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Effects of fuel prices on economic activity: Evidence from Sudan

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ABSTRACT

The impact of fuel prices on economic activity is a multifaceted phenomenon. Generally, an upward trend in fuel prices has the potential to impede economic growth, concurrently diminishing consumer expenditure on alternative commodities and services. The objective of this study is to scrutinize the influence of fuel prices on economic activity within Sudan, covering the period from 2000 to 2021. Employing a descriptive methodology, the study delineated the observed phenomenon, while employing a standard analytical approach for data analysis. The study yielded several noteworthy findings. Notably, at a confidence level of 1%, there was a statistically significant impact of fuel prices on oil revenues, as evident from the correlation coefficient of 0.628. Specifically, a 1% increase in fuel prices corresponded to a 0.099% increase in Sudan's oil revenues. Moreover, the study ascertained that the level of fuel prices significantly affected economic growth, whereby a 1% increase in fuel prices resulted in a 0.096% reduction in Sudan's economic growth rate. These findings align with previous research. Consequently, elevated fuel prices incur escalated transportation costs, amplifying the expenses associated with production and transport for businesses. Furthermore, higher fuel prices can instigate inflationary pressures, as the augmented transportation costs contribute to increased production expenses. Ultimately, this can constrain consumer spending, as individuals have limited disposable income for non-essential items. Conversely, lower fuel prices can engender heightened economic activity, granting consumers greater purchasing power for alternative goods and services.

1. Introduction

Energy plays a pivotal role in the broader context of economic growth, thereby warranting special attention within the field of economics. In economic terms, any resource or raw material possessing a substantial amount of physical energy is categorized as an "energy" resource. Economic analysis predominantly focuses on the process of value creation in production, rather than the specific energy flows or physical labor involved (Ayres and Van Den Bergh, 2005). Among the critical factors influencing civilization and essential for global economic advancement is the affordability of energy. Energy resources stand as one of the most influential assets, shaping the economic, social, and political trajectories of nations and regions. However, despite the undeniable necessity of energy consumption for economic growth, the dynamic expansion of the global economy has led to a marked surge in energy demand in recent years (Gao and Zhu, 2019; Brodny and Tutak, 2020; Bednář et al., 2022).

The following details can be noted when examining the connections between the economy and energy: Energy efficiency and affordable energy are both essential for economic growth (Fouquet, 2014). When viewed historically, the availability of a relatively cheap energy source like coal is viewed as a major contributor to the industrial revolution in Britain and later on in the world (Allen, 2009). The amount of GDP and the amount of energy used in the economy have a clear, long-term link. It is obvious that this link lessens for nations with medium and high consumption levels of energy, but it is still significant for nations with lower levels of energy consumption. This is due to the more effective utilization of energy in highly developed nations. Because of advancements in technology, domestic output growth has outpaced that of energy production. According to Henri (2017), the volume

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of the product per unit of energy consumption roughly doubled during the 20th century. Changes in GDP and changes in energy consumption have a definite short-term link. Given their significant economic and social ramifications, understanding how and by how much changes in gasoline costs affect consumer price inflation and the varied impact on households is essential for policymaking.

While analysts believe that these inflationary pressures were largely transitory in advanced economies due to supply-demand imbalances brought on by the pandemic and a base effect from a recovery in commodity prices, they are likely to persist in emerging and developing nations due to higher oil and food prices and exchange rate depreciation. Crude oil prices, which fell to less than $10 per barrel in March 2020, rose to more than $80 per barrel by October 2021, a figure far higher than before the epidemic. Additionally, the surge took place in the context of the world's openness and aggressive supply control by oil-producing nations. Increased inflationary pressures brought on by rising oil prices could result in an early tightening of financial conditions globally, posing serious threats to the post-COVID-19 global recovery. Because households do not consume goods and services in the same ratio, their reactions to changes in fuel prices in the price of their goods and services basket will vary. It is well known that the poor spend a large percentage of their income on food, which makes them particularly vulnerable to shocks in fuel prices because, primarily due to transportation costs, food prices are highly sensitive to changes in fuel prices. The scale of the pass-through is smaller but more enduring in developing countries than in advanced economies, and increases in fuel prices are linked to higher inflation. Finally, as a result of this persistence, changes in gasoline prices have a bigger effect on consumer price levels in developing economies. Transport CPI stands out as the component of the CPI that is, predictably, the most sensitive to fuel prices in both advanced and emerging nations (Kpodar and Liu, 2022). High fuel costs are now frequently cited as a major obstacle to the growth of the economy. Due to their economic circumstances, the industrialized countries of the world can resist the negative impacts of an oil price shock. On the other hand, developing nations are the ones who suffer the most from a lack of oil-saving technology and methods for replacing oil in the industrial process, it would seem evident that gasoline prices and economic growth are related.

The prevailing theory in the literature holds that while fuel prices affect inflation, they hurt economic growth (Przekota, 2022). Environmental protection is given a lot of consideration in this context, which is why policymakers are advised to support initiatives that lower oil consumption and encourage the use of renewable energy sources to spur economic growth. This is said to safeguard economies against changes in global oil prices and inflation while also assisting in the sustainable environmental goal of lowering oil usage (Sarmah and Bal, 2021).

Sudan is a country located in the northeast corner of Africa, bordered by Egypt, Eritrea, Ethiopia, South Sudan, Central African Republic, Tchad, and Libya. It is the third largest country in Africa and has a population of over 40 million people. Sudan has a long history of economic instability due to its reliance on oil exports for revenue. In recent years, fuel prices have been a major factor in the country's economic activity. The purpose of this paper is to examine the impact of fuel prices on economic activity in Sudan and discuss potential solutions to help improve the country's economic situation. The rest of this paper falls into the following sections: section two reviews the literature. Section three presents the research methodology and hypotheses. Section four reports the applied framework. The conclusion remarks and recommendations are presented in section five.

2. Literature review

The price of oil and the rate of inflation are theoretically positively correlated, this is because oil is the primary raw material for all economies, and an increase in its price (input costs) will undoubtedly have a beneficial effect on the price (costs) of finished products. According to studies in this field, there is a high correlation between the two (Bobai, 2012), although there are also reports that the impact varies depending on how long the observed price period is (Sek et al., 2015). The condition is heavily influenced by the nation's level of economic development (Taghizadeh-Hesary et al., 2016). According to studies on how inflation reacts to changes in fuel prices, inflation is positively and significantly impacted by an increase in oil prices whereas inflation is not significantly impacted by a decrease in oil prices. On the other hand, inflation slows while output levels rise dramatically when the pace of increase in energy prices is relatively sluggish (Pelin and GÃœNEY, 2013). As the economy switched from coal to oil over the past 200 years, its vulnerability to supply shocks has decreased significantly (van de Ven and Fouquet, 2017; Kilian, 2009). The economic effects of energy costs, especially the price of oil, in the post-war period have been extensively analyzed. Several studies have shown that the rise in oil prices has a significant negative impact on GDP (Bildirici et al., 2009), although energy importers have a net positive result impact (Lafakis et al., 2015).

There is an unbalanced relationship between domestic goods and oil prices, according to several studies. Price rises have a greater impact than price cuts (Lardic and Mignon, 2008). It is possible that endogenously determining impacts on the part of monetary policy account for a large portion of the recessionary consequences of oil price increases rather than actual changes in oil prices. As a result of rising inflation brought on by the increase in oil prices, central banks tightened monetary policy

(Hunt et al., 2002; Przekota, 2022). The effect of fuel costs on inflation was the subject of numerous in-depth research. Indeed, Chou and Tseng (2011) discovered that oil prices have a significant long-run impact on CPI inflation in China, India, Indonesia, Jordan, Korea, Malaysia, Pakistan, the Philippines, Singapore, Taiwan, and Turkey, but no short-run impact was shown. Oil prices were discovered to have a long-lasting impact on inflation in Europe (Cuñado and de Gracia, 2003). In contrast, Du et al. (2010) discovered that inflation is more susceptible to changes in gasoline prices in less developed nations than in highly developed countries. Particularly, the United States is mentioned as a nation where inflation is not extremely sensitive to changes in fuel prices. The same study also revealed that European Union members lacked a high level of sensitivity (Przekota, 2022).

