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The Effect of National Income on Goods Imports in Saudi Arabia: Using Time Series Data

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ABSTRACT

This study investigates the relationship between national-income and goods - imports in Saudi Arabia, a country heavily reliant on oil exports and actively pursuing economic diversification as part of its Vision 2030 plan. Utilizing annual time series data from 2002 to 2023 sourced from the World Bank and Statista, the research examines the impact of national-income, inflation, and oil - prices on goods - imports. These imports are crucial for modernizing infrastructure and enhancing industrial capacity. The research employs econometric techniques, including unit root tests, cointegration analysis, and regression modeling, to understand how these factors interact and influence import patterns in Saudi Arabia. The analysis also explores the long-run equilibrium relationships among the variables and assesses the quality of the model through residual diagnostics and variance inflation factor (VIF) analysis. The findings provide valuable insights for policymakers aiming to manage import flows, promote domestic production, and ensure sustainable economic development in the post-oil era.

Keywords: Dickey-Fuller Test; Time Series Data; Goods – Imports; Variance Inflation Factor; National-Income.

INTRODUCTION

Saudi Arabia's economy is predominantly reliant on oil exports, which account for a significant portion of its national-income. In response to fluctuating oil - prices and the need for a more resilient economic framework, the country is actively pursuing a comprehensive diversification strategy encapsulated in its Vision 2030 plan. This ambitious initiative aims to reduce the kinNaom's dependency on oil and promote sustainable economic growth through investments in various sectors, including tourism, entertainment, technology, and renewable energy. A critical component of this diversification effort is the substantial investment in goods, which are essential for modernizing infrastructure and enhancing industrial capabilities. goods encompass a wide range of items, including advanced machinery, sophisticated equipment, and specialized industrial tools, all of which are crucial for expanding production capacities and fostering innovation. This paper delves into the intricate relationship between national-income and the importation of these vital goods. As Saudi Arabia's national-income evolves, driven by both oil revenues and diversification efforts, the demand for high-quality goods is expected to grow. Understanding this relationship is pivotal for policymakers tasked with managing import flows, incentivizing domestic production, and ensuring long-term sustainable economic development. By closely analyzing how changes in national-income

influence goods - imports, stakeholders can create informed policies that support economic resilience and growth in the post-oil era.

