An Empirical Analysis of the Determinants of Diesel Pump Prices in Uganda

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Abstract: Diesel fuel is a critical production input in Uganda, supporting transportation, agriculture, construction, manufacturing, and power generation, yet its pump prices have exhibited persistent volatility with far-reaching macroeconomic effects. This study empirically examines the short-run and long-run determinants of diesel pump prices in Uganda using quarterly time-series data on employment (ETP), foreign direct investment (FDI), gross capital formation (GCF), and inflation (INF) within a Vector Error Correction Model (VECM) framework. Unit root tests indicate that all variables are integrated of order one, while Johansen cointegration tests confirm the existence of a stable long-run relationship. Empirical results show that employment growth (ETP) exerts the strongest influence on diesel pump prices, with a long-run elasticity of 21.71, implying that a 1% increase in employment is associated with approximately a 21.7% increase in diesel pump prices over time, reflecting demand-driven pressures arising from structural transformation. In the short run, employment exhibits a small but statistically significant negative elasticity (–0.0033), suggesting temporary supply-side adjustments that moderate price pressures. Foreign direct investment (FDI) has a price-reducing effect in both horizons, with long-run and short-run elasticities of –0.47 and –0.23, respectively, indicating that increased FDI lowers diesel pump prices through improvements in supply chains, storage, and distribution efficiency. Gross capital formation (GCF) reduces diesel pump prices in the short run, with an elasticity of –0.065, but is statistically insignificant in the long run, suggesting that initial efficiency gains are offset by induced demand over time. Inflation exhibits near-zero and statistically insignificant elasticities in both the short and long run, implying that diesel pump prices in Uganda are largely insulated from domestic inflationary pressures. The error-correction coefficient indicates that approximately 11% of short-run disequilibrium is corrected each quarter. These findings underscore that diesel pump prices in Uganda are primarily driven by real economic activity and structural factors rather than general price movements, offering important implications for fuel pricing policy and macroeconomic stabilization in oil-importing developing economies.

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I. INTRODUCTION

Energy prices, particularly petroleum fuel prices, remain a central driver of economic performance globally due to their pervasive influence on production, transportation, and consumption systems (Borucka & Sobczuk, 2025). Diesel fuel is especially critical, accounting for a substantial share of energy use in freight transport, agriculture, construction, and manufacturing (IEA, 2020). Globally, petroleum products account for about 31% of total final energy consumption, with diesel representing more than 40% of fuel used in road freight transport (IEA, 2023). Over the past two (2) decades, international crude oil prices have exhibited pronounced volatility, with Brent crude prices rising from an average of USD 43 per barrel in 2004 to over USD 100 in 2012, collapsing to USD 41 in 2020, and rebounding to above USD 95 in 2022 following global supply disruptions (IEA, 2023). These fluctuations have been rapidly transmitted to domestic diesel pump prices, significantly affecting production costs, inflation dynamics, and household welfare, particularly in oil-importing economies (Baumeister & Kilian, 2016).

Theoretically, global debates on diesel price determination center on the relative importance of demand-side forces, such as employment growth, income expansion, and structural transformation, versus supply-side influences including capital investment, infrastructure development, and foreign direct investment (Stern & Kander, 2012). Classical demand theory and structural transformation models suggest that rising employment and industrialization increase energy demand disproportionately, exerting persistent upward pressure on fuel prices (Lewis, 1954). Empirical studies confirm that in developing economies, long-run income and employment elasticities of fuel demand often exceed unity, indicating that fuel demand grows faster than output (Burke & Csereklyei, 2016). Conversely, endogenous growth and modernization theories argue that capital accumulation and FDI can offset demand pressures by enhancing supply efficiency, lowering distribution costs, and improving market competition (Romer, 1990; Rostow, 1960). However, global evidence remains mixed, revealing unresolved gaps regarding the net long-run impact of employment growth and investment on diesel pump prices.

Regionally, these debates are particularly pronounced in Sub-Saharan Africa, where diesel dominates commercial energy use due to limited rail networks, weak electricity coverage, and heavy reliance on road transport (IEA, 2020). The region imports over 85% of its refined petroleum products,

making domestic pump prices highly vulnerable to external shocks (IMF, 2022). Transport alone accounts for approximately 60–70% of total diesel consumption in Sub-Saharan Africa, compared to less than 40% in advanced economies (IEA, 2023). Empirical evidence shows that a 1% increase in economic activity or employment in African economies can raise fuel demand by between 1.2% and 1.6% in the long run, reflecting diesel-intensive growth patterns (Burke & Csereklyei, 2016; Tamba, 2012). At the same time, the region has experienced rising investment inflows. Net FDI inflows to Sub-Saharan Africa increased from about USD 17 billion in 2005 to over USD 44 billion in 2022, with a growing share directed toward transport infrastructure, logistics, and energy-related sectors (UNCTAD, 2023). Studies show that such investments can reduce fuel distribution costs by 5–15% in the short run through improved storage, reduced transit losses, and enhanced competition among distributors (Adewuyi & Awodumi, 2017). Nevertheless, regional evidence suggests that these supply-side gains are often temporary, as expanding economic activity subsequently drives up diesel demand, neutralizing long-run price reductions (Calderón & Servén, 2014).

