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Analyzing the Impact of Fuel Rents on Poverty in Egypt

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ABSTRACT

This study investigates the dynamic relationship between fuel rents and poverty in Egypt over the period 1991–2021 using an Autoregressive Distributed Lag (ARDL) model to capture both short-run and long-run effects. Although resource-rich economies like Egypt have the potential to utilize fuel rents to alleviate poverty, empirical findings are often inconclusive due to factors such as price volatility, Dutch disease, and institutional challenges. Employing annual time-series data, the analysis examines how oil rents—as a percentage of GDP—impact poverty levels, controlling for GDP growth and inflation. The results of this paper indicate that, in the short run, fuel rents and macroeconomic variables have statistically insignificant effects on poverty, reflecting complex and delayed transmission mechanisms. However, the overall model demonstrates strong explanatory power, suggesting these variables jointly influence poverty dynamics. The findings contribute to the ongoing debate on the resource curse in Egypt and underscore the importance of prudent fiscal management and complementary policies to convert fuel wealth into sustainable poverty reduction. This research offers valuable insights for policymakers seeking to mitigate resource dependence risks while promoting inclusive economic growth.

Keywords: Fuel rents; Poverty; Egypt; ARDL model

1. Introduction

The persistence of poverty in resource-rich nations presents a critical and often frustrating paradox for development economics. Globally, countries endowed with significant natural wealth, such as oil and gas, theoretically possess the means to catalyze economic growth and substantially alleviate poverty. Yet, the empirical reality frequently diverges, revealing a complex, and at times detrimental, relationship where resource abundance coexists with, or even exacerbates, deprivation. This paper delves into this intricate nexus by conducting a focused empirical investigation into the impact of fuel rents on poverty in Egypt, a nation characterized by substantial hydrocarbon resources alongside deeply entrenched challenges of socio-economic inequality and a pressing need for sustainable development pathways.

Understanding the multifaceted mechanisms through which fuel rents influence poverty is paramount. Fuel rents, representing the surplus revenues from the extraction and export of oil and gas over production costs, are not inherently beneficial or detrimental; their impact is contingent upon a host of mediating factors. On one hand, prudent management of these rents can finance essential public goods, critical infrastructure development, and targeted social programs, thereby directly and indirectly reducing poverty. On the other hand, a heavy reliance on fuel rents can expose an economy to significant volatility tied to fluctuating global commodity prices. It can also precipitate the "Dutch disease" phenomenon, where the booming natural resource sector draws capital and labor away from other tradable sectors like manufacturing and agriculture, potentially hindering diversification and long-term growth. Furthermore, the allure of easily captured rents can foster rent-seeking behaviors, weaken institutional quality and governance structures, and divert resources from productive investments, all of which can perpetuate or worsen poverty and inequality. These dynamics are particularly pertinent in Egypt, a country whose economic trajectory has been significantly shaped by its hydrocarbon sector and which continues to grapple with the policy challenges of translating resource wealth into broad-based improvements in living standards for its populace.

This study aims to empirically assess the dynamic relationship between fuel rents and poverty levels in Egypt, utilizing annual time series data spanning the period from 1991 to 2021. By employing an Autoregressive Distributed Lag (ARDL) modelling approach, this research seeks to rigorously quantify both the short-run and, crucially, the long-run effects of fuel rents on poverty.

The model also incorporates other key macroeconomic determinants of poverty, including Gross Domestic Product (GDP), and inflation to provide a more comprehensive analysis. The central research question guiding this investigation is: To what extent, and through what identifiable economic dynamics, have fuel rents contributed to, or alleviated, poverty within the specific institutional and economic context of Egypt over the past three decades?

The primary contribution of this paper to the existing body of literature is its detailed, country-specific econometric analysis for Egypt, a major economy in the Middle East and North Africa (MENA) region where the interplay between resource revenues and poverty has profound and ongoing policy implications.

2. The Resource-Poverty Nexus: Theoretical Underpinnings

The relationship between natural resource wealth and poverty reduction represents one of the most persistent paradoxes in development economics. While resource abundance theoretically provides the fiscal means to alleviate poverty, empirical evidence reveals a complex and often contradictory relationship that defies simplistic explanations. This theoretical framework section develops a comprehensive model to understand the multifaceted channels through which fuel rents influence poverty outcomes.