In the context of the Malaysian economy, Baharumshah and Rashid [1] examined the links among exports, imports, and economic growth from 1974 to 1994 using the Johansen Procedure and the vector-error correction (VEC) model. They identified a stationary long-run relationship between exports, imports, and growth, concluding that outward-oriented development strategies, which facilitate the importation of foreign technology, are critical determinants of long-run growth in Malaysia. Thangavelu and Rajaguru [2] explored the relationship between foreign trade and productivity growth by employing the multivariate co-integration test based on the Johansen-Juselius method, using annual data from 1960 to 1996. Their findings revealed significant causal effects from imports to productivity growth, indicating the presence of import-led productivity growth in India, Indonesia, Malaysia, the Philippines, Singapore, and Taiwan. In studying transition economies in Europe, Awokuse [3] analyzed the relationship between exports, imports, and economic growth using the Johansen Cointegration Test and Granger Causality Test on various monthly datasets from 1993 to 2004. The results supported the validity of the import-led hypothesis for both the Czech Republic and Poland. Awokuse concluded that many past studies' narrow focus on the role of exports as the primary engine of growth could be misleading or at best incomplete. Moreover, Awokuse [4] tested the import-led growth hypothesis for Latin American economies by applying the Johansen Cointegration and Granger causality tests, as well as impulse response functions on various quarterly datasets from 1990 to 2002. His empirical results confirmed the significant role of imports in stimulating economic growth in Argentina, Colombia, and Peru, with the effect of imports on growth being relatively stronger than that of exports. Mishra [5] investigated the relationship between imports and economic growth in India for the period from 1970 to 2010 using Johansen co-integration and Granger causality tests. The study indicated a long-run equilibrium relationship between imports and real economic growth in India. Azgun and Servinc [6] analyzed the effects of exports and imports on economic growth in Turkey from 1998 to 2008, using the Engle-Granger causality test. Their findings suggested that economic growth in Turkey depends more on imports than on exports, failing to support the export-led growth hypothesis while validating the import-led growth hypothesis. They concluded that exports grow in response to imports. Focusing on the Republic of Korea, Kim et al. [7] investigated the relationship between exports, imports, and economic growth through the lens of Johansen Cointegration, Granger causality tests, and impulse response functions, utilizing quarterly data from 1980 to 2003. Their results demonstrated that imports significantly positively impact productivity growth, while the export-led growth hypothesis was not supported. Kim argued that the idea of desirable exports versus undesirable imports might be misguided and counterproductive. He highlighted that policymaker should recognize the substantial benefits of import liberalization in terms of increased productivity and economic growth. Sukirno [8] The initial production costs of domestically produced goods may be higher than imports, but this initiative is based on the belief that the import substitution manufacturing sector will eventually become profitable, rooted in the "infant industry argument" for protectionist measures. National-income encompasses the total final accounting figures for goods and services produced in a year, including income from domestic companies, wages for workers, and taxes. This data can also help forecast the economy's future, aiding business leaders in economic planning for growth. Ucak and Arısoy [9] investigated the link between foreign trade and productivity growth for the Turkish economy during the period from 1980 to 2007. Groumpos [10] Imports indicate a country's demand for raw materials and contribute to societal progress by allowing access to quality goods at lower prices than domestic production. Following World War II, many developing countries adopted import substitution strategies to boost urban industrial development, aiming to replace imports with domestically produced consumer products. These strategies often involve joint ventures with foreign companies, supported by tarIf protections and investment incentives. Heni Widiya [11] This study defines goods as man-made products essential for producing goods and services. It explores how national-income, interest rates, foreign reserves, and inflation impact imports over the short and long term, using data from Bank Indonesia and the Central Statistics Agency from Q1 2005 to Q4 2020, analyzed via the Error Correction Model (ECM). Results show that, in the long run, national-income and inflation have weak positive effects on imports, while interest rates negatively impact them, and foreign reserves have a strong positive effect. In the short term, none of these factors significantly influence Indonesia's imports of goods. The remainder of the paper is organized as follows: Section 3 outlines the model specification and methodology, while Section 4 discusses the unit root tests. Section 5 covers the cointegration tests, and Section 6, we focus on estimating the model, followed by an evaluation of the model's quality in Section 7. Finally, the paper concludes with a summary of the findings.

MODEL SPECIFICATION AND METHODOLOGY

This study employs comprehensive annual time series data for Saudi Arabia, covering the period from 2002 to 2023. The primary source of this data is the World Bank's World Development Indicators (WDI), which offers a robust database of key economic, social, and environmental metrics. The variables analyzed in this research

include goods - imports, National-income, Oil - prices. By examining these variables, the study aims to uncover significant trends and relationships, providing insights into Saudi Arabia's economic development and policy implications during this critical timeframe look at table 1.

$$G_i = a + a_1 Na + a_2 I_f + a_3 O_p + U_1$$

G_i = goods - imports
N_a = -national income-
I_f = -inflation-
O_p = -oil price-
C = -intercept-.
a_1, a_2, a_3 = The parameters
U_I = Random variables

Table 1: study variables

Variable	definition	Data	Variable
Gi	goods - imports	World bank	Independent
Na	national - income	World bank	Depended
If	inflation	World bank	Depended
Op	oil - price	statista	Depended