Uganda imports nearly 100% of its refined petroleum products, with over 90% transported by road through the Northern and Central Corridors, significantly increasing vulnerability to international oil price and logistics shocks (IMF, 2023; Bategeka & Okumu, 2020). Diesel accounts for approximately 65% of total petroleum consumption in Uganda and is the primary fuel for commercial transport, agricultural mechanization, construction equipment, and backup electricity generation (UBOS, 2023). Between 2010 and 2023, average diesel pump prices increased from about UGX 2,700 per litre to over UGX 6,500 per litre, representing an increase of more than 140%, with sharp spikes observed during periods of global oil price surges and regional supply disruptions (IMF, 2023; UBOS, 2023; World Bank, 2022). Over the same period, Uganda's employment-to-population ratio rose from approximately 71% in 2010 to about 78% in 2022 (World Bank, 2022), reflecting rapid labor absorption in transport services, construction, trade, and agro-processing sectors that are highly diesel-intensive (UBOS, 2023). Concurrently, gross capital formation increased from about 20% of GDP in 2005 to over 27% of GDP by 2022, while net FDI inflows averaged USD 1.3–1.8 billion annually over the last decade, with significant investments in infrastructure, logistics, and energy-related activities (World Bank, 2022; Bategeka & Okumu, 2020). Inflation, however, has remained relatively moderate, averaging 5–6% per annum over the past decade, yet diesel

pump prices have frequently exhibited movements that diverge from domestic inflation trends, suggesting limited direct pass-through from general price levels to fuel prices (Killian, Sonia, Anthony, & Francis, 2026). Despite notable volatility in diesel pump prices in Uganda and their close links to key macroeconomic outcomes, existing empirical studies remain limited in explaining their underlying determinants, thereby constraining effective policy formulation and motivating this study (Inchauste & Victor, 2017; Sterner, 2012).

➤ *Problem Statement*

Diesel fuel is a critical input in Uganda's economy, supporting transportation, agriculture, manufacturing, construction, and power generation (NPA, 2025). As a landlocked country that depends almost entirely on imported petroleum products, Uganda is highly exposed to volatility in diesel pump prices (UBOS, 2023). In recent years, fluctuations in diesel prices, driven by global oil market shocks, domestic economic expansion, and structural supply constraints, have raised production and transport costs, intensified inflationary pressures, and weakened the competitiveness of key productive sectors, particularly agriculture and small-scale manufacturing (NPA, 2025; MEMD, 2022).

Despite diesel's economic significance, policy responses in Uganda have largely relied on short-term tax adjustments and administrative measures, with limited empirical evidence on the underlying macroeconomic and structural drivers of diesel pump prices (IMF, 2022). Existing studies predominantly focus on international oil prices and exchange rate movements, often neglecting domestic factors such as employment dynamics, foreign direct investment, capital formation, and inflation (World Bank, 2022), as well as differences between short-run and long-run price adjustments (Burke & Csereklyei, 2016). Consequently, Uganda-specific evidence on the magnitude and adjustment dynamics of these effects remains limited, a gap this study addresses by analyzing the short- and long-run determinants of diesel pump prices in Uganda using a Vector Error Correction Model to inform policy.

II. LITERATURE REVIEW

The pricing of diesel fuel has long been a subject of interest in economic literature due to its central role in production, transportation, and overall macroeconomic performance. Theoretical explanations of diesel pump price dynamics are rooted in demand–supply interactions, structural change, capital accumulation, and international price transmission mechanisms. At the core of demand-driven pricing theory is the proposition that fuel prices respond positively to aggregate economic activity (Sterner, 2012). As employment levels rise, production and consumption expand, increasing demand for energy inputs such as diesel (IMF, 2022). Keynesian aggregate demand theory supports this linkage, arguing that higher employment raises income and spending, thereby intensifying demand pressures in energy markets

(Burke & Csereklyei, 2016). In log–log specifications, employment-related variables are therefore expected to exert positive long-run elasticities on fuel prices, particularly in economies where transport and industrial activity are highly diesel-dependent (Bategeka & Okumu, 2020).

Closely related to this perspective is structural transformation theory, which explains how economies evolve from agrarian systems toward industrial and service-oriented structures. Lewis (1954) argues that as labor shifts into higher-productivity sectors, demand for modern inputs, including energy, rises disproportionately. Diesel fuel plays a critical role in this transformation by powering machinery, logistics, and commercial transport (IMF, 2022). As a result, sustained increases in employment associated with industrialization can generate strong upward pressure on diesel prices over time, especially where domestic refining capacity and storage infrastructure are limited. Stern & Kander (2012) further emphasize that energy demand elasticities tend to be high during early and middle stages of development, reinforcing the expectation of strong long-run relationships between employment growth and fuel prices in developing economies such as Uganda (Stern & Kander, 2012).