It is general knowledge that prices of gasoline have an asymmetrical impact on inflation (Long and Liang, 2018), in a study of the Chinese economy, based on the autoregressive ARDL and asymmetric autoregressive NARDL models, it was discovered that the long-term effects of global oil price fluctuations on CPI and PPI price indices are asymmetric, and the effects of rising global oil prices on PPI and CPI are greater than the effects of falling global oil prices on falling PPI and CPI indices. This suggests that inflationary changes persist even with falling oil prices. The same methodology was used to draw similar conclusions about India. India is an intriguing case because it was discovered that fluctuations in oil prices affected inflation there more so than changes in the amount of money in circulation did (Pandey and Shettigar, 2016). In that regard, Le and Nguyen (2019) looked at the relationship between energy security and economic growth for a global sample of 74 nations from 2002 to 2013. To capture issues of energy security, they employed an expanded version of the Cobb-Douglas production. According to the study, both the entire sample and specific country subsamples have greater economic growth when there is energy security. Economic growth is hampered by energy insecurity as indicated by energy intensity and carbon intensity variables. Mensah et al. (2019) used a PMG panel ARDL technique to investigate the relationship between economic growth, fossil fuel energy consumption, CO_2 emissions, and oil price in Africa. The results showed a bilateral causal relationship between the use of fossil fuels and economic growth as well as a bilateral causal relationship between the use of fossil fuels and carbon emissions in the long and short term for all panels, in addition to a unilateral causal relationship between carbon emissions and economic growth in the long and short terms for non-oil exporters.

According to Talha et al. (2021), oil prices, energy consumption, and economic growth had a substantial impact on Malaysia's inflation rates. Economic development and the cost of non-renewable energy both have a significant impact on the shift to renewable energy, according to empirical findings from (Li and Leung, 2021). As a result, while calculating economic output, capital, labor, and the consumption of renewable energy all play a role, no Granger causality was found between the use of renewable energy and economic production, according to the results. Hordofa et al. (2022) discussed how the industrialized world also felt the effects of this pandemic similarly. The research sought to assess the impact of natural resource rents-including those from oil, natural gas, and energy on the economic performance of the G7 economies between 1990 and 2020. The study used unique diagnostic and unit root methodologies to identify the impact of COVID-19, utilizing updated panel data methods. The findings revealed a deterioration in economic performance both during and after COVID-19. According to the study, the rent from natural resources like oil and gas contributes to increased economic performance.

To calculate the percentage of the United States' gross domestic product that is spent each year on fuels, including nuclear ore, and fossil fuels, and the development of the economy, Aucott and Hall (2014) analyzed fuel consumption and cost, the study discovered an inverse correlation between these variables and showed that an important factor affecting economic success is the cost and availability of energy. It was thought the link was compatible with studies using the energy return on investment concept, which holds that more expensive and scarce fuels constitute a drag on economic growth. A threshold in the neighborhood of 4% is suggested by the best-fitting linear equation between the percent of GDP (energy cost share) and year-over-year GDP change variables; if the percent of GDP spent on fuels is higher than this, weaker economic performance is likely to occur. Recently, increasing energy prices, notably fuel prices, have received a lot of attention. Numerous studies highlighted the harm that this poses to economic growth, but similar circumstances have historically occurred. As a result, Przekota (2022) presented the simple query: How do gasoline prices affect commerce and economic growth? The study's foundation was the Polish economy from 2000 until 2020. Indeed, Poland imports energy products, thus it should react strongly to changes in the gasoline price. For the Polish economy's fuel costs, maritime trade, gross domestic product, and inflation, a VAR model was developed. The findings show that the Polish economy is extremely resistant to market volatility. Naturally, when fuel prices are lower, it is simpler to function, but high prices are not an emergency. In addition, continued technical advancement makes it easier for economies to weather fuel market crises than they did in the 20th century. Therefore, it is clear that a country's development does not depend on having cheap fuel. Higher fuel costs may help an economy grow, and the fear of rising fuel costs only serves to accelerate the inflationary process. From the literature review, we conclude that fuel prices have an impact on the global economy and developing countries specifically, and rising fuel prices can have a significant negative impact on economic activities. Unlike in advanced economies, the impact of fuel prices can be less impactful. The impact of rising fuel prices also affects both monetary and fiscal policy, economic growth, GDP, and the inflation rate.

3. Methodology and hypotheses

The research will use a set of approaches that are commensurate with the objectives of the research and achieve its purpose. Indeed, the research will use the descriptive approach to suit the subject of the research, through which the phenomenon to be studied is described. It will also use the standard analytical approach, through which standard methods are used to analyze research data by using Eviews.

The main hypothesis is: There is a statistically significant effect of fuel prices on economic activity. While the sub-hypotheses are:

- There is a statistically significant effect of fuel prices on oil rents.
- There is a statistically significant effect of fuel prices on the economic growth rate.
- There is a statistically significant effect of fuel prices on the GDP per capita.
- There is a statistically significant effect of fuel prices on the inflation rate.
- There is a statistically significant effect of fuel prices on exports.
- There is a statistically significant effect of fuel prices on imports.

4. Applied framework

The primary focus of this study is to investigate the influence of fuel prices on economic activity in Sudan within the timeframe spanning from 2000 to 2021. In order to accomplish the main objective of this research, an analysis is conducted to examine the impact of fuel prices on various economic indicators in Sudan, namely oil rents, the rate of economic growth, GDP per capita, inflation rate, exports, and imports. The research also seeks to establish the associations between the independent variable, which is fuel prices, and the dependent variables, which encompass oil rents, the rate of economic growth, GDP per capita, inflation rate, exports, and imports. This is achieved by calculating a simple regression equation to assess the relationship between fuel prices and the aforementioned economic indicators in Sudan (Hassan and Abdullah, 2015).

4.1. Sudan's fuel prices and economic indicators (2000-2021)

A. Fuel prices: From the study of the data presented in Table 1, it was found that Fuel Prices during the period (2000-2021) ranged between two limits, the lowest of which was about 21.30 ($/barrel) in 2001, a maximum of about 111.60 ($/barrel) in 2012, the annual average value reached approximately 63.88 ($/barrel) and the increase rate during the study period was 4% (Fig. 1).

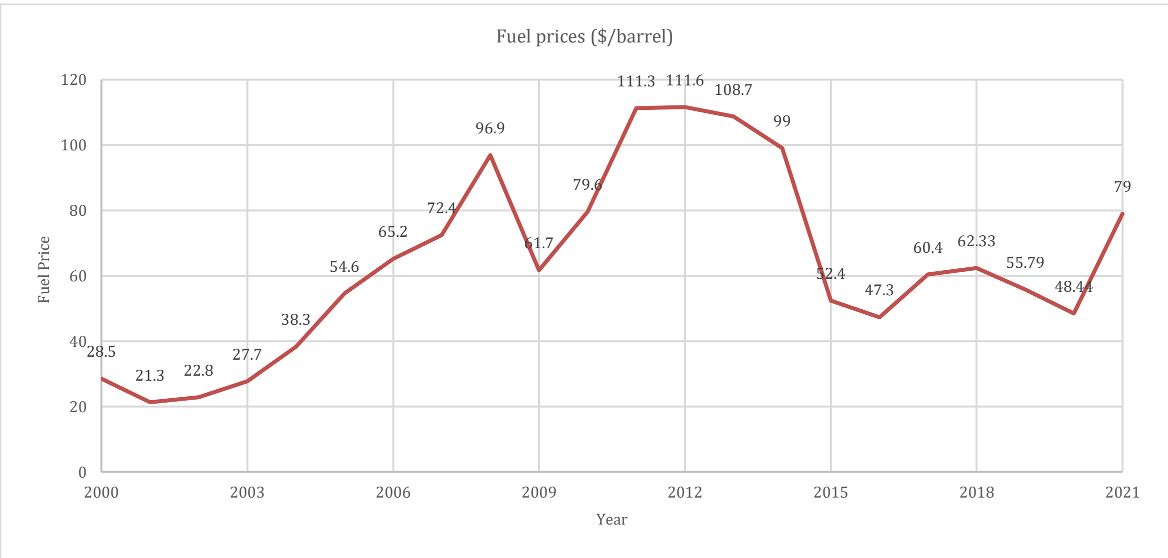

Fig. 1: Fuel prices during the period (2000-2021)

