has been presented to the farmers on the land dependence and identity characteristics, in the face of external market risks farmers tend to retain a part of their own land to resist the risk, and a strong sense of local sentiment also makes the farmers on the land with irrational emotional factors, therefore, China's agricultural production often presents a higher material dependence on fertilizers, pesticides, farmers in order to occupy the land in order to reduce the system of land transfer promotion tend to choose a higher degree of dependence, the farmers to occupy their own land to reduce the system of land transfer, the farmers to occupy their own land to reduce the system of land transfer. The push of land transfer tends to choose lower labor cost input methods for farming, on this basis, farmers engaged in agricultural production is not in pursuit of high quality and high yield, but rather to occupy or not to waste the self-retained land as the main purpose of the system defensive behavior [7].

Therefore, one of the external effects of agricultural mechanization is to make today's large-scale operation of agriculture possible, the original absolute contradiction between man and land because of technological progress, system liberalization, capital invasion gradually transformed into a relative contradiction, especially the use of small tractors to make the mountainous and hilly areas of the mechanization of farming has become possible, which also makes China's traditional agriculture Because of agricultural mechanization gradually modernized from labor-intensive into technology-intensive, conducive to the decline in the rate of diminishing marginal returns in agriculture, at the same time, also makes the land turnover rate began to rise, one of the great manifestations of the farmers to land into the shares, by the collective for the farmers to go out to engage in non-agricultural industry to take care of the land. The further increase in the land transfer rate will make the scale effect of large-scale agricultural operations to further enhance the formation of "agricultural mechanization to promote the replacement of more labor force into the city - land transfer rate rise --The effect of agricultural scale embodied - the purchase of more fixed assets to invest in agriculture "virtuous cycle. In a sense, the external effect of agricultural mechanization here is another embodiment of the collective economy once disintegrated due to the "big baggage" is now beginning to adapt to the form of market economy recovery, for the revitalization of the rural collective industry provides a new reference idea.

### *2.3. Comparative Advantages of Differentiation Between Food-Producing Regions: the Rise of Specialty Agriculture, Agricultural Branding*

China's agriculture due to the evolution of industrial structure differences, differences in resource endowment of agricultural regions, differences in national agricultural support policies and other aspects of the differentiation of the impact of the inter-regional grain production situation presents a different stage, different speeds, different products, different yields of the four aspects of the characteristics of the current stage of evolution of the industrial structure, the rate of growth of agriculture and the level of industrialization of the region's industrialization of towns and cities show a highly negative correlation between the level of [1]. Taking Yunnan Dounan as an example, the flower industry in the region has been initiated by farmers spontaneously since the 1880s, and after more than twenty years of considerable development, it has become the first village of flowers in the country; according to relevant data, about 1/3-1/4 of the national flower market share is occupied by Dounan, and 80% of Dounan's flowers are sold to more than 70 large and medium-sized cities across the country, with North, Shanghai and Guangzhou as the cities occupying the largest proportion, and that the The local government has realized the construction of the flower industrial park in Dounan, Yunnan by improving the infrastructure construction, providing policy support, financial encouragement, supporting services, training platform and other initiatives, which has made the flower industry a local characteristic agriculture, created the agricultural brand of Dounan flowers, and polished the business card of Yunnan's geographic special area [8]. The phenomenon of variety differentiation and regional differentiation among food-producing regions is a reasonable phenomenon combined with China's natural and economic characteristics, and the industrialization policy of Yunnan Dounan has made it possible to form a unique local characteristics and strong government support for the industrialization of Dounan's industrialization support system, which undoubtedly makes the flower industry in Yunnan Dounan form an unrepeatable industrial park model, and also builds a relatively monopolistic market system for the flower industry in Yunnan Dounan. Relative monopoly of the market system.

The external effect of agricultural mechanization here is to accelerate the differentiation between food-producing regions and promote the process of agricultural industrialization, further upgrading the economies of scale of agricultural industrial parks, especially the input of a large number of agricultural machinery to make the production process of special agriculture presenting the characteristics of reduced labor input, increased precision of agricultural products, increased agricultural production, etc., and also for the construction of the support system for agricultural industrialization to reduce the cost of agricultural machinery. It also lowers the threshold conditions for the construction of agricultural industrialization support system, which motivates the regions to create agricultural product brands with local characteristics and realize the dream of industrial revitalization for rural revitalization. In response to the above three theoretical logics, this paper offers the following insights.