The role of foreign direct investment in fuel price dynamics is theoretically explained through modernization theory and market efficiency arguments. Rostow (1960) posits that external capital inflows facilitate modernization by introducing advanced technology, managerial expertise, and infrastructure development (Rostow, 1960). In the energy sector, FDI can enhance storage capacity, improve fuel distribution networks, and promote competition among suppliers, thereby reducing transaction costs and stabilizing prices. Asiedu (2013) further notes that FDI directed toward infrastructure-intensive sectors in Sub-Saharan Africa improves allocative efficiency and lowers operational costs (Asiedu, 2013). From this standpoint, FDI is expected to exert a negative effect on diesel pump prices, particularly when investments are channeled into logistics, transport corridors, and wholesale petroleum markets (Pindyck & Rubinfeld, 2018).

Capital accumulation theory, particularly as articulated within the endogenous growth framework, also provides insights into fuel price behavior. Romer (1990) emphasizes that gross capital formation expands productive capacity and lowers unit costs through scale and efficiency effects. In the context of fuel markets, short-run increases in capital investment, such as roads, depots, and storage facilities, can ease supply bottlenecks and reduce distribution costs, leading to lower diesel prices (Romer, 1990). However, as Calderón and Servén (2014) argue, these gains may be offset in the long run by induced demand effects, as improved infrastructure stimulates economic activity and energy consumption. Consequently, the net long-run impact of capital formation on fuel prices may be neutral, despite short-run price reductions (Calderón & Servén, 2014).

Macroeconomic price transmission theories also highlight the role of inflation in shaping fuel prices (Barsky & Kilian, 2004). Standard models suggest that rising inflation increases production and distribution costs, which may be passed on to consumers (Hooker, 2002). However, in petroleum markets, domestic inflation often plays a secondary role because fuel prices are largely determined by international oil prices and exchange rate movements. Arze del Granado, Coady, and Gillingham (2012) demonstrate that in many developing countries, fuel pricing mechanisms are either benchmarked to global prices or subject to administrative smoothing, weakening the direct pass-through from domestic inflation. Consequently, inflation may exhibit weak or insignificant effects on diesel pump prices, particularly in the long run (Coady, Arze del Granado, & Gillingham, 2012).

Exchange rate and international price transmission theories further explain fuel price formation in open economies. According to the law of one price, imported fuel prices should reflect global oil prices adjusted for exchange rates. Depreciation raises the local currency cost of imports, while appreciation reduces it (Edwards & Golub, 2004). However, volatility can generate offsetting effects by simultaneously influencing import costs and export competitiveness, sometimes neutralizing the net impact on domestic prices. Mundlak, Cavallo, and Domenech (2004) argue that in economies with partial pass-through, fuel subsidies, or pricing inertia, exchange rate effects may be statistically insignificant at the aggregate level (Mundlak, Cavallo, & Domenech, 2004).

Empirical literature largely supports these theoretical propositions, though findings vary across contexts. Burke and Csereklyei (2016), using a cross-country panel, find that employment and income elasticities of energy demand are significantly positive in developing economies, reflecting strong demand-side effects on fuel prices.

In Sub-Saharan Africa, rising employment in transport, manufacturing, and construction has been shown to increase diesel consumption and price pressures (IEA, 2020). Uganda-specific evidence from the Uganda Bureau of Statistics (2023) similarly indicates that periods of employment expansion coincide with rising fuel demand, particularly in urban and industrial corridors (UBOS, 2023).

Empirical studies on FDI consistently highlight its price-moderating role in energy markets. Adewuyi and Awodumi (2017) show that foreign capital inflows reduce energy prices by improving infrastructure efficiency and lowering distribution costs. In Africa, Asiedu (2013) finds that FDI enhances supply-side capacity and competition, contributing to more stable and affordable energy prices. However, some studies caution that the impact of FDI depends on sectoral allocation, where inflows are concentrated in enclave or capital-intensive sectors, spillovers to domestic fuel markets may be limited (Alfaro, 2003).

Evidence on gross capital formation mirrors the theoretical ambiguity. Calderón and Servén (2014) document that infrastructure investment lowers energy prices in the short run, especially in landlocked countries, by easing logistical constraints. Conversely, Narayan and Smyth (2007) find that long-run effects are often insignificant due to demand expansion offsetting supply-side improvements (Narayan & Smyth, 2007). This pattern is commonly observed in developing economies undergoing rapid growth.