The "resource curse" literature has evolved significantly since Sachs and Warner's (1995) seminal work, which documented the counterintuitive negative association between resource abundance and economic growth. Contemporary scholarship has moved beyond this binary relationship to examine the conditional factors and transmission mechanisms that determine whether natural resource wealth becomes a "blessing" or a "curse" for development outcomes (Ross, 2015; Mehlum et al., 2006).

The theoretical approach is grounded in three key insights from the literature. First, it is recognized that the impact of resource wealth on poverty is fundamentally mediated by institutional quality, as emphasized by Acemoglu and Robinson (2012) and Mehlum et al. (2006). Second, the distinction between short-run and long-run effects was incorporated, acknowledging that resource revenues may have different—and sometimes contradictory—impacts across different time horizons (van der Ploeg & Venables, 2013). Third the multiple pathways through which resource rents can influence poverty was explicitly modelled, moving beyond the narrow focus on growth effects that characterized earlier literature (Havro & Santiso, 2011).

This theoretical framework shows four primary transmission channels—fiscal, macroeconomic, institutional, and human capital—through which fuel rents influence poverty outcomes.

2.1 Fiscal Channel: Revenue Allocation and Public Expenditure

The fiscal channel represents how resource revenues are collected, managed, and allocated through government budgets. According to the fiscal linkage theory proposed by Ross (2015), natural resource revenues can reduce poverty when effectively channeled through public spending on social services, infrastructure, and targeted poverty reduction programs. However, as Collier and Hoeffler (2009) argue, resource-rich countries often face challenges in revenue management due to volatility and institutional weaknesses.

2.2 Macroeconomic Channel: Dutch Disease and Structural Effects

The macroeconomic channel encompasses the broader economic effects of resource dependence on economic structure, prices, and employment. The Dutch Disease theory, as formalized by Corden and Neary (1982), explains how resource booms can lead to real exchange rate appreciation, making non-resource tradable sectors less competitive internationally. This can result in premature deindustrialization and reduced employment opportunities, particularly for low-skilled workers (Rodrik, 2016).

2.3. Institutional Channel: Governance Quality and Rent-Seeking

The institutional channel focuses on how resource wealth affects the quality of governance, which in turn influences poverty outcomes. The "resource curse" literature, pioneered by Sachs and Warner (1995) and expanded by Mehlum et al. (2006), emphasizes that institutional quality determines whether resource abundance becomes a blessing or a curse. Weak institutions can lead to rent-seeking behavior, corruption, and policy distortions that undermine poverty reduction efforts.

2.4. Human Capital Channel: Education, Health, and Capabilities

The human capital channel considers how resource wealth affects investments in education, health, and other capabilities that enable people to escape poverty. Sen's (1999) capabilities approach provides a theoretical foundation for understanding poverty not just as income deprivation but as capability deprivation. Resource revenues can potentially finance human capital investments, but as Gylfason (2001) argues, resource-dependent countries often underinvest in education.

These four channels do not operate in isolation but interact in complex ways that evolve over time. Building on Havro and Santiso's (2011) work on successful resource management, this paper proposes an integrated dynamic framework where institutional quality serves as the central mediating factor that determines how effectively fuel rents can be translated into poverty reduction.

3. Literature Review

The relationship between natural resource wealth—particularly fuel rents—and poverty has been extensively examined in development economics. The literature reveals a nuanced interplay: while natural resources can provide governments with substantial revenue to finance poverty alleviation, they may also exacerbate inequality and underdevelopment in the absence of strong institutions and effective redistribution mechanisms. A substantial body of research has explored the macroeconomic consequences of resource rents, particularly in oil-exporting countries. The "resource curse" or "paradox of plenty" literature suggests that abundant resource revenues, especially in countries with weak institutions, often fail to translate into sustainable development or poverty reduction (Sachs & Warner, 2001; Bainomugisha et al., 2006). Contributing factors include rent-seeking behavior, economic volatility, and poor fiscal management. Studies of countries such as Nigeria and Venezuela demonstrate how mismanaged oil revenues have intensified inequality and failed to improve living standards (Agu & Nyatanga, 2020; Musgrove, 1981).