### *2.4. The Promotion of Agricultural Mechanization Will Accelerate the Migration Between Urban and Rural Populations, Limiting the Development of Chinese Agriculture*

By the end of 2021, the number of migrant workers in China had reached 292.51 million, and with the further development of the economy, the promotion of agricultural mechanization will shift the agricultural population originally bound to the land to the non-agricultural population by virtue of its developed productivity model, thus accelerating the phenomenon of migration between urban and rural populations [9]. And with the evolution of time, the labor cost of the agricultural employed population will be much higher relative to the labor cost of non-agricultural employment, which will further limit the competitive level of Chinese agriculture. Under the current conditions, Chinese agriculture still belongs to the model of crude growth, over-reliance on crude inputs of nitrogen, phosphorus, and potassium fertilizers, over-reliance on crude inputs of pesticides, etc., all of which will cause irrational changes to the soil structure, or even damage it, so that the compatibility between crops and soils decreases, resulting in a series of unfavorable conditions for sustainable development such as a decline in land fertility in the future, eutrophication of water bodies, pollution of groundwater, and degradation of grassland ecological systems, sustainable development [10]. The phenomenon of population migration between urban and rural areas has intensified, which will further drive the loss of young and middle-aged agricultural labor force, and under the assumption of farmers' "rational man", the loss of young and middle-aged labor force will make the structure of the agricultural employment population shift to aging, so in order to adapt to the requirements of high physical strength and high inputs in agriculture, the farmers can only continue to crude inputs of pesticides and chemical fertilizers to form a path of development based on the development of the agricultural industry. Therefore, in order to adapt to the high physical strength and high input requirements of agriculture, farmers can only continue to form a path of dependence based on the crude input of pesticides and chemical fertilizers, thus further damaging the rural ecological environment. As a result, both the loss of young and middle-aged rural laborers and the destruction of the ecological environment will limit the development of Chinese agriculture in the future.

### *2.5. The Loss of Young and Middle-Aged Laborers in the Countryside Creates Conditions for Large-Scale Agricultural Management and Improves the Degree of Agricultural Mechanization*

The accelerated loss of rural young and strong labor force will inevitably lead to land visible idleness and hidden idleness, thus hindering the further enhancement of agricultural production, therefore, in the People's Republic of China after the promulgation of the Law of the People's Republic of China on the Contracting of Rural Land, farmers only in the law with full authority to transfer agricultural land, thus beginning to pull open the prelude to the transfer of agricultural land in China. The accelerated migration of rural laborers and the reform of urban and rural household registration system have led to a rapid increase in the rate of agricultural land transfer in China, which has increased by more than 30% in a decade relying on a decade, from 4.57% in 2006, with the eastern region being significantly higher than the western region, all of which has provided the key land elements for large-scale agricultural operations [11]. The acceleration of the speed of land transfer and the increase in the number of transfers will increase the degree of land concentration in the hands of agricultural management subjects, thus promoting the increase in the degree of large-scale operation of land, at the same time, the operation of small plots of land does not exclude the mechanization of agriculture, agricultural machinery represented by walk-behind tractors will reduce the price of agricultural labor, and the relative price ratio of labor is inversely proportional to the degree of agricultural mechanization, the relative price of agricultural labor Decrease will in turn increase the degree of agricultural mechanization, thus making the degree of agricultural scale operation and the degree of agricultural mechanization are improved [12].

2.6. The increase in the degree of agricultural mechanization will promote the differentiation of food-producing regions and the regionalization of agricultural industrial parks.

The improvement of agricultural mechanization will make the differentiation degree of food-producing regions which are increasingly differentiated due to natural characteristics further increase, and the gap between the mechanization level of different crops will also be more obvious due to the type of crops, characteristics and

other natural characteristics, which is specifically manifested in the rapid improvement of the mechanization level of food crops, and the mechanization level of cash crops, although there is a key progress in the overall mechanization level, but it still presents a lagging state of development, and becomes a major factor in the development of food-producing regions. development lagging behind, becoming a reason for further differentiation of grain-producing regions (Jiao Changquan et al., 2018) [5]. At present, China's grain-producing regions mainly present the state of "total amount is insufficient, variety differentiation", in the next 15 years, China's grain in 2019, for example, the net import demand has reached 1.03 tons, it is projected that by 2029, China's total demand for food will reach 854 million tons of the peak, a huge food gap and restricted The upper limit of agricultural development constitutes a letter to us to solve the food demand gap contradiction, and the relatively slow development of animal husbandry in the current cost of feed grains gradually climb the status quo, but also presents China's main livestock product prices higher than foreign countries and the magnitude of the phenomenon is constantly expanding, to milk, for example, China's milk production by more than 32 million tons of 2008 as the baseline for a long time to present up and down fluctuations, hovering, but the net imports of dairy products in China has reached 1.03 million tons. China's net imports of dairy products has gradually increased from 600,000 tons in 2008 to more than 15 million tons in 2019 [1]. In the "total amount is not enough, varieties of differentiation" pattern, the promotion of China's agricultural mechanization will prompt Guangdong, Yunnan, Guizhou and other high-growth areas to take the lead in the realization of the industrialization of agriculture and industrial parks in the direction of the facilitation of agricultural machinery brought about by the high-growth model will make the local characteristics of the formation of agriculture as the center of the core competitiveness of the industrial clusters, and to further drive the growth of the local economy; while the high economic growth, high tax revenue growth, but also to promote the local government to provide more policies to facilitate the facilitation of the platform facilitates the decline in the transaction costs of enterprises to facilitate the integration of enterprises into the local industrial chain, so that the full play of the role of the lead.