Empirical findings on inflation and fuel prices generally confirm weak direct relationships. Arze del Granado et al. (2012) show that fuel prices respond more strongly to global oil price shocks than to domestic inflation. Cologni and Manera (2008) similarly find that inflation pass-through to fuel prices is partial and slow. Overall, the literature reveals that diesel pump prices are shaped more by structural and real economic factors, such as employment growth, capital flows, and infrastructure, than by nominal variables like inflation (Burke & Csereklyei, 2016). However, there remains a paucity of country-specific studies for Uganda that jointly examine short-run and long-run elasticities within a unified time-series framework (IEA, 2020). This study contributes to the literature by addressing this gap through a VECM approach that explicitly distinguishes between transitory and permanent effects of macroeconomic determinants on diesel pump prices.

III.   RESEARCH METHODOLOGY

This study employed a longitudinal time series research design to analyse the determinants of diesel pump prices in Uganda, consistent with Kerlinger's (1986) definition of research design as a structured plan for addressing research questions. A time series approach is appropriate for capturing long-term trends and dynamic interactions between the study variables (Wooldridge, 2013). The study used secondary quantitative quarterly data obtained from the World Bank Development Indicators and the Brent, ensuring reliability and consistency for empirical analysis. The empirical model was derived from the general time-series structure.

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=0}^{q1} \theta_{1j} X_{1,t-j} + \sum_{j=0}^{q2} Q_{2j} X_{2,t-j} + \cdots + \sum_{j=0}^{qk} Q_{kj} X_{k,t-j} + \varepsilon_t \ldots\ldots\ldots\text{i}$$

leading to the study's empirical specification;

$$DPP_t = B_0 + \beta_1 logETP + \beta_2 logINF + \beta_3 FDI + \beta_4 LogGCF + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.ii$$

Pre-estimation involved unit root testing using the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) to determine the order of integration of the variables. The Johansen cointegration test was adopted due to its suitability for models containing I(1) variables. Model diagnostics, including the VIF test for multicollinearity, the LM test for serial

correlation (Kennedy, 2008; Greene, 2012), and the White/Breusch-Pagan test for heteroscedasticity, were conducted to ensure robustness (Gujarati & Porter, 2009). All analyses were performed using **STATA 17**, and ethical considerations were upheld through transparent, responsible use of secondary data for academic purposes (Greene, 2012).

IV. RESULTS AND FINDINGS

The descriptive statistics in Table 1 indicate the central tendency and dispersion of the study variables.

Table 1: Descriptive Analysis of the Study Variables

Variable	n	Mean	Std. Dev.	Min	Max	CV(%)
Log_DPP	60	8.170534	.2084776	7.790117	8.723833	2.55
Log_ETP	60	4.216056	.0066181	4.199845	4.231524	0.16
Log_INF	60	1.533629	.5585402	.5128236	2.763573	36.41
Log_FDI	60	1.303241	.3334296	.7299578	1.868831	25.57
Log_GCF	60	22.90214	.154029	22.69009	23.13265	0.67

Source: Author's compilation

Log_DPP has a mean of 8.17 and a relatively low standard deviation of 0.208, suggesting that the domestic petrol price series is fairly stable over the observed period. Similarly, Log_ETP, representing employment to population ratio, shows minimal variation with a mean of 4.22 and a standard deviation of 0.0066, indicating very little fluctuation in the series. In contrast, Log_INF and Log_FDI exhibit higher variability. Inflation (Log_INF) has a coefficient of variation (CV) of 36.41%, reflecting substantial fluctuations in inflation rates over time, which may affect economic stability. Foreign direct investment (Log_FDI) also shows moderate variability with a CV of 25.57%, suggesting that inflows of foreign capital into the economy are less stable compared to domestic petrol prices or export performance. Finally, Log_GCF, representing gross capital formation, has a high mean of 22.90 with a low standard deviation of 0.154 and a CV of 0.67%, indicating that capital formation in Uganda is relatively consistent over the sample period. Overall, these descriptive statistics provide an initial insight into the relative stability and volatility of the macroeconomic variables, which is important for further econometric analysis, such as stationarity and cointegration tests (Wooldridge, 2013; Alin, 2010).

Table 2: Augmented Dickey-Fuller Unit Root Test Results for the Series

Variable	Test Statistic (Level)	P-value (Level)	Test Statistic (1st Diff)	P-value (1st Diff)	Order of Integration
Log_DPP	-0.731	0.8385	-5.014	0.0000	I(1)
Log_ETP	-1.086	0.7208	-3.219	0.0189	I(1)
Log_INF	-0.393	0.9113	-3.351	0.0127	I(1)
Log_FDI	-0.869	0.7979	-2.906	0.0447	I(1)
Log_GCF	-0.263	0.9306	-2.942	0.0406	I(1)

Source: Author's compilation

At their levels, all variables fail to reject the null hypothesis of a unit root, as indicated by their high P-values (all above 0.05). This means that Log_DPP, Log_ETP, Log_INF, Log_FDI, and Log_GCF are non-stationary in their original form, which is common for macroeconomic time series (Farrar & Glauber, 2019). Using non-stationary series in regression could produce spurious results, so first differencing is necessary (Montgomery, Peck, & Vining, 2021). After first differencing, the ADF test shows that all variables become stationary, with P-values all below 0.05. This confirms that the series is integrated of order one, I(1). Consequently, these series are now suitable for cointegration analysis to explore long-run relationships between the variables.

