



Tripartite relationship among Agricultural Domestic Product, Agricultural Investment, and Public Spending: An applicative study in Libya using the VECM causality method

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العلاقة الثلاثية بين الناتج المحلي الزراعي والاستثمار الزراعي والإنفاق العام: دراسة تطبيقية في ليبيا باستخدام طريقة السببية لنموذج تصحيح الخطأ المتجهي (VECM)

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Abstract:

This research investigates the tripartite relationship among investment, public expending, and agricultural GDP in Libya. A VECM model was utilized for time series data from 1980 to 2023. The findings showed that the stationarity at the first difference and there is cointegration among study variables. It also emphasized the appearance of a long-run relationship moving from Agricultural domestic product and public expending towards agricultural investment, and Agricultural domestic product and agricultural investment towards public expending. On another note, the three variables have no causal relationship in short-run. The research is recommends increasing the effectiveness of investments in stimulating Agricultural domestic product by directing agricultural investments towards projects with high feasibility and high financial returns that rely on technology to increase productivity, in addition to developing research related to developing varieties and strains suitable for the local environment and training for workers in the field of agricultural production.

Key words: Agricultural investment; Public expending; and Agricultural domestic product; VECM causality test.

المخلص:

تناول هذا البحث العلاقة الثلاثية بين الاستثمار والإنفاق العام والناتج المحلي الإجمالي الزراعي في ليبيا. تم استخدام نموذج VECM لبيانات السلاسل الزمنية من 1980 إلى 2023. وأظهرت النتائج أن المتغيرات مستقرة عند الفرق الأول وكذلك هناك تكامل مشترك بين متغيرات الدراسة. كما أكدت النتائج على ظهور علاقة طويلة المدى تنتقل من الناتج المحلي الزراعي والإنفاق العام نحو الاستثمار الزراعي، ومن الناتج المحلي الزراعي والاستثمار الزراعي نحو الإنفاق العام. ومن ناحية أخرى، ليس هناك علاقة سببية بين المتغيرات الثلاثة في المدى القصير. ويوصي البحث بزيادة فاعلية الاستثمارات في تحفيز الناتج المحلي الزراعي من خلال توجيه الاستثمارات الزراعية نحو المشاريع ذات الجدوى العالية والعوائد المالية العالية التي تعتمد على التكنولوجيا لزيادة الإنتاجية، بالإضافة إلى التطوير البحوث المتعلقة بتطوير الأصناف والسلالات المناسبة للبيئة المحلية وتدريب العاملين في مجال الإنتاج الزراعي.

الكلمات المفتاحية: الاستثمار الزراعي، الإنفاق الحكومي، الناتج المحلي الزراعي، متجه تصحيح الخطأ للسببية.

Introduction:

Agriculture serves as the backbone of the economy because its shares in national GDP, market for industrial commodities and primary production requirements for industrial operate Wasnik et al (2024). Furthermore, it addresses the growing demand for food Narasaiah and Suresh (2011). In addition, it is income stream of foreign trade for earning, maintenance, and inbound shipments for other sectors Faraj et al (2020).

The importance of the agricultural sector in Libya, as in other developing countries, lies in providing food for its population. In addition to its contribution to the gross domestic product (GDP), estimated at 7.01% AOAD (2025), its exports ranged 0.16% AOAD (2025). Agricultural raw materials also serve as a source for many processing industries Makail (2025). These contributions to the agricultural sector are attributed to oil revenues, which have enabled the expansion and development of agricultural production projects and related services Faraj et al (2020).

Government spending plays an active and vital role in accelerating economic development as a result of its investment in infrastructure and many services for economic development Amaghionyeodiwe (2019). Where, government expending is the most influential policies in economy Atmania (2019). It also promotes demand, enhance production performance, and removes structural limitations Long (2025).

Research Problem:

Like other developing oil-producing nations, Libya sought to utilize its oil revenues to develop its productive sectors, including agriculture. with the aim of achieving food security through agricultural products, diversifying its national income sources, and reducing its dependence on oil resources. This was achieved through spending and investment in various sectors, with agriculture receiving a significant share of these investments. However, the return on these investments, as reflected in agricultural GDP, is meager compared to the amount of money invested. Despite existing studies addressing this relationship, debate continues regarding the importance of investments in achieving agricultural GDP growth. This divergence in opinion underscores the need for further studies to understand this causation relationship about contribution of funds spent on the agricultural sector.