B. Oil rents: Table 1 presents that oil rents in Sudan during the period (2000-2021) ranged between two limits, the lowest of which was about 0.79 billion $ (In 2021), with a maximum of approximately 17.60 (Billion $). In 2011, the annual average value reached about 4.44 billion $ and the decrease rate during the study period was 2.4% (Fig. 2).

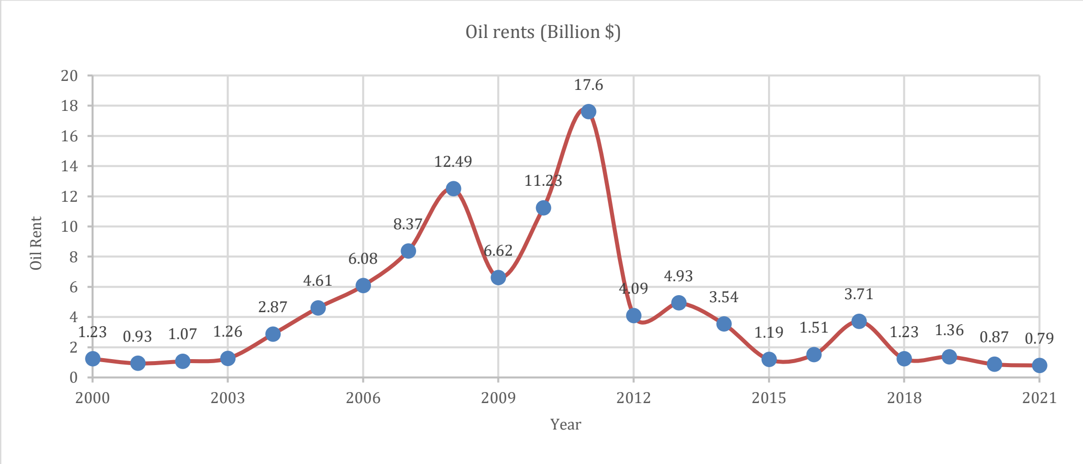

Fig. 2: The oil rents in Sudan during the period (2000-2021)

C. The economic growth rate: From data presented in Table 1, it was found that the rate of economic activity during the period (2000-2021) ranged between two limits, the lowest of which was about–17% in 2012, a maximum of about 6.53% in 2000, the annual average value reached about 1.69% and the decrease rate during the study period was 44.4% (Fig. 3).

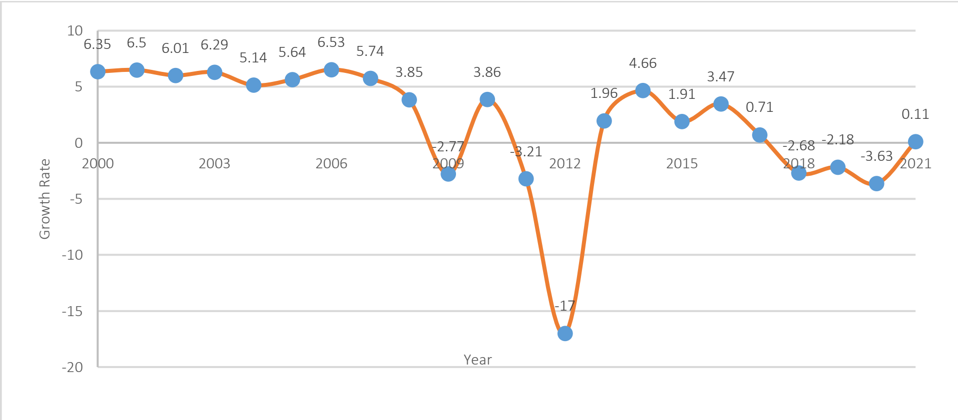

Fig. 3: The rate of economic growth in Sudan During the period (2000-2021)

D. GDP per capita: From the data presented in Table 1, the GDP per capita during the period (2000-2021) ranged between two limits, the lowest of which was about 366.17 $. In 2000, with a maximum of about 3178.31 $ while in 2017, the annual average value reached about 1322.64 $, and the increase rate during the study period was 4.1% (Fig. 4).

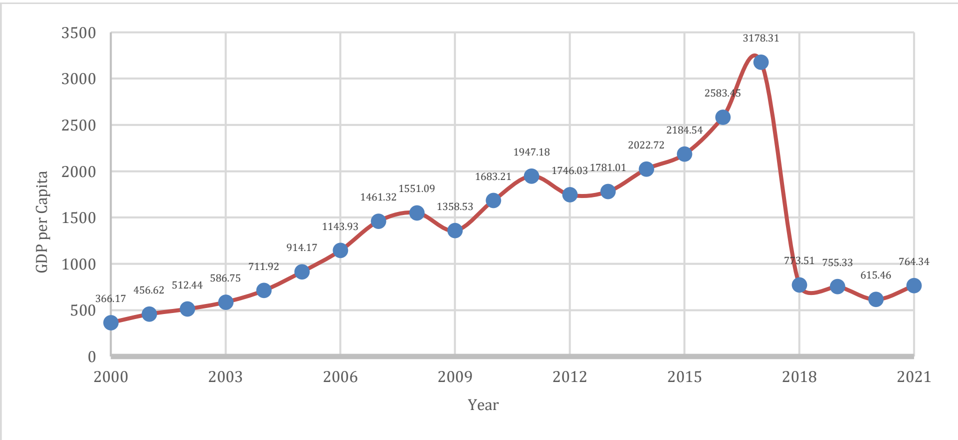

Fig. 4: Gross domestic product per capita in Sudan (2000-2021)

E. Inflation rate: From the data presented in Table 1, the inflation rate in Sudan during the period (2000-2021) ranged between two limits, the lowest of which was about 1.94% in 2001, with a maximum of about 382.82% in 2021, the annual average value reached approximately 43.54% and the increase rate during the study period was 14.7% (Fig. 5).

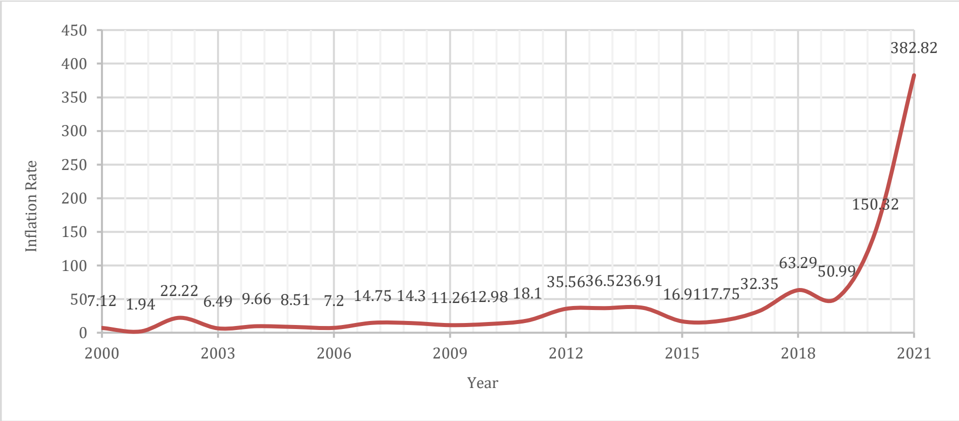

Fig. 5: Inflation rate in Sudan from 2000 to 2021

F. Fuel exports: From the study of the data presented in Table 1, the fuel exports in Sudan During the period (2000-2021), ranged between two limits, the lowest of which was about 0.99 billion $ in 2000), a maximum of approximately 11.02 billion $ in 2008, the annual average value reached about 4.32 (Billion $ (and the increase rate during the study period was 2.6% (Fig. 6).