➤ *Multicollinearity Test:*
Table 3 below presents the results of the multicollinearity test conducted using the Variance Inflation Factor (VIF) for the study's explanatory variables. Multicollinearity occurs when two (2) or more independent variables in a regression model are highly correlated, which can distort coefficient estimates and reduce the reliability of statistical inferences (O'Brien, 2017). The VIF measures the extent to which the variance of a regression coefficient is inflated due to multicollinearity, with values above 10 commonly indicating a serious multicollinearity problem (Gujarati & Porter, 2009).

Table 3: Multicollinearity Test Using Variance Inflation Factor

Variable	VIF	1/VIF
Log_GCF	8.49	0.117784
Log_FDI	6.79	0.147274

Log_INF	2.39	0.418529
Log_ETP	1.10	0.908647
Mean VIF	**4.69**	

Source: Author's compilation

The results show that the VIF values for all variables range from 1.10 (Log_ETP) to 8.49 (Log_GCF), with a mean VIF of 4.69. Since all VIF values are below the commonly accepted threshold of 10, multicollinearity is not considered a severe issue in this dataset (Hair, Black, Babin, & Anderson, 2019). This implies that the independent variables are sufficiently independent of one another, allowing for reliable estimation of regression coefficients (Kim & Yoon, 2020). Among the variables, Log_GCF exhibits the highest VIF, suggesting a moderate correlation with other explanatory variables, whereas Log_ETP shows the lowest VIF, indicating minimal correlation (Vatcheva, Lee, McCormick, & Rahbar, 2016). Overall, the model is suitable for regression analysis without major concerns about multicollinearity (Kennedy, 2008; Alin, 2010).

➢ *Lag Order Selection:*
Before estimation or conducting a cointegration analysis, it is important to determine the optimal number of lags for the model. The choice of lag length affects the model's ability to capture the dynamic relationships among the variables while avoiding overfitting (Midi, Sarkar, & Rana, 2010). Table 4 below presents the results of various lag-order selection criteria, including the Likelihood Ratio (LR) test, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion (SBIC).

Table 4: Optimal Lags for the Model

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	614.376				1.6e-16	-22.1591	-22.0886	-21.9766
1	704.986	181.22*	25	0.000	1.5e-17*	-24.545*	-24.1215*	-23.4501*
2	720.512	31.052	25	0.187	2.2e-17	-24.2004	-23.4242	-22.1931
3	731.161	21.297	25	0.676	3.9e-17	-23.6786	-22.5495	-20.7588
4	746.014	29.707	25	0.235	6.4e-17	-23.3096	-21.8277	-19.4774

Source: Author's compilation

The lag-order selection criteria are used to determine the optimal number of lags to include in the model. From Table 4 above, the likelihood ratio (LR) test shows that moving from lag 0 to lag 1 produces a highly significant improvement in model fit (LR = 181.22, P = 0.000), indicating that at least one (1) lag is necessary to capture the dynamics of the variables. Subsequent increases in lag length (lags 2, 3, and 4) do not produce statistically significant improvements based on the LR test, suggesting that adding more lags would not meaningfully enhance the model. Additionally, the information criteria, Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion (SBIC), all support lag 1 as the optimal choice, as indicated by the lowest values and asterisks marking the optimal lag. The Final Prediction Error (FPE) is also minimized at lag 1, reinforcing that including one (1) lag balances model fit with parsimony (Kutner, Nachtsheim, Neter, & Li, 2005). Overall, this analysis suggests that a model with one (1) lag is most appropriate for capturing the interrelationships among the endogenous variables (Wooldridge, 2013; Kutner, Nachtsheim, Neter, & Li, 2005; Alin, 2010).

➢ *Johansen Test for Cointegration*
When time series variables are integrated of order one, I(1), standard regression analysis can produce spurious results due to non-stationarity (Dormann, et al., 2013). To examine whether a long-run equilibrium relationship exists among such variables, the Johansen cointegration test is commonly applied. This test uses a system-based approach that allows for multiple cointegrating relationships and provides two test statistics, the Trace statistic and the Maximum Eigenvalue statistic, to determine the number of cointegrating vectors. Table 5 below presents the Johansen test results, indicating whether a stable long-run relationship exists.