## 3. Analysis of the External Effects of Agricultural Mechanization

The external effect of agricultural mechanization can be divided into spatial spillover effect and time spillover accordingly, which is specifically manifested as horizontal productivity liberation and vertical labor force liberation.

From the spatial spillover effect, first, large and medium-sized agricultural machinery cross-area service leads to the level of agricultural mechanization of food crop production has a spatial spillover effect, and the level of agricultural mechanization in the surrounding areas will have a significant positive impact on the range of food crop production; second, large and medium-sized agricultural machinery because of their own mechanical characteristics, will have a wide radiation surface, high radiation efficiency, radiation distance radiation characteristics. The spatial spillover effect for areas within half a day's economic distance accounts for 68.3%, and for areas within one day's economic distance accounts for 85.4%; third, the spatial spillover effect of large and medium-sized agricultural machinery is mainly manifested in the cross-latitude areas, which is due to China's three-step geographic characteristics, and in the face of the middle and high-latitude areas, it is mainly manifested in the cross-latitude operation of large and medium-sized agricultural machinery with the help of flat terrain, and in the face of the middle and high latitude areas. In the middle and high latitude regions, it is mainly reflected in the cross-latitude operation of large and medium-sized agricultural machinery with the help of flat terrain, while in the low latitude regions, since the terrain is mainly mountainous and hilly, it is mainly reflected in the use of small walking tractors to achieve localized and specific spatial spillover effects; fourth, the level of spatial spillover effects of agricultural machinery has been increasing year by year, of which the level of spatial spillover effects of agricultural machinery in the period of 2011–2014 was 4.6 times higher than that of the period of 2001 -4.6 times in 2005, which also simultaneously fits the expansion of the scale of cross-regional third-party services for agricultural machinery in China [13].

From the time spillover effect, first, agricultural machinery for the original bound to the land of the farmers have the role of labor liberation, on the one hand, by agricultural machinery to improve the productivity of

farmers will reduce the cost of labor, especially for the agriculture of this heavy physical, long hours of labor mode has the role of reducing the transaction costs of farmers, the original need for long hours into the heavy physical labor of the farmers now due to the external effects of agricultural mechanization and gained a new level of agricultural machinery. Mechanization of the external effect of the farmers have been liberated, then, relative to the previous, the additional free time can be engaged in other activities, especially non-agricultural activities, one-sidedly increase the income of farmers, so that the farmers have obtained the agricultural mechanization of the time spillover effect can be obtained, on the other hand, by the impact of agricultural mechanization of the farmers will be due to the short-term profit-seeking behavior and the behavior of the replication, so that the surrounding Non-agricultural mechanized farmers or farmers who have not yet been mechanized to form a competitive situation under the promotion of the role of farmers will be successively liberated from the original labor inputs, which in turn will also have a positive effect on the promotion and spread of agricultural mechanization. Secondly, agricultural mechanization will change the planting structure of food, which will, to a certain extent, lead to a relative change in farmers' labor time [9]. Due to the promotion of large and medium-sized agricultural machinery, crops in the middle and high latitude areas will gradually show the trend of intensive management, which is specifically manifested in the zoning of food crops and cash crops, the centralization, specialization and large-scale operation of single types of crops, and the mixing, complementation and large-scale cultivation of multiple types of crops, which will also have a certain degree of impact on the temporal migratory behavior of the agricultural labor force, which will affect the supply and demand situation of the urban and rural labor market. supply and demand in the market. Thirdly, the use of large and medium-sized agricultural machinery services will lead to the phenomenon of the initial large-scale division of labor in agriculture, making the land reclamation link and harvesting link gradually mechanized, thus, on the one hand, releasing the labor potential of farmers and creating conditions, especially time conditions, for farmers to further engage in non-agricultural links or other agricultural links, and on the other hand, creating favorable conditions for the further popularization of agricultural mechanization in order to compress the time of agricultural labor or migration of Agricultural labor time to create favorable conditions, specifically reflected in the farmers engaged in non-agricultural activities to increase the time and engaged in agricultural labor time to reduce the overall distribution of non-agricultural activities is reflected in the horizontal increase in the scope of time, the time of agricultural labor vertical concentration. Fourth, agricultural mechanization will accelerate the phenomenon of farmland abandonment in land transfer, making the already serious phenomenon of farmland abandonment show further fragmentation and remoteness, which also makes the costs of farmland abandonment management, land integration services, and reclamation of abandoned farmland intensify, especially the time cost, which is embodied in the lengthening of the time cost of management, and the time scope of the horizontal expansion [11].