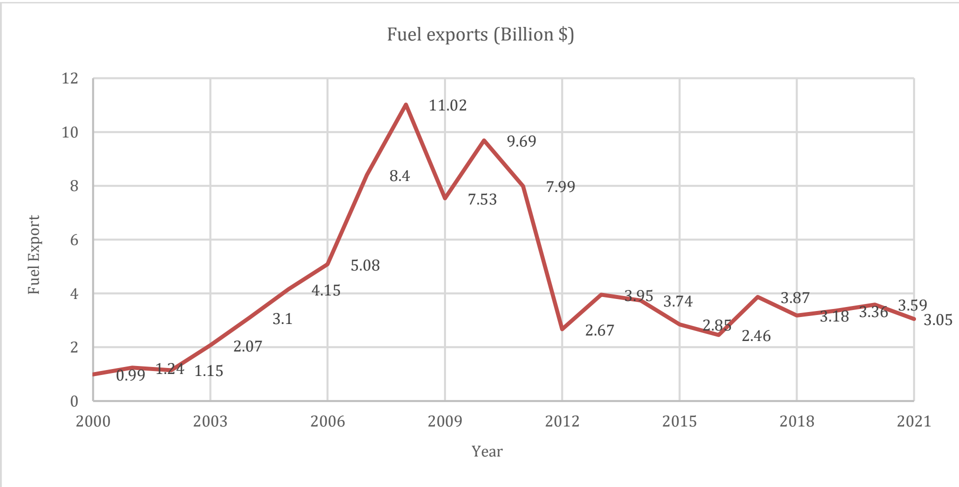

Fig. 6: The fuel exports in Sudan during the period (2000-2021)

G. Fuel imports: From the study of the data presented in Table 1, it was found that fuel imports in Sudan During the period (2000-2021), ranged between two limits, the lowest of which was about 0.03 billion $ in 2001, with a maximum of about 1.03 billion $. In 2021, the annual average value reached about 0.32 billion $. The increase rate during the study period was 7.3% (Fig. 7).

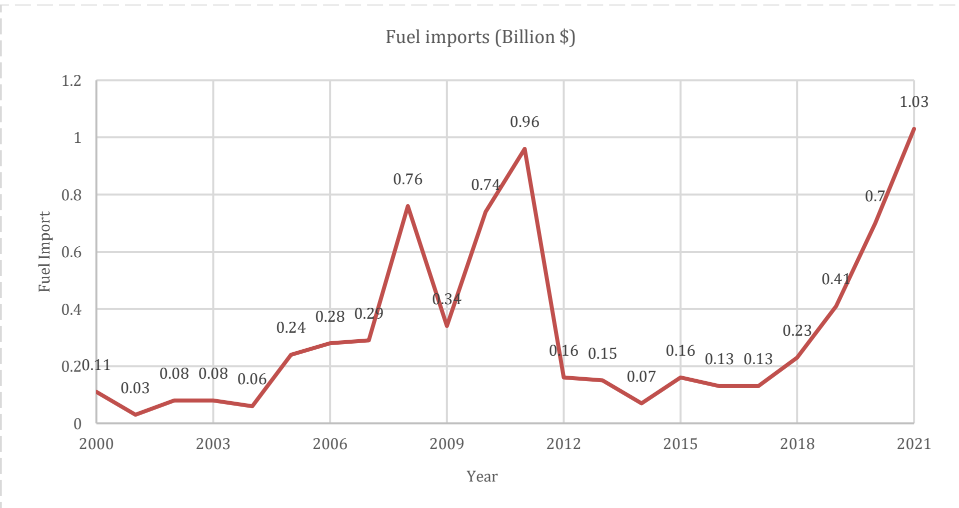

Fig. 7: The fuel imports in Sudan during the period (2000-2021)

Table 1: The evolution of fuel prices, oil rents, rate of economic growth, GDP per capita, inflation rate, fuel exports, and fuel imports in Sudan

Years	Fuel prices ($/barrel)	Oil rents (Billion $)	Rate of economic growth %	GDP per capita ($)	Inflation rate %	Fuel exports (Billion $)	Fuel imports (Billion $)
2000	28.5	1.23	6.35	366.17	7.12	0.99	0.11
2001	21.3	0.93	6.5	456.62	1.94	1.24	0.03
2002	22.8	1.07	6.01	512.44	22.22	1.15	0.08
2003	27.7	1.26	6.29	586.75	6.49	2.07	0.08
2004	38.3	2.87	5.14	711.92	9.66	3.1	0.06
2005	54.6	4.61	5.64	914.17	8.51	4.15	0.24
2006	65.2	6.08	6.53	1143.93	7.2	5.08	0.28
2007	72.4	8.37	5.74	1461.32	14.75	8.4	0.29
2008	96.9	12.49	3.85	1551.09	14.3	11.02	0.76
2009	61.7	6.62	-2.77	1358.53	11.26	7.53	0.34
2010	79.6	11.23	3.86	1683.21	12.98	9.69	0.74
2011	111.3	17.6	-3.21	1947.18	18.1	7.99	0.96
2012	111.6	4.09	-17	1746.03	35.56	2.67	0.16
2013	108.7	4.93	1.96	1781.01	36.52	3.95	0.15
2014	99	3.54	4.66	2022.72	36.91	3.74	0.07
2015	52.4	1.19	1.91	2184.54	16.91	2.85	0.16
2016	47.3	1.51	3.47	2583.45	17.75	2.46	0.13
2017	60.4	3.71	0.71	3178.31	32.35	3.87	0.13
2018	62.33	1.23	-2.68	773.51	63.29	3.18	0.23
2019	55.79	1.36	-2.18	755.33	50.99	3.36	0.41
2020	48.44	0.87	-3.63	615.46	150.32	3.59	0.7
2021	79	0.79	0.11	764.34	382.82	3.05	1.03

4.2. Standard relationships: Fuel prices and economic indicators in Sudan

In order to measure and analyze impact of the explanatory variable (Fuel Prices) on the dependent variables (oil rents, rate of economic growth, GDP per capita, inflation rate, fuel exports, and fuel imports) during the period (2000-2021), the standard relationships between (Fuel Prices) and each of (oil rents, rate of economic growth, GDP per capita, inflation rate, fuel exports, and fuel imports) were calculated by using a set of standard tests such as the expanded Dickey-Fuller test, the causality test, and the cointegration test, added to ARDL, slow periods, and vector test in the short and long run to test the relationship between variables by using Eviews software.

- Standard model of the relationship between Fuel Prices and oil rents:

- Unit root test: Developed Dickey-Fuller test (ADF) was used to measure the stability of the variables. Table 2 shows the instability of the Fuel Prices series (X) at its level. The stability occurred after taking the first difference, which demonstrates that the series is integrated with the first degree. Table 2 shows also the instability of the oil rent series (Y1) at its level. The stability occurred after taking the first difference, which shows that the series is integrated with the first degree. Since the two series are complementary to the same degree, it is possible to use the ARDL cointegration.
- Causality test: It is clear that there are no two-way or one-way causal relationships between the variables at a 5% level of significance as reported in Table 3.
- Bounds test: It turns out that there is no cointegration between the variables at the significance level of 0.05 as represented in Table 4.