Goods - Imports: Mean: The average value indicates a substantial level of imports, which is essential for the Saudi Arabian economy, Wide Range: The large standard deviation (4.26) and the difference between the minimum (2.96) and maximum (1.59) values suggest significant fluctuations in import levels over the years, Negative Skewness: A negative skewness (-0.417514) indicates that there are more years with higher import values, with fewer years showing particularly low values, Platykurtic Distribution: The kurtosis (1.913471) being less than 3 reflects a platykurtic distribution, meaning the data is less peaked and has thinner tails compared to a normal distribution, inflation (Consumer Price Index): Moderate Average inflation: The mean inflation rate of 2.59% suggests a relatively controlled inflationary environment over the period, Volatility: The standard deviation (2.74) indicates some volatility in inflation, with periods of both higher and lower rates, Positive Skewness: A positive skewness (0.762284) implies that there are more years with lower inflation rates and fewer years experiencing significant spikes in inflation, Leptokurtic Distribution: The kurtosis (3.850263) greater than 3 indicates a leptokurtic distribution, suggesting fatter tails and a sharper peak compared to a normal distribution, which results in a higher probability of observing extreme inflation values. National-income: High Average National-income: The mean of 4.43 reflects the substantial size of the Saudi Arabian economy, Moderate Dispersion: The standard deviation (1.71) shows moderate variability in national-income over the period, Negative Skewness: The negative skewness (-0.368960) suggests that more years have higher national-income levels, with fewer years at the lower end, Platykurtic Distribution: The kurtosis (1.748589) indicates a platykurtic distribution, similar to what was observed for goods - imports. Oil - price: High Average Oil - price: The mean oil - price of $68.17 per barrel underscores the significance of oil revenues for the Saudi Arabian economy, High Volatility: The large standard deviation (28.20) reflects the well-known volatility of global oil - prices, Slight Positive Skewness: The slight positive skewness (0.128103) indicates that there are slightly more years with lower oil - prices and fewer years with very high prices, Platykurtic Distribution: The kurtosis (1.900176) suggests a platykurtic distribution, similar to those observed for goods - imports and National-income. Look at table2.

Table 2: Descriptive Stats (2002-2023)

	Gi	If	Na	Op
Mean	1.04	2.589797	4.43	68.16895
Median	1.20	2.236290	5.24	64.30000
Maximum	1.59	9.870248	6.71	111.6300
Minimum	2.96	-2.093333	1.56	23.80000
Std. Dev.	4.26	2.744971	1.71	28.20282
Skewness	-0.417514	0.762284	-0.368960	0.128103
Kurtosis	1.913471	3.850263	1.748589	1.900176
Jarque-Bera	1.486604	2.412408	1.670857	1.009577
Probability	0.475541	0.299331	0.433689	0.603633
Sum	1.97	49.20614	8.41E+12	1295.210
Sum Sq. Dev.	3.26	135.6276	5.26E+23	14317.18
Observations	19	19	19	19

Unit Roots Test

Understanding the behavior of economic time series data is essential for accurate forecasting and analysis. A key concept in time series analysis is stationarity, which refers to the stability of statistical properties (such as mean and variance) over time. Non-stationary data, often characterized by trends or drifts, can lead to misleading conclusions If not properly addressed. This analysis examines the stationarity of four economic indicators, which we will refer to as Gi, Na, If, and Op, using unit root tests. These tests determine whether a time series has a "unit root," a feature that indicates non-stationarity. Specifically, we utilize the Augmented Dickey-Fuller (ADF) test, a common tool for this purpose. Our findings reveal a consistent pattern across all four indicators. In their original form (at "level"), each variable exhibits non-stationarity. The p-values associated with the ADF tests are all greater than the conventional significance level of 0.05, leading us to fail to reject the null hypothesis of non-stationarity. This suggests the presence of trends or drifts in the original data, making them unsuitable for many standard time series models. However, the situation changes dramatically when we consider the first difference of each variable. First differencing involves calculating the change in each variable from one period to the next. This transformation often removes the trend component, making the data stationary. Indeed, for all four indicators, the p-values associated with the ADF tests on the first-differenced data fall below the 0.05 threshold. This provides strong evidence that the first-differenced series are stationary. To put it simply: Imagine a stock price that is constantly increasing (a trend). However, the daily change in the stock price may fluctuate around a stable average. That change is analogous to our first-differenced data, which is now stationary. The key takeaway from this analysis is that while the original time series for Gi, Na, If, and Op are non-stationary, they become stationary after first differencing. This indicates that these variables have underlying trends or drifts that need to be accounted for in any subsequent time series modeling. Failing to do so can lead to spurious regressions and unreliable forecasts. This insight is crucial for building robust models and drawing meaningful conclusions about the dynamics of these important economic indicators., Look at table 3.