The importance of research:

The relationship among three variables, represent two significant variables in agricultural policy decision-making, as well as contributing to understanding the causal relationship between them and enriching the discussion thereof.

Research objectives:

The research aims to detect causal relationships among variables by employed the vecm causality method. Moreover, it ascertains the relationship direction.

Previous Studies:

Numerous studies have explored this causal relationship and affecting its performance; however, their results have been conflicting and inconclusive. One such study belongs to Ngobeni & Muchopa (2022). It studied this relationship among these variables from 1983 to 2019. The study displayed its findings that government expending in agriculture does not lead to this causes in the direction of agricultural output value in South Africa. In the same way, a study by Adetule & Olakunle (2022) which used Granger causality test to studied the cause - and - direction among government expending and agricultural output efficiency in Nigeria during 1986- 2019. The study finding found that there is an absence of cause – direction relationships regarding government expending and agricultural production. At any rate, it emphasized the importance of providing employment opportunities for young people in rural and peri-urban areas to alleviate socioeconomic problems and improve the agricultural sector.

Another study conducted by Mostafa (2021) discussed determining the relationship trend with respect to public expenditure and economic expansion, comprises the agricultural sector covered a period of 69 years, draws on Granger's causality evidence. Unidirectional cause occurs from public expenditure to economic expansion was noted. This result demonstrated the effective role of public expenditure in economic expansion in Egypt. In their research Salisu & Haladu (2021) sought in their study from 1985 to 2019 in Nigeria for probing the causation relationship inter-variable relationships among agricultural production, public expenditure, and economic expansion. Evidence confirmed that public expenditure has favorable outcome on real Gross Domestic Product in ARDL model estimates in immediate and future horizons. Over and above that, Sogah et al (2024) analyzed the ramifications of public expenditure on agricultural production efficiency. The research relied on quarter data spanning first quarter 2000 - the fourth quarter 2022 in Ghana. Short and long-run outcomes substantiated that public expenditure effectively boosted and enduring impacts agricultural production efficiency.

Regarding studies that have addressed the repercussions of agricultural investment on agricultural goods output, starting with khaled (2019) they used a semi-logarithmic regression model during the period 1990–2011 to analyze agricultural investment and its impact on agricultural production in Libya. The outcomes pointed to the fact that 71% of the changes in agricultural production were meaningful attributable to changes in independent variables, including the investment rate in Libya. Furthermore, Abdulqader and Mohamed (2025) conducted a study to understand the significance of agricultural investment in the Libyan agricultural sector during the period 2000-2020. The results found that the average capital intensification coefficient in the agricultural sector was about 4.14 during the study period, which means that the sector needs more investment to improve its activity.

Lusungu and Chisasa (2023) used secondary data in the Democratic Republic of Congo from 1980 to 2019 to investigate the important of agricultural investment on agricultural goods output. The findings evidence suggests a cause and direction association (Unidirectional) association between agricultural goods output and agricultural investment. Moreover, they demonstrated a cause and direction association span from employment to agricultural investment. Additionally, it extends from agricultural investment to land allocation. Conversely, Ben Chehida and Sarah (2023) applied cointegration, along with VECM over the years 1990-2021 to investigate the role agricultural investment and agricultural goods outputs in Algeria. In over two runs they had opposite association between agricultural investment and agricultural goods output in over two runs. Finally in Nigeria, Rufai and Selin (2013) sought to applied data from 1960 to 2008 to cover an association between foreign direct investment and agricultural goods output in agriculture utilization Granger's causality test. The study outcomes exhibited association running from foreign direct agriculture investment to wards agricultural output in a short-run only and nothing mentioned in long-run outcomes.

Research methodology and data source:

Model Specification:

This section deals with the quantitative analysis of time series data spanning from 1980 to 2023 by making use of Vecm methodology. These relationships possess integration structures that can constrain the long-run behavior of independent variables, aligning them with their integration's relationships, while simultaneously allowing for short-term adaptive mechanisms. The underlying framework of vecm casuality takes on the appears as Faraj (2024):

$$\Delta \ln Y_t = a + \sum_{i=1}^{k-1} z_{1i} \Delta \ln Y_{t-i} + \sum_{j=1}^{k-1} z_{2j} \Delta \ln X_{t-j} + \lambda_1 ECT_{t-1} + \epsilon_{1t} \tag{1}$$

$$\Delta \ln X_t = a + \sum_{i=1}^{k-1} z_{1i} \Delta \ln Y_{t-i} + \sum_{j=1}^{k-1} z_{2j} \Delta \ln X_{t-j} + \lambda_2 ECT_{t-1} + \epsilon_{2t} \tag{2}$$

Where; $z_{-}(1)$, $z_{-}(2)$ = represents parameters to account current value temporary dynamics parameters of the model's modification long-run a steady state; ϵ = residuals; λ_1 = quickness of modification coefficient with a minus sign; ECT_{t-1} = the error correction term, $K-1$ = lag order minus 1.