Table 2: Developed Dickey-Fuller test

Variables	Level			1st Difference		
	ADF	Sig.	Result	ADF	Sig.	Result
X	-0.154	0.619	Not stationary	-3.947	0.000	stationary
Y1	-1.464	0.130	Not stationary	-6.063	0.000	stationary

Table 3: Causality test

Null hypothesis	Observation	F-statistics	Probability
Y1 does not Granger Cause X	20	1.37139	0.2838
X does not Granger Cause Y1		0.97163	0.4011

Table 4: Cointegration test

F- Bounds test		Null hypothesis: No relationship		
Test statistics	Value	Sign	1(0)	1(1)
			Asymptotic: n= 1000	
F- Statistics	1.823566	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

- Number of temporal lag periods test: Table 5 shows the optimal number of periods of time lag is four time periods for the independent variable (Fuel Prices) and two time periods for the dependent variable (oil rents).

Table 5: Test lag times

Variables	Coefficient	Standard error	t-statistic	Probability
Y1(-1)	0.685113	0.236553	2.896236	0.0159
Y1(-2)	0.411991	0.278721	1.478148	0.1702
X	0.052019	0.044349	1.172944	0.2680
X(-1)	-0.130573	0.056992	-2.291090	0.0449
X(-2)	-0.066244	0.071735	-0.923448	0.3775
X(-3)	0.182254	0.057390	3.175719	0.0099
X(-4)	-0.124582	0.036468	-3.416155	0.0066
C	5.248541	2.773849	1.892151	0.0878
R-square		0.816358		
Adjusted R squared		0.687809		
S.E of regression		2.594482		
Sum squared res		67.31338		
F- statistics		6.350559		
Probability (F- statistics		0.004861		
Durbin-Watson stat		1.734512		

- Error correction vectors model in the long and short term: Table 6 suggests that the value of the error limit correction coefficient amounted to 0.097103, and it turned into observed to be large at 0.05. This method that there may be a correction from the short-term to the long-term of 0.097103. The long-term equation suggests that there may be no impact of correction withinside the long term due to the fact X isn't large at 0.05.

Table 6: Test results for error correction vectors (ECM regression) (Case 2: Restricted constant and no trend)

Variables	Coefficient	Standard Error	t-Statistic	Probability
D(Y1(-1))	-0.411991	0.194099	-2.122584	0.0598
D(X)	0.052019	0.034527	1.506644	0.1628
D(X (-1))	0.008571	0.042428	0.202007	0.8440
D(X (-2))	-0.057673	0.035478	-1.625611	0.1351
D(X (-3))	0.124582	0.032956	3.780220	0.0283
CointEq (-1)	0.097103	0.037899	2.562194	0.0283
R- square		0.794970		
Adjusted R squared		0.709540		
S.E of regression		2.368427		
Sum squared res		67.31338		
Durbin-Watson stat		1.734512		
		Levels equation		
Variables	Coefficient	Std. Error	t-statistic	Probability
X	0.897237	2.360213	0.380151	0.7118
C	-54.05100	153.7475	-0.351557	0.7325

- Standard model of the relationship between Fuel Prices and the economic growth rate:

- Unit root test: To measure the stability of the model variables, the developed Dickey-Fuller test (ADF) was used. Table 7 shows the instability of the Fuel Prices series (X) at its level. The stability occurred after taking the first difference, which shows that the series is integrated with the first degree; while the stability of the rate of economic growth series (Y2) occurred at its level. This indicates that the series is integrated from (0) degrees because the two series aren't integrated at the same degree, the ARDL cointegration is used.
- Causality test: From Table 8, it clears that there are no two-way or one-way causal relationships between the variables at the significance level of 0.05.
- Bounds test: From Table 9, it turns out the absence of cointegration between the variables at the significance level of 0.05.
- Number of temporal lag periods test: Table 10 shows that the optimal number of periods of time lag is four time periods for the independent variable (Fuel Prices) and one time period for the dependent variable (rate of economic growth).
- Error correction vectors model in the long and short-Run: Table 11 shows that the value of the error limit correction coefficient amounted to 0.710926, and it was found to be significant at 0.01. This means the presence of correction from the short-run to the long-run at a speed of 0.710926. The long-term equation shows that there is no effect of correction in the long term because X is not significant at 0.05.

Table 7: Developed Dickey-Fuller test

Variables	Level			1st Difference		
	ADF	Sig.	Result	ADF	Sig.	Result
X	-0.154	0.619	Not stationary	-3.947	0.000	stationary
Y2	-2.915	0.005	stationary			

Table 8: Causality test

Null hypothesis	Observation	F-statistics	Probability
Y2 does not Granger Cause X	20	0.94276	0.4115
X does not Granger Cause Y2		3.47695	0.0575

Table 9: Cointegration test

F- Bounds test		Null hypothesis: No relationship		
Test statistics	Value	Significance	1(0)	1(1)
			Asymptotic: n= 1000	
F-statistics	3.237382	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Table 10: Test lag times

Variables	Coefficient	Std. error	t-statistic	Probability
Y2(-1)	0.289074	0.235025	1.229974	0.2444
X	-0.014858	0.064568	-0.230122	0.8222
X(-1)	-0.158497	0.078034	-2.031117	0.0671
X(-2)	0.157626	0.095144	1.656718	0.1258
X(-3)	0.071369	0.089210	0.800005	0.4406
X(-4)	-0.150132	0.059602	-2.518915	0.0285
C	6.681811	4.545504	1.469982	0.1696
R-square		0.289074		
Adjusted R-squared		-0.441901		
S.E of regression		4.168300		
Sum squared res		191.1220		
DW stat		1.602383		
F-statistic		3.243425		
Probability (F-statistic)		0.043586		

Table 11: Test results for error correction vectors (ECM regression) (Case 2: Restricted constant and no trend)

Variables	Coefficient	Std. Error	t-Statistic	Probability
D(X)	-0.014858	0.049881	-0.297881	0.7713
D(X (-1))	-0.078863	0.055401	-1.423496	0.1823
D(X (-2)	0.078763	0.053360	1.476079	0.1680
D(X (-3))	0.150132	0.051803	2.898159	0.0145
CointEq (-1)	-0.710926	0.209841	-3.387918	0.0061
R-square		0.743318		
Adjusted R squared		0.664339		
S.E of regression		3.834278		
Sum squared res		191.1220		
Durbin-Watson stat		1.602383		
		Levels equation		
Variables	Coefficient	Standard error	t-statistic	Probability
X	-0.132914	0.072941	-1.822215	0.0957
C	9.398745	5.296968	1.774363	0.1036

- The standard model of the relationship between Fuel Prices and the GDP per capita:

- Unit root test: To measure the stability of the model variables, the developed Dickey-Fuller test (ADF) was used. Table 12 shows the instability of the Fuel Prices series (X) at its level, and the stability occurred after taking the first difference. This shows that the series is integrated with the first degree, as well as the instability of the GDP per capita series (Y3) at its level. The stability occurred after taking the first difference, which shows that the series is integrated with the first degree. Since the two series are complementary to the same degree, it is possible to use the ARDL cointegration.
- Causality test: From Table 13, it is clear that there are no two-way or one-way causal relationships between the variables at the significance level of 0.05.
- Bounds test: From Table 14, it turns out that there is a cointegration between the variables at the significance level of 0.01.
- Number of temporal lag periods test: Table 15 shows that the optimal number lag of periods of time is four, for the independent variable (Fuel Prices) and four time periods for the dependent variable (GDP per capita).
- Error correction vectors model in the long and short term: Table 16 shows that the value of the error limit correction coefficient amounted to 1.633875, and it was found to be significant at 0.01. This indicates a correction from the short to the long-term at a speed of 1.633875. The long-term equation shows an effect of correction in the long-term for the reason that X is significant at 0.01.