Table 5: Johansen Cointegration Test Results for I(1) Variables

Maximum Rank	Params		LL	Eigenvalue	Trace Statistic	Critical Value 5%	
0	5		657.28205	.	104.3338	68.52	
1	14		684.10631	0.59719	50.6853	47.21	
2	21		696.71851	0.34788	25.4609*	29.68	
3	26		705.64295	0.26105	7.6120	15.41	
4	29		709.44873	0.12103	0.0004	3.76	

| 5 | 30 | 709.44895 | 0.00001 | | | |

Source: Author's compilation

The Trace statistic indicates that the null hypothesis of no cointegration (rank = 0) is rejected at the 5% significance level since 104.334 > 68.52, suggesting at least one cointegrating relationship (Alin, 2010). Further, the test indicates that the presence of two cointegrating vectors is not statistically significant, as the Trace statistic for rank = 2 (25.461) is less than the 5% critical value (29.68). Therefore, the results suggest the existence of one (1) cointegrating relationship among the variables, implying that despite being non-stationary in levels, the variables share a stable long-term equilibrium.

➤ *Regression Estimates for Study Objectives:*

Based on the unit root test results and cointegrating relationships in the empirical model, this study utilised the Vector Error Correction Model (VECM). VECM is appropriate for this study because all the variables are integrated of order one (I(1)) and are cointegrated, allowing the model to capture both the long-run equilibrium relationships and the short-run dynamics among the variables.

Table 6: The VECM Regression Estimates

DLog_DPP	Coef.		P-value	Sig
Long-run Estimates				
Log_ETP	21.70786		0.000	***
Log_INF	0.00069		0.990	
Log_FDI	-0.47036		0.001	**
Log_GCF	0.14993		0.674	
Short-run Estimates				
Log_ETP	-0.00332		0.011	**
Log_INF	-0.18026		0.112	
Log_FDI	-0.22971		0.000	***
Log_GCF	-0.06461		0.000	***
ECT	-0.11009		0.009	**

Source: Author's compilation *** *p<.01, ** p<.05, * p<.1*

➤ *Long-Run Estimates:*

In the long-run equilibrium relationship, three (3) variables emerge as statistically significant determinants of diesel pump prices (DPP). Employment to population ratio (Log_ETP) have a strong positive effect, highlighting that elevated employment is associated with increased domestic production over time. Foreign direct investment (Log_FDI) exhibits a significant negative relationship, suggesting that, in the long run, FDI inflows may be concentrated in sectors not directly contributing to domestic production or could crowd out local production. Gross capital formation (Log_GCF) and inflation (Log_INF) do not show statistically significant long-run effects, implying their impact on domestic production is neutralized over extended periods.

➤ *Short-Run Estimates:*

In the short run, the dynamics differ slightly. Employment to population ratio (Log_ETP), FDI (Log_FDI), and GCF (Log_GCF) retain statistically significant short-run impacts on diesel pump prices, indicating that short-term changes in these variables immediately influence diesel pump prices. Inflation and other variables are statistically insignificant in the short run, suggesting their effects accumulate more gradually rather than appearing instantly.

➤ *Error Correction Term (ECT):*

The negative and statistically significant ECT (-0.110, P-value = 0.009) confirms a valid long-run cointegrating relationship among the variables. This indicates that any short-run deviation from the long-run equilibrium is systematically corrected over time. Specifically, the coefficient suggests a relatively moderate adjustment speed, meaning approximately 11% of any disequilibrium from the previous period is corrected in the current quarter; for example, a 1% shock to diesel pump prices away from its long-run path would be corrected by about 0.11% in the subsequent quarter.

➤ *Post Diagnostic Tests:*

The study conducted post-model estimation tests to validate the robustness of the model.

➤ *Normality of the Residuals:*

Table 7 below reports results of the Jarque–Bera normality test, together with its skewness and kurtosis components, applied to the residuals of the Vector Error Correction Model (VECM). These tests assess whether the residuals of each equation and the system as a whole are normally distributed, which is a desirable property for valid statistical inference in multivariate time-series models (Greene, 2012).

Table 7: Multivariate Normality Test Results (VECM Residuals)

Variable	Jarque–Bera χ²	JB P-Value	Skewness	Skewness P-Value		Kurtosis	Kurtosis P-Value
D_Log_DPP	20.652	0.00003	0.9943	0.00199		5.1426	0.00087
D_Log_ETP	25.287	0.00000	0.0205	0.94923		6.2345	0.00000
D_Log_INF	183.056	0.00000	2.0097	0.00000		10.7200	0.00000
D_Log_FDI	10.497	0.00526	−0.3275	0.30863		4.9785	0.00210
D_Log_GCF	27.912	0.00000	−0.0623	0.84645		6.3962	0.00000
ALL (Joint)	**267.403**	**0.00000**	—	**0.00000**		—	**0.00000**

Source: Author's compilation

The VECM residuals deviate from normality due to significant skewness and excess kurtosis. However, this outcome is common in quarterly macroeconomic time-series data and does not invalidate the VECM estimates (Hair, Black, Babin, & Anderson, 2019). Since the model is primarily used for analyzing long-run relationships and short-run dynamics rather than precise small-sample inference, the results remain reliable (Alin, 2010). The VECM estimates remain consistent, and inference is conducted using asymptotic properties (Gujarati & Porter, 2009).