Data source:

The research draws on the Central Bank of Libya, the Economic Research Center, and the General Planning Council. Other sources included data from the Arab Organization for Agricultural Development, and the Unified Arab Economic Report in the interval from 1980 to 2023as well as previously published studies.

Results and Discussion:

Unit Root test:

It is crucial to perform a stationary test on time series data before estimating the model to avoid autocorrelation and spurious estimation. Causality tests also assume that time series data are stationary Khalaf (2015). In this context, the Phillips-Perron test was adopted to assessment the stationarity case. The PP test outcomes in Table 1 signified that they had first difference at the 1% level across all cases. Hence, this permits the implement VECM causality method.

Table (1): Phillips-Perron (PP) Unit Root test

Variable	At Level		First Difference		Decision
	Value	Prob	Value	Prob	
Y	-1.3514	0.5969	-21.5422	0.0000	I(1)
X1	-2.4320	0.1392	-9.9566	0.0000	I(1)
X2	0.3625	0.9789	-8.1309	0.0000	I(1)
Test tabulated value					
1% of significance	-3.5924		-3.5966		
5% of significance	-3.9314		-2.9331		
10% of significance	-2.6039		-2.6048		

Footnote: Y= Agricultural GDP; X1= Agricultural Investment; X2=Public spending. Eviews 12 outputs.

Cointegration Test:

Johansen's cointegration test is a broader methodology than the Engle-Granger test; it allows for the determination of the numeral of long-run association among various integrated factors of the equivalent order Abdelrazak (2019). The result of the unrestricted cointegration rank test trace test by Johansen showed that the trace statistic value 31.0528 was surpasses the threshold amount of 29.7907. This implies on significance of a long-run relationships among the variables at 5%. Based on that, the research accepts the H_1 hypothesis as per to the trace test as illustrated in the following Table.

Table (2): unrestricted cointegration rank test (trace)

Hypothesized no. of CE(s)	Trace Statistic	5% critical Value	Prob.**
None *	31.05289	29.79707	0.0357
At most 1	11.40367	15.49471	0.1879
At most 2	0.669316	3.841465	0.4133

Trace statistical significance at 5 %

Picking the ideal threshold Lag:

The choice of Lag order in the VAR model was used to determine it before conducting the causality test, and it was equal to 5 based on the smallest of the Akaike Information Criterion.

Table (3): VAR Picking the ideal threshold Lag Criteria

Lag	AIC
0	7.786815
1	4.701456
2	4.697200
3	4.671202
4	4.801983
5	4.592495*

EvIEWS 12 outputs.

Measured causality test in long-run case:

The analysis of Vecm method in the tables provided equations 3, 4, and 5, together with Table 4, the findings revealed to do not find any long-run association among the factors of agricultural investment and public expending on Libyan agricultural domestic product. The error correction coefficient was positive C1 (0.056) and non-significant (78%), suggesting that the system is not close to equilibrium and that the variable is unresponsive to long-run equilibrium. From another aspect, the error correction coefficient for the agricultural investment as dependent variable was negative C18 (-0.8253) and statistically significant at 8%, indicating a long-run causal relationship extending from Libyan agricultural domestic product and public expending to agricultural investment. Regarding the dependent variable, public expending. In additionally, a significant association in long-run case, along with a beneficial ect (-1) of C35 (0.3319). This long-run causal relationship extends from agricultural GDP and agricultural investment to public spending. The beneficial sign of the ect (-1) parameter revealed that the system is far from equilibrium.