Table 12: Developed Dickey-Fuller test

Variables	Level			1st Difference		
	ADF	Sig.	Result	ADF	Sig.	Result
X	-0.154	0.619	Not stationary	-3.947	0.000	stationary
Y3	-0.789	0.362	Not stationary	-4.979	0.000	stationary

Table 13: Causality test

Null hypothesis	Observation	F-statistics	Probability
Y3 does not Granger Cause X	20	0.10792	0.8984
X does not Granger Cause Y3		2.63101	0.1048

Table 14: Cointegration test

F- Bounds test		Null hypothesis: No relationship		
Test statistics	Value	Significance	1(0)	1(1)
			Asymptotic: n= 1000	
F- Statistics	4.947615	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Table 15: Test lag times

Variables	Coefficient	Standard error	t-statistic	Probability
Y3(-1)	-0.134556	0.324702	-0.414397	0.6895
Y3(-2)	0.090907	0.213684	0.425430	0.6817
Y3(-3)	-0.047573	0.226586	-0.209957	0.8390
Y3(-4)	-0.542654	0.228811	-2.371627	0.0451
X	5.194179	6.164821	0.842552	0.4240
X(-1)	-6.519168	7.324405	-0.890061	0.3994
X(-2)	-3.147061	7.904480	-0.398136	0.7009
X(-3)	21.69403	8.046996	2.695917	0.0272
X(-4)	10.62441	10.63927	0.998603	0.3472
C	604.8110	384.7040	1.572147	0.1546
R-square		0.858468		
Adjusted R-squared		0.699244		
S.E of regression		390.6233		
Sum squared res		1220693		
F-statistics		5.391576		
Prob (F-statistics		0.013287		
DW stat		2.164152		

Table 16: Test results for error correction vectors (ECM regression) (Case 2: Restricted constant and no trend)

Variables	Coefficient	Standard error	t-statistic	Probability
D(Y3(-1))	0.499320	0.198299	2.518009	0.0359
D(Y3(-2))	0.590227	0.178160	3.312899	0.0107
D(Y3(-3))	0.542654	0.202386	2.681279	0.0279
D(X)	5.194179	4.454119	1.166152	0.2771
D (X (-1))	-29.17137	6.976553	-4.181345	0.0031
D (X (-2)	-32.31844	8.057789	-4.010832	0.0039
D (X (-3))	-10.62441	8.869551	-1.197852	0.2653
CointEq (-1)	-1.633875	0.379320	-4.307384	0.0026
R- Square		0.822908		
Adjusted R- Squared		0.698944		
S.E of Regression		349.3841		
Sum Squared residue		1220693		
DW Stat		2.164152		
		Levels equation		
Variables	Coefficient	Standard error	t-statistic	Probability
X	17.04315	3.177848	5.363110	0.0007
C	370.1696	227.7619		0.1428

- The standard model of the relationship between Fuel Prices and the inflation rate:

- Unit root test: To measure the stability of the model variables, the developed Dickey-Fuller test (ADF) was used. Table 17 shows the instability of the Fuel Prices series (X) at its level, and the stability occurred after we take the first difference. This shows that the series is integrated with the first degree, as well as the instability of the inflation rate series (Y4) at its level. The stability occurred after taking the second difference, which shows that the series is integrated with the second degree. Since the two series are not integrated at the same degree, ARDL cointegration is used.
- Causality test: It is clear that there are no two-way or one-way causal relationships between the variables at the significance level of 0.05 (Table 18).
- Bounds test: From Table 19, it turns out that there is cointegration between the variables at the significance level of 0.01.
- Number of temporal lag periods test: Table 20 shows that the optimal number of periods of time lag is three time periods for the independent variable (Fuel Prices) and three-time periods for the dependent variable (inflation rate).
- Error correction vectors model in the long and short term: Table 21 shows that the value of the error limit correction coefficient amounted to 3.538508, and it was found to be significant at 0.01. This means that there is a correction going from the short term to the long term at a speed of 3.538508. The long-term equation shows that there is no effect of correction in the long term because X is not significant at 0.05.

Table 17: Developed Dickey-Fuller Test

Variables	Level			1st Difference			2nd Difference		
	ADF	Sig.	Result	ADF	Sig.	Result	ADF	Sig.	Result
X	-0.154	0.619	Not stationary	-3.947	0.000	Stationary	-----	-----	-----
Y4	6.092	0.999	Not stationary	3.399	0.992	Not stationary	-1.899	0.046	stationary

Table 18: Causality test

Null hypothesis	Observation	F-statistics	Probability
Y4 does not Granger Cause X	20	1.76267	0.2053
X does not Granger Cause Y4		1.85191	0.1911

Table 19: Cointegration test

F- Bounds test		Null hypothesis: No relationship		
Test statistics	Value	Significance	1(0)	1(1)
			Asymptotic: n= 1000	
F- Statistics	7.412784	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Table 20: Test lag times

Variables	Coefficient	Standard error	t-statistic	Probability
Y4(-1)	1.496597	0.376302	3.977122	0.0022
Y4(-2)	1.257448	0.638274	1.970075	0.0745
Y4(-3)	1.784463	0.929160	1.920512	0.0188
X	1.061782	0.385643	2.753279	0.0188
X (-1)	-0.257383	0.493300	-0.521758	0.6122
X (-2)	-0.454959	0.486359	-0.935438	0.3696
X (-3)	-0.589407	0.441308	-1.335591	0.2087
C	-47.92598	21.81078	-2.197353	0.0503
R-square		0.949790		
Adjusted R-squared		0.917838		
S.E of regression		25.04978		
Sum squared residue		6902.409		
F-statistics		29.72550		
Probability (F- statistics		0.000003		
Durbin-Watson stat		2.181683		

Table 21: Test results for error correction vectors (ECM regression) (Case 2: Restricted constant and no trend)

Variables	Coefficient	Standard error	t-Statistic	Probability
D(Y4(-1))	-3.041911	0.971810	-3.130149	0.0096
D(Y4(-2))	-1.784463	0.842265	-2.118647	0.0577
D(X)	1.061782	0.315980	3.360286	0.0064
D(X (-1))	1.044365	0.413712	2.524379	0.0283
D(X (-2)	0.589407	0.397796	1.481681	0.1665
CointEq (-1)	3.538508	0.690230	5.126567	0.0003
R- Square		0.883922		
Adjusted R- Squared		0.839276		
S.E of Regression		23.04245		
DW Stat		2.181683		
		Levels equation		
Variables	Coefficient	Standard error	t-statistic	Probability
X	0.067816	0.074724	0.907545	0.3836
C	13.54412	5.398023	2.509089	0.0290

- Standard model of the relationship between the Fuel Prices and the fuel exports:

- Unit root test: To measure the stability of the model variables, the developed Dickey-Fuller test (ADF) was used. Table 22 shows the instability of the Fuel Prices series (X) at its level, and the stability occurred after taking the first difference. Thus, the series is integrated with the 1st degree, as well as the instability of the fuel exports series (Y5) at its level. The stability occurred after taking the 1st difference, which shows that the series is integrated with the (1) degree. Since the two series are complementary to the same degree, it is possible to use the ARDL cointegration.
- Causality test: It is clear from Table 23 that there are no two-way or one-way causal relationships between the variables at the significance level of 0.05.
- Bounds test: Table 24 turns out that there is no cointegration between the variables at the significance level of 0.01.
- Number of temporal lag periods test: Table 25 shows that the optimal number of periods of time lag is two time periods for the independent variable (Fuel Prices) and four time periods for the dependent variable (fuel exports).
- Error correction vectors model in the long and short term: Table 26 shows that the value of the error limit correction coefficient amounted to 1.025757, and it was found to be significant at 0.01. This means that there is a correction from the short term to the long term at a speed of 1.025757. The long-term equation shows that there is an effect of correction in the long term because X is significant at 0.01.