## 4. Path Exploration of Agricultural Mechanization

At present, in the context of the family contract responsibility system, agricultural mechanization inputs, use and promotion will break the current tripartite pattern of agricultural - land - people bound, release production potential, thus affecting the degree of population migration between urban and rural areas, the degree of agricultural scale, the degree of food-producing areas between the degree of differentiation, for this reason, this paper puts forward the following path of agricultural mechanization to explore.

(1) Promote agricultural machinery according to local conditions to realize the liberation of agricultural productivity. For the middle and high latitude areas, such as the Jianghan Plain, the North China Plain and other areas to promote large and medium-sized tractors, large and medium-sized rice transplanter and other large agricultural machinery according to local conditions, and advocate the outsourcing of large and medium-sized agricultural machinery services to promote the comprehensive purchase of third-party rice transplanter, harvesting services, etc., and improve the rational use of the external effects of agricultural mechanization, and can be used for the high and low position between the regions is not a big span between the regions, the government can adopt the regions jointly purchased the form of agricultural mechanization. For regions with a small span of high and low locations, the government can adopt the form of joint purchasing between regions to

directly or indirectly subsidize farmers during the busy season, thus effectively improving the level of agricultural mechanization and the implementation of policies to help and benefit farmers. For low latitude areas and hilly areas, the government should "directly put + indirect subsidies" in the form of agricultural machinery to promote the form of regional locking and joint purchase of small walking tractors for agricultural bulk ordering, thus effectively reducing the indiscriminate use of funds to assist and benefit agriculture, reduce administrative transaction costs and promote Transaction costs, to achieve the level of agricultural mechanization and the improvement of the level of agricultural assistance and benefit to agriculture.

(2) Implementing agricultural industrialization through regional division and helping agricultural industrial parks. Through the big data informatization platform to the regional differentiation phenomenon for a reasonable summary, locking the current high growth areas, such as Guangdong Province, Yunnan Province, Gansu Province and Guizhou Province, etc., on which the "government-guided, enterprise stationed, farmers to participate in the" mode to introduce the relevant ancillary facilities, agricultural machinery, grain-producing areas that have been differentiated into zones Operation and management, at the same time, set up a specialized agricultural processing plant, agricultural services supermarkets and other business entities in the area, reduce the search cost of farmers, business users and transaction costs, so that the industrial park agglomeration effect emerges, so that the formation of economies of scale, to release the economic vitality.

(3) Upgrade the mechanization of traditional farmers and increase the proportion of part-time farmers. Through the government's direct investment and indirect subsidies in the form of mechanization upgrading of traditional farmers, so as to increase the proportion of farmers using agricultural machinery, reduce the farmers' time transaction costs, for farmers to engage in non-agricultural activities to provide a time base, and ultimately promote the phenomenon of farmers' part-time employment. The phenomenon of part-time farmers has a positive effect on maintaining social stability, absorbing political costs, and raising the threshold of financial risk. Part-time farmers who stray between urban and rural areas are front-line workers in various fields when they are not farming, adding bricks and mortar to the design of urban buildings and contributing labor to the transportation of urban services, and then return to the land to become farmers during busy periods or risky periods, objectively absorbing up social, financial, and political risks [14].

## 5. Policy Recommendations

The external effect of agricultural mechanization has a deep impact on rural revitalization, and the input and use of agricultural machinery is of positive value and significance for releasing the production potential of rural areas and stimulating the capacity building of the rural autopoietic system, to this end, this paper puts forward the following policy recommendations:

(1) Based on regional comparative advantages, develop a good blueprint for agricultural mechanization. Local governments should combine the local actual situation, find out where the comparative advantage between regions, to 5–15 years for the industrial growth cycle, in advance to develop a good future agricultural mechanization input blueprint, use blueprint, for the regional development of local characteristics of agricultural products to create a solid power base.