➤ *Lagrange Multiplier (LM) Test for Autocorrelation*
The Lagrange Multiplier (LM) test was conducted to examine the presence of serial correlation in the residuals of the estimated Vector Error Correction Model (VECM) (Midi, Sarkar, & Rana, 2010). The null hypothesis of the test states that there is no autocorrelation at the specified lag order (Kennedy, 2008).

Table 8: Diagnostic Test for Autocorrelation in the Vector Error Correction Model

Lag	chi2	df	Prob > chi2
1	18.9261	25	0.80065
2	18.3137	25	0.82879

H0: no autocorrelation at lag order

The results show that for **lag 1** (χ^2 = 18.93, P = 0.8007) and **lag 2** (χ^2 = 18.31, P = 0.8288), the P-values are well above the conventional 5% significance level. Consequently, the null hypothesis of no autocorrelation cannot be rejected at either lag order. This implies that the residuals of the VECM are free from serial correlation, indicating that the model is well specified and dynamically stable (Wooldridge, 2013). Therefore, the estimated VECM results can be considered reliable for inference on both short-run dynamics and long-run relationships among the variables (Alin, 2010).

➤ *Stability Test (Eigenvalue Stability Condition)*
Table 9 below presents the results of the eigenvalue stability test for the estimated VECM. The test examines whether the dynamic system underlying the VECM is stable by assessing the modulus of the companion matrix eigenvalues. In a correctly specified VECM, the number of unit moduli (eigenvalues with modulus equal to one) should correspond to the number of cointegrating relationships imposed by the model, while all remaining eigenvalues should lie strictly within the unit circle (Wooldridge, 2013).

Table 9: Eigenvalue Stability Condition Test Results

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
.7659295 + .03904977i	.766924
.7659295 - .03904977i	.766924
.5966097 + .3208564i	.677416
.5966097 - .3208564i	.677416
.6242272	.624227
.476581	.476581

Source: Author's compilation The VECM specification imposes 4 unit moduli.

The results show four (4) eigenvalues with a modulus equal to one (1), which is consistent with the four (4) cointegrating relations imposed in the VECM specification (Alin, 2010). This confirms that the long-run equilibrium relationships are properly incorporated into the model (O'Brien, 2017). All other eigenvalues have moduli less than one (1), indicating that the short-run dynamics of the system are stable and converge back to the long-run equilibrium following shocks (Wooldridge, 2013). Overall, the eigenvalue stability condition is satisfied, implying that the estimated VECM is dynamically stable and suitable for inference and policy analysis (Alin, 2010).

V. DISCUSSION OF RESULTS

➤ *Employment-to-Population Ratio and Diesel Pump Prices*

The results indicate that the employment-to-population ratio (Log_ETP) is the most influential determinant of diesel pump prices, exerting a strong positive effect in the long run and a statistically significant negative effect in the short run. In elasticity terms, the long-run coefficient of 21.71 implies that a 1% increase in employment levels is associated with approximately a 21.7% increase in diesel pump prices over time, holding other factors constant. This exceptionally large elasticity suggests that sustained improvements in employment significantly raise aggregate demand for diesel through expanded transport activity, industrial production, construction, and commercial agriculture, all of which are diesel-intensive sectors in Uganda (Umair, et al., 2024).

In the short run, however, the elasticity of –0.0033 indicates that a 1% increase in employment temporarily reduces diesel pump prices by about 0.33%. This counterintuitive short-run effect may reflect transitional supply-side responses, such as improved logistical efficiency, increased fuel imports, or short-term government interventions aimed at cushioning fuel prices during periods of economic expansion (Tamba, 2012). Over time, these short-run adjustments dissipate, and demand-side pressures dominate, resulting in higher prices in the long run. Theoretically, these findings align with demand-driven pricing models and structural transformation theory, which posit that as labor shifts into productive sectors, energy demand rises faster than supply capacity, leading to higher fuel prices (Lewis, 1954; Stern & Kander, 2012). Empirical evidence supports this interpretation. For Uganda, UBOS (2023) documents rising diesel consumption associated with employment growth in transport, manufacturing, and construction (Borucka & Sobczuk, 2025; Tamba, 2012). Similar results are observed by Burke & Csereklyei (2016), who find strong long-run income and employment elasticities of fuel demand in developing economies.

➤ *Foreign Direct Investment and Diesel Pump Prices*

Foreign Direct Investment (Log_FDI) exhibits a statistically significant negative effect on diesel pump prices in both the long and short run. In the long run, the elasticity of –

0.47 implies that a 1% increase in FDI inflows reduces diesel pump prices by approximately 0.47%. In the short run, the effect is even stronger, with an elasticity of –0.23, meaning a 1% increase in FDI lowers diesel prices by about 0.23% within the same period. These findings suggest that FDI contributes to price-stabilizing effects in Uganda's fuel market, possibly through improvements in supply chains, storage infrastructure, logistics efficiency, and competition in fuel distribution (Sijabat, 2025; MoFPED, 2023). FDI in energy-related infrastructure, transport corridors, and wholesale petroleum distribution can reduce transaction costs and mitigate supply bottlenecks, translating into lower pump prices (Lewis, 1954).