Table 22: Developed Dickey-Fuller test

Variables	Level			1st Difference		
	ADF	Sig.	Result	ADF	Sig.	Result
X	-0.154	0.619	Not stationary	-3.947	0.000	stationary
Y5	-0.735	0.386	Not stationary	-4.646	0.000	stationary

Table 23: Causality test

Null hypothesis	Observation	F-statistics	Probability
Y5 does not Granger Cause X	20	1.41263	0.2741
X does not Granger Cause Y5		1.24182	0.3169

Table 24: Cointegration test

F- Bounds test		Null hypothesis: No relationship		
Test statistics	Value	Significance	1(0)	1(1)
			Asymptotic: n= 1000	
F- Statistics	3.078695	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Table 25: Test lag times

Variables	Coefficient	Standard error	t-statistic	Probability
Y5(-1)	0.801885	0.239401	3.349548	0.0074
Y5(-2)	-0.131464	0.268168	-0.490229	0.6345
Y5(-3)	0.072030	0.327725	0.219788	0.8305
Y5(-4)	-0.768208	0.288012	-2.667278	0.0236
X	0.064109	0.034027	1.884047	0.0889
X (-1)	-0.023687	0.037038	-0.639516	0.5369
X (-2)	0.043525	0.027778	1.566857	0.1482
C	-1.145956	1.948851	-0.588016	0.5696
R-square		0.791298		
Adjusted R-squared		0.645207		
S.E of regression		1.593925		
Sum squared residue		25.40595		
F-statistics		5.416467		
Probability (F-statistics		0.008663		
Durbin-Watson stat		2.486129		

Table 26: Test results for error correction vectors (ECM regression) (Case 2: Restricted constant and no trend)

Variables	Coefficient	Standard error	t-Statistic	Probability
D(Y5(-1))	0.827642	0.288381	2.869964	0.0167
D(Y5(-2))	0.696178	0.269341	2.584745	0.0272
D(Y5(-3))	0.768208	0.254361	3.020147	0.0129
D(X)	0.064109	0.023657	2.709995	0.0219
D (X (-1))	-0.043525	0.020942	-2.078393	0.0644
CointEq (-1)	-1.025757	0.308113	-3.329160	0.0076
R- Square		0.658374		
Adjusted R- Squared		0.516029		
S.E of Regression		1.455047		
Sum Squared residue		25.40595		
Log-likelihood		-28.64240		
Durbin- Watson Stat		2.486129		
Mean Dependent Var		0.054444		
S.D Dependent var		2.091547		
Akaike info criterion		3.849156		
		Levels equation		
Variables	Coefficient	Standard error	t-statistic	Probability
X	0.081839	0.023216	3.525051	0.0055
C	-1.117181	1.707788	-0.654169	0.5278

- The standard model of the relationship between Fuel Prices and fuel imports:

- Unit root test: To measure the stability of the model variables, the developed Dickey-Fuller test (ADF) was used. Table 27 shows the instability of the Fuel Prices series (X) at its level, and the stability occurred after taking the 1st difference. Hence it shows the integration of the series with the first degree, as well as the instability of the fuel imports series (Y6) at its level. The stability occurred after the first difference, which shows that the series is integrated with the first degree. Since the two series are complementary to the same degree, it is possible to use the ARDL cointegration.
- Causality test: Table 28 illustrates that there are no two-way or one-way causal relationships between the variables at the significance level of 0.05.
- Bounds test: It turns out that there is no cointegration between the variables at the significance level of 0.01 (Table 29).
- Number of temporal lag periods test: Table 30 shows that the optimal number of periods of time lag is four time periods for the independent variable (Fuel Prices) and one time period for the dependent variable (fuel imports).
- Error correction vectors model in the long and short term: Table 31 shows that the value of the error limit correction coefficient was insignificant at the level of 0.05. There is no correction from the short term to the long term, and the long-term equation shows that there is no effect of correction in the long term because X is not significant at 0.05.

Table 27: Developed Dickey-Fuller test

Variables	Level			1st Difference		
	ADF	Sig.	Result	ADF	Sig.	Result
X	-0.154	0.619	Not stationary	-3.947	0.000	stationary
Y6	-0.495	0.489	Not stationary	-5.141	0.000	stationary

Table 28: Causality test

Null hypothesis	Observation	F-statistics	Probability
Y6 does not Granger Cause X	20	3.23689	0.0678
X does not Granger Cause Y6		1.75729	0.2062

Table 29: Cointegration test

F- Bounds test	Null hypothesis: No levels of relationship			
Test statistics	Value	Significance	1(0)	1(1)
			Asymptotic: n= 1000	
F- Statistics	1.283467	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Table 30: Test lag times

Variables	Coefficient	Standard error	t-statistic	Probability
Y6(-1)	0.730687	0.250814	2.913259	0.0141
X	0.004813	0.003562	1.351146	0.2038
X (-1)	-0.011186	0.004350	-2.571304	0.0260
X (-2)	0.003814	0.004651	0.819954	0.4297
X (-3)	0.005087	0.004462	1.140206	0.2784
X (-4)	-0.005465	0.003219	-1.697658	0.1176
C	0.325645	0.210193	1.549266	0.1496
R-square		0.642086		
Adjusted R-squared		0.446861		
S.E of regression		0.233188		
Sum squared residue		0.598145		
F-statistics		3.288945		
Probability (F-statistics		0.041818		
Durbin-Watson stat		1.965431		

Table 31: Test results for error correction vectors (ECM regression) (Case 2: Restricted constant and no trend)

Variables	Coefficient	Standard error	t-statistic	Probability
D(X)	0.004813	0.002690	1.789698	0.1010
D (X (-1))	-0.003436	0.003029	-1.134152	0.2808
D (X (-2))	0.000378	0.002782	0.135809	0.8944
D (X (-3))	0.005465	0.002806	1.947655	0.0774
CointEq (-1)	-0.269313	0.126249	-2.133184	0.0563
R- Square		0.596110		
Adjusted R- Squared		0.471836		
S.E of Regression		0.214502		
Sum Squared residue		0.598145		
DW Stat		1.965431		
		Levels equation		
Variables	Coefficient	Standard error	t-statistic	Probability
X	-0.010906	0.018560	-0.587589	0.5687
C	1.209169	1.413774	0.855277	0.4106

4.3. Effect of fuel prices on economic indicators in Sudan (2000-2021)

To examine the influence of the independent variable, namely "Fuel Prices," on various dependent variables such as "oil rents, rate of economic growth, GDP per capita, inflation rate, fuel exports, and fuel imports" in Sudan during the period from 2000 to 2021, a simple regression analysis was conducted. This regression analysis involved calculating the regression equation between the independent variable (Fuel Prices) and each of the dependent variables (oil rents, rate of economic growth, GDP per capita, inflation rate, fuel exports, and fuel imports) in Sudan during the specified time period (2000-2021).

a) Impact of the fuel prices on the oil rents in Sudan (2000-2021): The significance of the model was evident as the F value was statistically significant at 0.01, and there was a statistically significant impact of the (Fuel Prices) level on the (oil rents) level at 0.01. This supports the validity of the first sub-hypothesis of the study, which states that there is a statistically significant impact of the (Fuel Prices) level on the (oil rent) level. It turns out that the independent variable explains 39.4% of the changes that occur in the dependent variable, while the rest of the changes are due to other variables that were not included in the model. The value of the correlation coefficient is 0.628, and it turns out that whenever the level (Fuel Prices) increased by 1%, (oil rents) increased by 0.099% in Sudan (Table 32).

b) Impact of the fuel prices on the rate of economic growth in Sudan (2000-2021): The significance of the model was evident as the F value was statistically significant at 0.05. There was a statistically significant impact of the (Fuel Price) level on the (rate of economic growth) level at 0.05. This indicates the validity of the second sub-hypothesis of the study, which states that there is a statistically significant impact of the (Fuel Price) level on the (rate of economic growth) level. It turns out that the independent variable explains 24.6% of the changes that occur in the dependent variable, while the rest of the changes are due to other variables that were not included in the model. The value of the correlation coefficient is 0.496, and it turns out that whenever the level (Fuel Price) increased by 1%, (the rate of economic growth) decreased by 0.096% in Sudan (Table 33).