Table 3: Dickey-Fuller test

indicator	level		1st	
	t-statistics	**prob**	**t-statistics**	**prob**
Gi	-0.760634	0.8096	-3.184305	0.0363
Na	-1.542564	0.4900	-3.057554	0.0495
If	-2.794485	0.0760	-7.284086	0.0000
Op	-2.442404	0.1900	-4.336293	0.0032

Cointegration Test

The results of your cointegration test strongly indicate that there is one cointegrating relationship among variables. This suggests a stable, long-run equilibrium between them. While the individual variables may fluctuate over time, they tend to return to this equilibrium in the long run. Analysis Results: Row 1 (None): Statistic: 57.64567 > Critical Value: 47.85613, p-value: 0.0046 < 0.05, Conclusion: Reject the null hypothesis of "none." This indicates there is evidence of at least one cointegrating relationship. Row 2 (At most 1): Statistic: 27.15130 < Critical Value: 29.79707, p-value: 0.0980 > 0.05, Conclusion: Fail to reject the null hypothesis of "at most 1." This means there is not enough evidence to support the existence of a second cointegrating relationship. Look at table4.

Table 4: Cointegration Test

Hypothesized	Eigenvalue	Statistic	Critical Value	Prob.	Result
None	0.833671	57.64567	47.85613	0.0046	long-run relationship
At most 1	0.630786	27.15130	29.79707	0.0980	

Rejection of the hypothesis (0.05 level)

Estimating Model

Intercept (-7006817730.27): This indicates that when inflation, national-income, and oil - prices are all zero, the model predicts a negative value for goods - imports. . inflation - Consumer Price Index (366923118.629): A one-unit increase in inflation is associated with an increase of 366,923,118.629 units in goods - imports, holding other variables constant. National-income (0.220744433971): A one-unit increase in national-income is associated with an increase of 0.220744433971 units in goods - imports, holding other variables constant. Oil - price (173710631.491): A one-unit increase in oil - price corresponds to an increase of 173,710,631.491 units in goods - imports, holding other variables constant. Adjusted R-squared (0.879190): This suggests that approximately 87.92% of the variation in goods - imports is explained by the model, which incorporates the combined effects of inflation, national-income, and oil - prices. This relatively high R-squared indicates a good fit; however, it doesn't

necessarily imply that the model is perfect or that the relationships are causal. Durbin-Watson Statistic (0.996544): The Durbin-Watson statistic tests for autocorrelation in the residuals (the differences between actual and predicted values). A value close to 2 typically suggests no autocorrelation, while a value close to 0. Prob(F-statistic) (0.000000): This represents the p-value associated with the F-statistic, which tests the overall significance of the model. A p-value of 0.000000 (or very close to it) suggests that the model is statistically significant at any conventional significance level. This implies that at least one of the independent variables is likely to have a statistically significant relationship with the dependent variable. Look at table5

Table 5: Regression Model

Equation:	GOODS_IMPORTS = C(1) + C(2)inflation__CONSUMER_PRIC + C(3)NATIONAL_IINCOME + C(4)OIL_PRICE
Adjusted R-squared	0.879190
Durbin-Watson stat	0.996544
Prob(F-statistic)	0.000000
Substituted Coefficients:	GOODS_IMPORTS = -7006817730.27 + 366923118.629inflation__CONSUMER_PRIC + 0.220744433971NATIONAL_IINCOME + 173710631.491OIL_PRICE