The results are consistent with modernization theory, which emphasizes the role of external capital and technology transfer in improving market efficiency and lowering production and distribution costs (Rostow, 1960). Empirical studies reinforce this view. For example, Asiedu (2013) finds that FDI enhances infrastructure efficiency in Sub-Saharan Africa (Asiedu, 2013), while Adewuyi & Awodumi (2017) show that FDI inflows reduce domestic energy prices by easing supply constraints. However, the negative relationship also suggests that if FDI is concentrated in capital-intensive sectors with limited domestic linkages, its benefits may manifest more strongly through cost reductions than employment generation (Adewuyi & Awodumi, 2017).

➤ *Gross Capital Formation and Diesel Pump Prices*

Gross Capital Formation (Log_GCF) is statistically insignificant in the long run but negative and highly significant in the short run. The short-run elasticity of –0.065 implies that a 1% increase in capital formation reduces diesel pump prices by about 0.07%. This suggests that short-term investments in infrastructure, such as roads, storage facilities, and fuel depots improve distribution efficiency and reduce operational costs, temporarily easing diesel prices. The lack of long-run significance indicates that the price-reducing benefits of capital investment may be offset over time by rising demand for diesel as economic activity expands. In other words, while capital accumulation initially improves supply efficiency, it simultaneously fuels industrialization and transport demand, neutralizing its long-run effect on prices. This outcome aligns with endogenous growth theory, which recognizes that capital accumulation can have ambiguous price effects when demand-side expansion matches or exceeds supply-side improvements (Romer, 1990). Empirical support is found in Calderón & Servén (2014), who note that infrastructure investment in developing countries often lowers energy prices initially but has neutral long-run effects due to induced demand.

➤ *Inflation and Diesel Pump Prices*

Inflation (Log_INF) is statistically insignificant in both the short and long run, indicating that general price level changes do not directly translate into diesel pump price movements in Uganda during the study period. The near-zero long-run elasticity suggests that diesel prices are largely

insulated from domestic inflationary pressures, likely because fuel pricing is heavily influenced by international oil prices, exchange rate pass-through mechanisms, and administered pricing structures. This finding is consistent with fuel pricing frameworks in many developing countries, where domestic inflation has limited explanatory power once global energy market dynamics are accounted for (IMF, 2022). Similar evidence is provided by Arze del Granado et al. (2012), who show that petroleum product prices in low-income countries respond weakly to domestic inflation but strongly to external shocks (Coady, Arze del Granado, & Gillingham, 2012).

➢ *Error Correction Term (ECT) and Speed of Adjustment*

The ECT is negative and statistically significant, with a coefficient of –0.110, confirming the existence of a stable long-run cointegrating relationship among diesel pump prices and their determinants. This implies that approximately 11% of any short-run deviation from long-run equilibrium is corrected within one quarter. In elasticity terms, a 1% shock to diesel pump prices is corrected by about 0.11% in the subsequent quarter, indicating a moderate but meaningful adjustment process. This relatively slow speed of adjustment reflects structural rigidities in Uganda's fuel market, including import dependence, transportation bottlenecks, and pricing inertia. Similar adjustment speeds are reported in energy price studies for developing economies (Narayan & Smyth, 2007).

VI. CONCLUSION

The results demonstrate that diesel pump prices in Uganda are primarily driven by real economic activity and structural factors rather than general inflation. Employment growth exerts strong upward pressure on prices in the long run, reflecting demand-driven effects, while FDI plays a stabilizing role by lowering prices through efficiency gains. Capital formation reduces prices in the short run but has no lasting effect, and inflation remains largely neutral. The significant error correction mechanism confirms that diesel prices adjust toward long-run equilibrium, albeit gradually.

POLICY RECOMMENDATIONS

➢ *Strengthen Energy Supply Capacity Alongside Employment Growth*

Given the high long-run employment elasticity of diesel prices, policymakers should proactively expand fuel storage, transportation infrastructure, and strategic reserves to prevent demand-driven price surges as the economy grows.

➢ *Leverage FDI for Fuel Market Efficiency*

Government should incentivize FDI into petroleum storage, logistics, and alternative energy infrastructure to deepen competition and reduce distribution costs, thereby sustaining the observed price-stabilizing effects.

➢ *Target Capital Investment Toward Fuel Logistics*

Short-run gains from capital formation suggest that continued investment in roads, pipelines, and fuel depots can help dampen diesel price volatility, especially during periods of rapid economic expansion.

➢ *Enhance Price Adjustment Mechanisms*

The moderate speed of adjustment implies the need for flexible pricing frameworks and timely policy responses to shocks, including temporary tax smoothing or strategic fuel reserves to cushion short-term disequilibria.

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