(2) The public service of agricultural machinery to release the potential of market allocation of resources. Local governments can actively promote the outsourcing of agricultural machinery services, create agricultural services supermarket, shaping the agricultural professional manager model, with the help of production - government - package form, the third-party business entities to promote and support, so as to give full play to the ability of the market to allocate resources, with the help of the market this "invisible hand" and the government plan this With the help of the "invisible hand" of the market and the "tangible hand" of the government plan to play the concerto of rural revitalization.

(3) Take agricultural industrial parks as the pole and improve the scale effect of industrial parks. The government should actively promote the regional industrialization of agriculture to industrial parks to move forward, relying on the "government stage, enterprise singing" mode of agricultural enterprises to actively lead, and can use policy financial assistance, optimize the policy environment, provide exchange platforms, joint university research and development, and other forms of agricultural enterprises to help support, so as to fully

improve the economic effect of scale of agricultural industrial parks. The scale economy effect of the industrial park, release the production potential.

## 6. Insufficiency and Prospect

This paper summarizes, condenses, and puts forward its own viewpoints on the basis of the previous literature, with the help of analyzing the external effects of agricultural mechanization, combined with the theme of rural revitalization of the agricultural field of labor migration, agricultural mechanization services and other phenomena, and puts forward the relevant issues and paths to explore, and gives the policy recommendations on the basis of the authors of this paper for their own viewpoints to supplement. However, there are still deficiencies in the specific data analysis and exploration of agricultural mechanization, rural revitalization of specific issues related to and mechanization policy exploration, truth-seeking. For the next fifteen years of rural evolution and development law grasp, there is still the possibility of technological change, for the dividends of technological change beyond the system change, thus triggering the possibility of productivity revolution, the author of this paper holds a positive attitude.

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## Conflicts of Interest

The authors declare no conflict of interest.

## References

1 Ye X. China's Countryside Towards 2035: Vision, Challenges and Strategies. *Management World* 2021; **37** (**04**): 98–112.

2 De Brauw A, Giles J. Migrant Labor Markets and the Welfare of Rural Households in the Developing World: Evidence from China. *The World Bank Economic Review* 2018; **32**(**1**): 1–18.

3 Yang Z, Chen F, Zhang R. Non-farm Employment and the Behavior of Agricultural Outsourcing Services: Re-examining the "Substitution Effect" and "Income Effect". *Agricultural Technology and Economics* 2022;

(**03**): 84–99.

4 Quan SW. On the Evolutionary Logic of Agricultural Policies--Analyzing the Key Issues and Potential Risks of China's Agricultural Transformation. *China Rural Economy* 2022; (**02**): 15–35.

5 Jiao C, Dong L. From "Overcrowding" to "Mechanization": The Course, Dynamics and Impact of China's Agricultural Mechanization Revolution (1980–2015). *Management World* 2018; **34**(**10**): 173–190.

6 Chen Y, Sun W, Xue G. Literature Review and Theoretical Reflection on the Moderate Scale of Grain Management. *China Land Science* 2015; **29**(**05**): 8–15.

7 Luo B. Market Logic of Agricultural Land Transfer--Analytical Clues and Case Studies of "Property Rights Strength-Endowment Effect-Transaction Device". *Southern Economy* 2014; (**05**): 1–24.

8 Zheng F, Cheng Y. Analysis of Cooperative Efficiency of Rural Industrial Clusters in China-A Case Study of Yunnan Dounan Flowers. *China Rural Observation* 2005; (**04**): 14–24+44–81.

9 Zhang C, Peng C, Mao X. Non-farm Employment, Agricultural Mechanization and Agricultural Cultivation Structural Adjustment. *China Soft Science* 2022; (**06**): 62–71.

10 Zhao Y, Lu H. Thoughts Behind the "Ten Consecutive Increases" of Grain: Challenges and Path Choices in the Development of Modern Agriculture. *Research on Agricultural Modernization* 2015; **36**(**04**): 561–567.

11 Qiu T. Cultivated Land Abandonment in the Marketization of Agricultural Land Transfer. *Journal of South China Agricultural University (Social Science Edition)* 2022; **21**(**03**): 37–48.

12 Liu F. Research on the Conditions and Effects of Large-Scale Agricultural Land Management: Taking rural Northeast as an Example. *Management World* 2006; (**09**): 71–79+171–172.

13 Fang S, Wei L, Wu J. The Spatial Spillover Effect of Agricultural Mechanization and Its Distribution Law - the Perspective of Cross-Area Service of Agricultural Machinery. *Management World* 2017; (**11**): 65–78+ 187–188.

14 Dong X, Wen T. De-Dependence: the Real Experience of China in Resolving the Economic Crisis. *Decision Making* 2019; (**11**): 82.

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