Nevertheless, resource wealth can support poverty reduction when effectively managed. For instance, Prabowo et al. (2022) show that channeling fuel rents toward productive public spending or targeted social transfers can yield positive outcomes. These findings highlight that the relationship between natural resources and poverty is not deterministic but contingent on governance quality and institutional effectiveness. Despite the depth of existing research, relatively few studies examine fuel rents as a share of GDP—a macroeconomic indicator of national resource income—as opposed to consumer fuel prices or household-level welfare impacts. This study addresses that gap by evaluating the influence of aggregate fuel rents on national poverty rates in Egypt over time.

A separate but related body of literature focuses on the effects of fuel prices and energy subsidies, especially in developing countries where energy affordability is critical. Numerous studies find that rising fuel prices disproportionately burden low-income households. For example, Siddig et al. (2014) and Ersado (2012), using CGE and microsimulation models, find that the removal of fuel subsidies increases poverty in Nigeria and Armenia, respectively. Similarly, research on Indonesia by Sumantri (2022) and Adam et al. (2018) shows that fuel price hikes significantly worsen poverty, with the most severe impacts felt by rural and low-income populations. Several studies also underscore the heterogeneous effects of energy price shocks. Nganou et al. (2009) and Renner et al. (2019) find that women-headed households and rural residents are especially vulnerable. Krauss (2016) points to methodological challenges in estimating these impacts, including potential biases in measuring price and welfare responses. While these micro-level studies offer important insights into distributional effects, they provide limited guidance on how national poverty outcomes evolve in response to aggregate fuel revenue trends.

Beyond energy-specific analyses, another strand of literature explores how broader macroeconomic variables—such as inflation, growth, and public debt—interact with poverty. Chakravarty and Mitra (2010) argue that inflation, particularly when driven by rising fuel prices, can offset the benefits of economic growth for the poor. Faridi et al. (2021) show that oil price shocks, combined with high debt burdens, have exacerbated poverty in Pakistan. Although Raouf (2022) does not directly address poverty, the study links rising public debt in OECD countries to changes in the energy mix, with implications for long-term affordability and access. Collectively, these findings emphasize that macroeconomic volatility—whether stemming from fuel price instability or fiscal imbalances—can undermine poverty reduction efforts, even in resource-rich contexts.

Although Egypt is a significant hydrocarbon producer in the MENA region, few academic studies have directly linked fuel rents to poverty dynamics in the country. Most existing research focuses on energy subsidies, or the liberalization policies implemented after Egypt's 2014 economic reform program (e.g., World Bank, 2014; IMF, 2018). While these reforms contributed to fiscal consolidation, they also raised concerns about regressive impacts on vulnerable populations. Given Egypt's historical dependence on energy subsidies, its sizable oil and gas revenues, and enduring poverty challenges, a macroeconomic time-series investigation of this relationship is both timely and warranted.

This study contributes to the literature in three keyways. First, it shifts the analytical focus from household-level impacts and price-based policies to a macroeconomic perspective on fuel rents, measured as a share of GDP. Second, it employs an ARDL time-series methodology to assess both short-run and long-run effects, offering insights that complement the static or micro-focused models used in earlier work. Third, by focusing on Egypt—a resource-rich but under-researched country in this context—it fills a critical empirical gap in the literature on natural resources and poverty in the MENA region.

4. Methodology

This study employs an econometric time-series approach to investigate the dynamic relationship between fuel rents and poverty. The analysis focuses on understanding both the short-run and long-run effects of oil rents—expressed as a percentage of GDP—on national poverty levels. To achieve this, the Autoregressive Distributed Lag (ARDL) model developed by Pesaran et al. (2001) is used, given its suitability for small sample sizes and its ability to accommodate regressors that are integrated of different orders (i.e., I(0) or I(1)) but not I(2). This modeling strategy allows for the simultaneous estimation of short-run dynamics and long-run equilibrium relationships within a single reduced-form equation.

4.1 Data and Descriptive Statistics

This study analyzes annual time-series data for Egypt covering the period 1991-2021. The dependent variable, poverty level (P), represents the percentage of Egypt's population living below the national poverty line as measured by the United Nations Economic and Social Commission for Western Asia (ESCWA). The primary explanatory variable, oil rents (Oil), captures total hydrocarbon revenues (including crude oil, natural gas, and coal) expressed as a percentage of GDP, with data sourced from the World Bank's World Development Indicators.

To control for broader economic conditions, the model includes two key macroeconomic indicators from World Bank datasets: (1) GDP growth rate, measured as the annual percentage change in real Gross Domestic Product, and (2) inflation rate, calculated as the annual percentage change in the Consumer Price Index. Table 1 provides a summary of these variables and their data sources.