Table 32: Impact of the fuel prices on the oil rents in Sudan (2000-2021)

b	t	F	r	R^2	P-value
0.099	3.605**	12.995**	0.628	0.394	0.002

** Statistically significant at 0.01

Table 33: Impact of the fuel prices on the rate of economic growth in Sudan during the period (2000-2021)

b	t	F	r	R^2	P-value
-0.096	-2.552*	6.514*	0.496	0.246	0.019

* Statistically significant at 0.05

c) Impact of the fuel prices on the GDP per capita in Sudan during the period (2000-2021): The significance of the model was evident as the F value was statistically significant at 0.05, and there was a statistically significant impact of the (Fuel Price) level on the (GDP per capita) level at 0.05. This indicates the validity of the third sub-hypothesis of the study, which states that there is a statistically significant impact of the (Fuel Price) level on the (GDP per capita) level. It turns out that the independent variable explains 25.7% of the changes that occur in the dependent variable, while the rest of the changes are due to other variables that were not included in the model. The value of the correlation coefficient is 0.507, and it turns out that whenever the level (Fuel Prices) increased by 1%, (GDP per capita) decreased by 13.561% in Sudan (Table 34).

Table 34: Impact of the fuel prices on the rate of GDP per capita in Sudan during the period (2000 -2021)

b	t	F	r	R^2	P-value
13.561	2.631*	6.921*	0.507	0.257	0.016

* Statistically significant at 0.05

d) The fuel prices and their impact on inflation rate in Sudan (2000-2021): It turned out that the model was not significant, as the F value was not statistically significant at 0.05, and there was a statistically significant impact of the (Fuel Prices) level on the (inflation rate) level at 0.05. This indicates the non-validity of the fourth sub-hypothesis of the study. It was found that there was no statistically significant correlation between (Fuel Prices) and (inflation rate) at 0.05, as well as the absence of a statistically significant impact (Fuel Prices) on (inflation rate) at 0.05 in Sudan During the period (2000-2021) (Table 35).

e) Impact of the fuel prices on the fuel exports in Sudan During the period (2000-2021): The significance of the model was evident as the F value was statistically significant at 0.01, and there was a statistically significant impact of the (Fuel Prices) level on the (fuel exports) level at 0.01. This indicates the validity of the fifth sub-hypothesis of the study, which states that there is a statistically significant impact of the (Fuel Prices) level on the (fuel exports) level. It turns out that the independent variable explains 31.4% of the changes that occur in the dependent variable, while the rest of the changes are due to other variables that were not included in the model. The value of the correlation coefficient is 0.560, and it turns out that whenever the level (Fuel Prices) increased by 1%, (fuel exports) increased by 0.055% in Sudan (Table 36).

Table 35: Impact of the fuel prices on the inflation rate in Sudan during the period (2000-2021)

b	t	F	r	R^2	P-value
0.403	0.630	0.397	0.139	0.019	0.536

Table 36: Impact of the fuel prices on the fuel exports in Sudan during the period (2000-2021)

b	t	F	r	R^2	P-value
0.055	3.022**	9.134**	0.560	0.314	0.007

** Statistically significant at 0.01

f) Impact of the fuel prices on the fuel imports in Sudan During the period (2000-2021): The significance of the model was evident as the F value was statistically significant at 0.05, and there was a statistically significant impact of the (Fuel Prices) level on the (fuel imports) level at 0.05. This indicates the validity of the sixth sub-hypothesis of the study, which states that there is a statistically significant impact of the (Fuel Prices) level on the (fuel imports) level. It turns out that the independent variable explains 20.4% of the changes that occur in the dependent variable, while the rest of the changes are due to other variables that were not included in the model. The value of the correlation coefficient is 0.452, and it turns out that whenever the level (Fuel Prices) increased by 1%, (fuel imports) decreased by 0.005% in Sudan (Table 37).

Table 37: Impact of the fuel prices on the rate of fuel imports in Sudan during the period (2000-2021)

b	t	F	r	R^2	P-value
0.005	2.265*	5.132*	0.452	0.204	0.035

* Statistically significant at 0.05

5. Conclusion remarks

The findings of this study provide valuable insights regarding the impact of fuel prices on various economic indicators in Sudan. Firstly, it was observed that there was a statistically significant effect of fuel prices on oil rents, confirming the validity of the first sub-hypothesis. The correlation coefficient indicated a positive relationship, with a 1% increase in fuel prices corresponding to a 0.099% increase in oil rents in Sudan.

Secondly, the study established a statistically significant effect of fuel prices on the rate of economic growth, supporting the second sub-hypothesis. The correlation coefficient demonstrated a negative relationship, as a 1% increase in fuel prices resulted in a 0.096% decrease in the rate of economic growth in Sudan. These findings are consistent with previous studies by Le and Nguyen (2019), Mensah et al. (2019), Talha et al. (2021), and Przekota (2022), which also reported a similar positive effect.

Furthermore, the analysis revealed a statistically significant effect of fuel prices on GDP per capita, confirming the third sub-hypothesis. The correlation coefficient indicated a negative relationship, with a 1% increase in fuel prices corresponding to a substantial 13.561% decrease in GDP per capita in Sudan. This finding aligns with previous research by Le and Nguyen (2019), Mensah et al. (2019), Talha et al. (2021), Abdulrahman (2021), and Przekota (2022), while contrasting with the findings of Bildirici et al. (2009) that indicated negative effects.

In contrast, the fourth sub-hypothesis was not supported, as there was no statistically significant correlation between fuel prices and the inflation rate in Sudan during the period from 2000 to 2021. This finding diverges from studies by Hunt et al. (2002), Przekota (2022), Chou and Tseng (2011), Cuñado and de Gracia (2003), and Pandey and Shettigar (2016), which highlighted the impact of oil prices on inflation in the short and long term.

Regarding trade dynamics, the study revealed a statistically significant impact of fuel prices on fuel exports, supporting the fifth sub-hypothesis. The correlation coefficient indicated a positive relationship, with a 1% increase in fuel prices corresponding to a 0.055% increase in fuel exports in Sudan. Similarly, there was a statistically significant impact of fuel prices on fuel imports, confirming the sixth sub-hypothesis. The correlation coefficient showed a negative relationship, with a 1% increase in fuel prices resulting in a modest 0.005% decrease in fuel imports in Sudan.

In summary, the main hypothesis of the study was partially confirmed, as fuel prices demonstrated an impact on oil rents, the rate of economic growth, GDP per capita, fuel exports, and fuel imports. However, there was no significant impact on the inflation rate. Based on these findings, several recommendations are proposed:

- It is crucial to capitalize on high oil prices to implement effective financial and monetary policies in Sudan, fostering real economic development and social progress.
- Efforts should be made to maximize revenue generation from global oil prices, bolstering Sudan's financial capacity and achieving the desired economic development.
- Increasing government spending in sectors that facilitate rapid economic development while ensuring sustainable growth rates is advised.
- A focus on developing non-oil sectors and boosting their exports is recommended to enhance their contribution to Sudan's gross domestic product.
- Diversification of the Sudanese economy and the expansion of non-oil exports should be pursued, enabling optimal utilization of Sudan's natural, technical, and human resources.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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