$$D(Y) = C(1)*(Y(-1) + 0.661513796597*X1(-1) - 1.13952676322*X2(-1) - 0.0954638506634) + C(2)*D(Y(-1)) + C(3)*D(Y(-2)) + C(4)*D(Y(-3)) + C(5)*D(Y(-4)) + C(6)*D(Y(-5)) + C(7)*D(X1(-1)) + C(8)*D(X1(-2)) + C(9)*D(X1(-3)) + C(10)*D(X1(-4)) + C(11)*D(X1(-5)) + C(12)*D(X2(-1)) + C(13)*D(X2(-2)) + C(14)*D(X2(-3)) + C(15)*D(X2(-4)) + C(16)*D(X2(-5)) + C(17)...(3)$$

$$D(X1) = C(18)*(Y(-1) + 0.661513796597*X1(-1) - 1.13952676322*X2(-1) - 0.0954638506634) + C(19)*D(Y(-1)) + C(20)*D(Y(-2)) + C(21)*D(Y(-3)) + C(22)*D(Y(-4)) + C(23)*D(Y(-5)) + C(24)*D(X1(-1)) + C(25)*D(X1(-2)) + C(26)*D(X1(-3)) + C(27)*D(X1(-4)) + C(28)*D(X1(-5)) + C(29)*D(X2(-1)) + C(30)*D(X2(-2)) + C(31)*D(X2(-3)) + C(32)*D(X2(-4)) + C(33)*D(X2(-5)) + C(34)...(4)$$

$$D(X2) = C(35)*(Y(-1) + 0.661513796597*X1(-1) - 1.13952676322*X2(-1) - 0.0954638506634) + C(36)*D(Y(-1)) + C(37)*D(Y(-2)) + C(38)*D(Y(-3)) + C(39)*D(Y(-4)) + C(40)*D(Y(-5)) + C(41)*D(X1(-1)) + C(42)*D(X1(-2)) + C(43)*D(X1(-3)) + C(44)*D(X1(-4)) + C(45)*D(X1(-5)) + C(46)*D(X2(-1)) + C(47)*D(X2(-2)) + C(48)*D(X2(-3)) + C(49)*D(X2(-4)) + C(50)*D(X2(-5)) + C(51) ... (5)$$

Table (4): long-run causal relationship

Depended Variable	Coefficient of Error Correction Term	Symbol	Prob.
Agricultural GDP	0.0565	C1	0.7823
Agricultural Investment	- 0.8253	C18	0.0810
Public spending	0.3319	C35	0.0168

Eviews 12 outputs.

Measured causality test in short-run:

The short-term results revealed that the chi-squared probability of the Wald test for estimating short-run causality was greater than 5%, indicating no short-run causal relationship extends from agricultural investment to agricultural GDP 0.29. Regarding the public spending variable, the results did not show a causal relationship extending from public expending to Libyan agricultural domestic product 0.6847. Furthermore, the results did not show a short-run relationship between Libyan agricultural domestic product GDP and agricultural investment or public expending, with chi-squared probability values of 0.8521 and 0.14, respectively, both greater than 5%.

Table (5): Wald Test for short-run causality

The causal relationship and its direction	Chi-square Value	Prob.	Decision
Agricultural Investment does not Cause Agricultural GDP	4.913	0.29	X1≠ Y
Public spending does not Cause Agricultural GDP	2.278	0.68	X2≠ Y
Agricultural GDP does not Cause Agricultural Investment	1.354	0.85	Y≠ X1
Agricultural GDP does not Cause Public spending	6.841	0.14	Y≠ X2

Eviews 12 outputs.

Validation model tests:

The outcomes extracted from table below the model are free in both correlation and heteroskedasticity. Furthermore, the model exhibits a normal distribution, indicating that there are no significant problems with the model.

Table (6): Validation model tests

Test	Probability
Serial Correlation LM Test	0.320
Heteroskedasticity Test	0.830
Normality test Jarque-Bera	0.889

Eviews 12 outputs.

Conclusion:

This research sought to estimate the causal association among agricultural GDP, agricultural investment, and public expending in Libya during the period 1980-2023. A vector error correction (VEC) model was used to analysis the association among the factors, after establishing cointegration between them. The findings of testing the VEC equations revealed a long-run relationship extending from agricultural domestic product and public expending towards agricultural investment, as well as a long-run relationship extending from agricultural GDP and agricultural investment towards public spending. While, Wald test analysis findings in the short-run demonstrated no causal association among between the factors. Consequently, agricultural investment is not significant on the agricultural domestic product in both horizons (long and short run), and vice versa.

Recommendations:

Based on research findings indicating the weak contribution of agricultural investment to agricultural GDP, **the study recommends the following:**

1. Focusing investments on profitable projects that utilize modern technology.
2. Developing scientific research to identify high-yielding varieties and strains suitable for local conditions.

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