Table 1: Variable Definitions and Sources

Code	*Variable*	*Unit*	*Source*
P	Poverty Level	Percentage	ESCWA
Oil	Oil Rents	Percentage	WB
GDP	Gross Domestic Product	Percentage	WB
Inf	Inflation	Percentage	WB

The descriptive statistics in Table 2 reveal important patterns in our dataset. Over the 31-year study period, Egypt's average poverty rate stood at 37.3% of the population, with values ranging from a minimum of 30.6% to a maximum of 42.5%. Oil rents averaged 7.19% of GDP but showed considerable volatility, peaking at 12.46% during periods of high global commodity prices. Macroeconomic indicators also exhibited significant variation - GDP growth averaged 4.32% annually but fluctuated between 1.13% and 7.16%, while inflation averaged 9.88% with spikes reaching 22.93%. These statistics highlight the dynamic economic environment that has shaped poverty outcomes in Egypt during our study period.

Table 2: Descriptive Statistics

	GDP	INFLATION	OIL	POVERTY
Mean	4.319428	9.884742	7.188194	0.373097
Median	4.372019	9.876000	7.418000	0.379000
Maximum	7.156284	22.93300	12.45500	0.425000
Minimum	1.125405	0.919000	1.858000	0.306000
Std. Dev.	1.563097	5.543005	3.049082	0.030754
Skewness	-0.026911	0.611367	0.052066	-0.479331
Kurtosis	2.372313	2.942107	2.013464	2.589375
Jarque-Bera	0.512647	1.935472	1.271125	1.404876
Probability	0.773892	0.379942	0.529638	0.495376

Source: the author using E-views 10

4.2 Unit Root Test

Prior to model estimation, the time-series properties of all variables are examined using unit root tests to determine their order of integration. Stationarity refers to the property of a time series where its mean and covariance remain constant over time. The most applied method to test for stationarity is the Augmented Dickey-Fuller (ADF) test, which evaluates the null hypothesis that the series has a unit root against the alternative that it is stationary. (Raouf, 2016)

The results, presented in Table 3, indicate that poverty (P), and oil rents (Oil) are non-stationary at their levels but became stationary after first differencing I(1). Inflation (Inf) and GDP growth rate (GDP) are found to be stationary at their levels I (0). This mixed order of integration (I(0) and I (1)) supports the choice of the ARDL modelling approach for estimation.

Table 3: Unit Root Test Results (Augmented Dickey-Fuller)

Variable	*Level*	*1ST Difference*
Poverty	-2.12 (0.23)	-2.80 (0.07)
Oil Rents	-1.93 (0.31)	-5.29 (0.00)
GDP	-3.249 (0.0268)	-6.27 (0.00)
Inflation	-3.13 (0.03)	-4.11 (0.00)

Source: the author using E-views 10

4.3 ARDL Model Specification

This study employs an econometric time-series approach to investigate the dynamic relationship between fuel rents and poverty in Egypt over the period from 1991 to 2021. The analysis focuses on understanding both the short-run and long-run effects of fuel rents—expressed as a percentage of GDP—on national poverty levels. To achieve this, the Autoregressive Distributed Lag (ARDL) model, which is developed by Pesaran et al. (2001), is utilized, given its suitability for small sample sizes and its ability to accommodate regressors that are integrated of different orders (i.e., I(0) or I(1)) but not I(2). This modeling strategy allows for the simultaneous estimation of short-run dynamics and long-run equilibrium relationships within a single reduced-form equation.

The ARDL approach offers several advantages. First, it does not require all variables to have the same order of integration, which is particularly valuable given the mixed integration orders in our dataset. Second, it provides consistent estimates even with relatively small sample sizes, which is relevant given our 31-year study period. Third, it addresses potential endogeneity through the inclusion of lagged dependent and independent variables. Fourth, it allows for the direct estimation of both short-run and long-run relationships, facilitating a comprehensive understanding of how fuel rents affect poverty over different time horizons.

The general form of the ARDL (p, q) model for this study is specified as follows:

$$P_t = a_0 + \sum_{i=1}^{p} a_i P_{t-i} + \sum_{j=0}^{q_1} \beta_{1j} Oil_{t-j} + \sum_{j=0}^{q_2} \beta_{2j} GDP_{t-j} + \sum_{j=0}^{q_3} \beta_{4j} Inf_{t-j} + \epsilon t$$

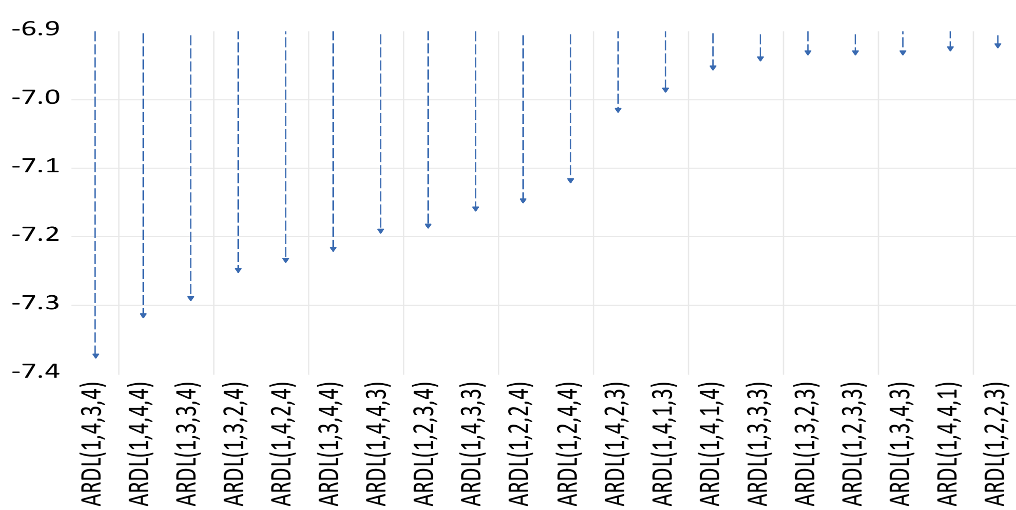
Where:

- P_t: Poverty level at time t (dependent variable).
- Oil_t: Oil price at time t.
- GDP_t: Gross Domestic Product at time t.
- Inf_t: Inflation rate at time t.
- ϵ_t: Error term at time t.

4.3.1 The Optimal Number of Lags

The appropriate lag structure is crucial for capturing the dynamic relationships between variables in time series analysis. A systematic approach to lag selection using the Akaike Information Criterion (AIC) has been employed, which balances model fit against parsimony. The maximum lag length is set at 4 for all explanatory variables, given the annual frequency of our data and the relatively short time series.

Figure (1): Akaike Information Criteria (top 20 models)



Source: the author using E-views 10

Figure (1) illustrates the top 20 ARDL models ranked by their AIC values. The model ARDL (1, 4, 3, 4) yields the lowest AIC value, indicating it as the optimal specification. This result confirms the importance of including sufficient lagged terms to account for delayed effects among the macroeconomic variables and poverty dynamics. The selected model thus includes one lag for the dependent variable and four, three, and four lags for the independent variables respectively, ensuring the model captures both short-run fluctuations and long-run relationships.

4.3.2 Bound Test

Before proceeding with the estimation of long-run relationships, a test for the existence of cointegration among the variables using the bounds testing procedure proposed by Pesaran et al. (2001) has been conducted. This approach involves estimating an unrestricted error correction model (UECM) and testing the joint significance of the lagged level variables.

The null hypothesis of no cointegration (H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$) is tested against the alternative hypothesis (H_1: at least one $\delta_i \neq 0$) using an F-test. The computed F-statistic is compared with the critical value bounds provided by Pesaran et al. (2001).

Table 4: Bounds Test for Cointegration

Test Type	Test Statistic	Value
F-statistic	F(4, 23)	**16.075881**
t-statistic	**t**	**-3.159000**

Source: Authors' calculations using EViews 10

Table 4 shows that the computed F-statistic of 16.076 substantially exceeds the upper bound critical value at the 1% significance level, providing strong evidence of a long-run equilibrium relationship among the variables. The t-statistic of -3.159 also supports this conclusion, as it exceeds the critical value in absolute terms.

These findings confirm the presence of cointegration, validating the use of the ARDL approach to estimate both short-run and long-run dynamics. The existence of a long-run relationship implies that although the variables may deviate from equilibrium in the short run, they tend to converge toward a stable equilibrium over time.

4.3.3 Estimation Results and Diagnostics

- **Short-Run Dynamics**

The error correction model captures both the short-run dynamics and the speed of adjustment toward long-run equilibrium. Table 5 presents the results of the error correction model, which was estimated using the sample period 1995-2021 with 27 observations.

Table 5: Error Correction Representation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.173863	0.019219	-9.046593	0.0000
D(GDP)	9.46E-05	0.000806	0.117334	0.9083
D(GDP(-1))	0.005072	0.000858	5.913205	0.0000
D(GDP(-2))	0.002690	0.000852	3.158454	0.0070
D(GDP(-3))	0.001674	0.000813	2.059510	0.0585
D(INFLATION)	0.000591	0.000222	2.663054	0.0186
D(INFLATION(-1))	0.000989	0.000260	3.796927	0.0020
D(INFLATION(-2))	0.000418	0.000204	2.051850	0.0594
D(OIL)	0.000439	0.000594	0.738629	0.4723
D(OIL(-1))	0.000270	0.000585	0.460414	0.6523
D(OIL(-2))	0.002172	0.000605	3.588976	0.0030
D(OIL(-3))	0.001575	0.000646	2.438234	0.0287
C	0.106468	0.011976	8.890033	0.0000

Note: p-values are incompatible with t-Bounds distribution. Source: Authors' calculations using EViews 10

The error correction term (COINTEQ) is negative and statistically significant at the 1% level, confirming the existence of a stable long-run relationship. The coefficient of -0.173863 indicates that approximately 17.4% of any disequilibrium between the actual and equilibrium poverty level is corrected within one year. The relatively slow adjustment speed suggests that poverty levels in Egypt respond gradually to shifts in macroeconomic conditions, including changes in fuel rents.

The short-run dynamics reveal interesting patterns. While contemporaneous changes in GDP and fuel rents have statistically insignificant effects on poverty, their lagged differences show significant impacts. Notably, the first lag of GDP growth has a positive and highly significant coefficient (0.005072), suggesting that the benefits of economic growth take time to translate into poverty reduction. Similarly, the second and third lags of fuel rents have positive and significant coefficients, indicating complex transmission mechanisms between resource revenues and poverty outcomes.

- **Long-Run Relationships**

Following the confirmation of cointegration, the long-run relationships between the variables have been estimated. The long-run coefficients are derived from the level relationship of the ARDL model and represent the equilibrium effects of the explanatory variables on poverty.

Table 6: Long-Run Coefficients

*Variable **	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
GDP(-1)	*-0.020523*	*0.012438*	*-1.650040*	*0.1120*
INFLATION(-1)	*-0.005365*	*0.002015*	*-2.662416*	*0.0136*
OIL(-1)	*-0.015161*	*0.006054*	*-2.504215*	*0.0195*

*Note: * Coefficients derived from the CEC regression.*

Source: Authors' calculations using EViews 10

The long-run coefficients provide meaningful insights into the structural determinants of poverty in Egypt. The negative coefficient for inflation (-0.0054), although initially counterintuitive, may be explained by Egypt's economic context. Periods of moderate inflation have often coincided with expansionary fiscal policies, including increased government expenditure on infrastructure and social welfare, which could counteract inflation's adverse effects on poverty. Moreover, Egypt's large informal economy may buffer low-income households through wage flexibility and informal price adjustments. Additionally, measurement issues may arise if nominal income rises faster than consumer prices in certain sectors, temporarily improving poverty metrics.

The long-run negative coefficient for fuel rents (-0.0152) is consistent with fiscal linkage theory. It suggests that sustained fuel revenues, when effectively managed, support pro-poor investments in public infrastructure, education, healthcare, and targeted subsidies. However, the insignificance of short-run fuel rent effects likely reflects policy lags—such as bureaucratic delays or the time needed for oil revenues to be converted into development spending. Moreover, fuel subsidies and stabilization mechanisms historically used in Egypt may have shielded households from immediate oil price fluctuations.

These findings emphasize the temporal dimension of resource wealth impacts: while fuel rents do not yield immediate benefits for poverty reduction, they can significantly contribute to long-term improvements when embedded within sustained fiscal frameworks.

4.4 Diagnostic Tests

To validate the robustness and reliability of the ARDL model estimation, several diagnostic tests were performed to examine key assumptions underlying the regression analysis.

Table 7: Diagnostic Test Results

Test	Statistic	Probability
Breusch-Godfrey Serial Correlation LM Test	1.498716	0.2743
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.752393	0.7016
Jarque-Bera Normality Test	1.316781	0.517684
Ramsey RESET Test	1.006350	0.3380

Source: Authors' calculations using EViews 10

First, the Breusch-Godfrey Serial Correlation LM test was applied to detect whether there is any presence of serial correlation in the residuals up to two lags. Serial correlation occurs when the error terms are correlated across observations, which can lead to inefficient estimates and invalid inference. The null hypothesis of this test states that no serial correlation exists. The obtained F-statistic value of approximately 1.5 with a corresponding p-value of 0.2743 is above the conventional significance level of 0.05, meaning we fail to reject the null hypothesis. This result suggests that the model residuals do not suffer from serial correlation, indicating that the error terms are independent over time, which is a desirable property in time series analysis.

Next, the Breusch-Pagan-Godfrey test was conducted to assess the assumption of homoscedasticity, that is, whether the variance of the residuals remains constant across all levels of the explanatory variables. Heteroskedasticity, or non-constant variance, can cause standard errors to be biased, affecting hypothesis testing. The test returned a statistic of 0.75 with a high p-value of 0.7016, which again is well above the usual 5% threshold. This leads us to accept the null hypothesis of homoscedasticity, indicating that the residuals have constant variance and the model does not suffer from heteroskedasticity problems.

The Jarque-Bera normality test was performed to check if the residuals follow a normal distribution, which is an important assumption for conducting reliable inference in regression analysis. The test statistic of 1.32 with a p-value of 0.52 suggests that we cannot reject the null hypothesis that the residuals are normally distributed. Normality of residuals supports the validity of t-tests and F-tests used for hypothesis testing within the model.

Lastly, the Ramsey RESET test was used to verify whether the model suffers from any functional form misspecification, such as omitted variables or incorrect nonlinear relationships. This test adds powers of the fitted values to the regression to detect any such misspecification. The F-statistic was approximately 1.01 with a p-value of 0.3380, indicating no evidence to reject the null hypothesis of correct model specification. This means that the selected ARDL model adequately captures the relationship among variables without missing important explanatory terms.

In summary, these diagnostic tests collectively indicate that the estimated ARDL model is well-specified and meets the key classical regression assumptions. There is no indication of serial correlation or heteroskedasticity in the residuals, the residuals appear to be normally distributed, and the model form is correctly specified. These results enhance the credibility of the long-run coefficient estimates and the overall reliability of the model findings.

5. Conclusion

This study examines the relationship between fuel revenues and poverty in Egypt over a thirty-year period using advanced econometric modeling. The analysis highlights a crucial distinction between short-term and long-term effects: changes in fuel income have little immediate impact on poverty but exhibit a clear and significant influence over longer horizons. This pattern suggests that poverty levels in Egypt adjust gradually to economic shifts, with impacts accumulating over time rather than manifesting suddenly.

The findings reinforce that possessing fuel resources alone does not guarantee poverty reduction; careful and strategic management of these revenues is essential to achieving meaningful improvements in living standards.

The study's insights have direct relevance to Egypt's progress toward several Sustainable Development Goals (SDGs). The long-run negative relationship between fuel rents and poverty supports SDG 1 (No Poverty), indicating that well-managed resource revenues can contribute to poverty alleviation. However, the delayed nature of these effects poses challenges for meeting SDG targets by 2030 without faster policy action. Furthermore, the complex interplay between fuel dependence and economic diversification relates closely to SDG 8 (Decent Work and

Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure). Policy recommendations for enhanced resource governance also align with SDG 16 (Peace, Justice, and Strong Institutions), particularly Target 16.6, which calls for accountable and transparent institutions. By addressing the fuel rents-poverty nexus through an SDG framework, this research supports Egypt's integrated approach to sustainable development as outlined in Vision 2030.

To maximize the poverty-reducing potential of fuel revenues, Egypt should pursue a set of complementary strategies. Establishing a dedicated national investment fund would enhance resource income management and secure long-term societal benefits. Replacing broad fuel subsidies with targeted assistance programs can better support vulnerable populations. Maintaining price stability through sound economic policies will protect households from sudden shocks. Promoting diversification by developing non-oil industries—especially those that generate employment across various skill levels—would strengthen economic resilience. Facilitating small business growth via improved access to finance and streamlined regulations can boost broader economic participation. These measures are most effective when implemented together in a coordinated manner.

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