Table 6 illustrates the directional relationships between the dependent variable, "goods - imports," and three independent variables: national-income, inflation, and oil - price. It shows how changes in each independent variable are expected to affect goods - imports, assuming all other factors remain constant (ceteris paribus). However, it's important to note that this analysis shows correlation rather than causation, and it does not indicate the strength of these relationships. Here's a breakdown: 1. National-income (Positive Relationship): There is a direct relationship between national-income and goods - imports. As national-income increases, goods - imports are expected to rise; conversely, If national-income decreases, goods - imports are likely to decrease as well. This trend is common; typically, as a country's income increases, it tends to import more goods. 2. inflation (Positive Relationship): This suggests that with increases in inflation, goods - imports are also expected to rise. This might seem counterintuitive, as one might expect higher inflation to reduce purchasing power and lower imports. However, a few factors might explain this positive relationship. For instance, If a country's currency depreciates due to inflation, imported goods may become more expensive, increasing the total value of imports even If the volume decreases. Additionally, If the imported goods are essential or not easily substituted, demand may remain high despite rising prices. 3. Oil - price (Positive Relationship): This indicates that as oil - prices increase, goods - imports are likewise expected to increase. The relationship is complex and depends on whether the country is a net oil importer or exporter. For a net oil importer, higher oil - prices raise the value of oil imports, which contributes to total goods - imports. Conversely, for a net oil exporter, increased oil - prices can boost export revenues, potentially leading to higher overall imports as the economy strengthens. Let's analyze these relationships in more detail, considering economic theory: 1. National-income and goods - imports (Positive): Economic Theory: This positive relationship is strongly backed by economic theory. Higher national-income generally reflects increased economic activity and higher aggregate demand. As income rises, consumers tend to purchase more goods and services, including imports. Businesses also increase their demand for imported inputs (e.g., raw materials, intermediate goods) to support higher production levels. This principle is a fundamental aspect of macroeconomics related to the income elasticity of demand for imports. Example: If a country's NAP grows, consumers are likely to buy more imported electronics, vehicles, and clothing. Businesses will also import more machinery and parts to expand their operations. 2. inflation and goods - imports (Positive - Potentially Complex): Economic Theory: The relationship between inflation and goods - imports is nuanced and influenced by several factors: Currency Depreciation: If inflation leads to currency depreciation, the domestic price of imports increases. This may lead to a decrease in the volume of imports, but the overall value of imports (measured in domestic currency) could still rise, especially If demand is inelastic. Relative Price Changes: inflation can alter relative prices within an economy. If domestically produced goods see a price increase faster than that of imported goods, consumers might shift their purchases to imports, even If the domestic price of imports is rising. Expectations: If businesses anticipate further inflation and currency depreciation, they might increase imports in the short term to avoid paying higher prices later. Composition of Imports: The impact of inflation can also depend on the types of goods being imported. If a significant portion consists of essential items (e.g., food, medicine, energy), demand might remain relatively inelastic, leading to an increase in import value with rising inflation. Example: In a scenario where a country faces high inflation and currency depreciation, consumers may buy fewer luxury imported goods but still import essential food items, resulting in an overall increase in the value of goods - imports.3. Oil - price and goods - imports (Positive): Economic Theory: The relationship between oil - prices and goods - imports significantly depends on whether a country is a net oil importer or exporter: Net Oil Importer: For a net oil

importer, rising oil - prices directly increase the value of oil imports, which is a component of total goods - imports. Higher oil - prices can also lead to increased production costs for businesses, potentially reducing overall economic activity and dampening demand for other imports. The overall effect will hinge on the balance of these Opposing factors. Net Oil Exporter: For a net oil exporter, increased oil - prices lead to higher e export revenues, which may indirectly result in greater imports as the economy strengthens and consumers' purchasing power improves. In conclusion, the relationships between goods - imports, national-income, inflation, and oil - prices are interconnected.

Table 6: The relationship between variables

independent variables	**relationship between dependent variable goods - imports and independent Na, If, Op.**
national-income	positive
inflation	positive
oil - price	positive

Model Quality

Figure 1 shows a histogram of the residuals from a statistical model, likely a regression analysis. Let's break down the analysis: 1. Histogram: - Shape: The histogram exhibits a roughly symmetrical distribution of residuals centered around zero. This is a good sign, as it suggests that the errors are randomly distributed. However, it is not perfectly normal (bell-shaped). There is a slight positive skewness indicated by the longer tail on the right side. - Bars: Each bar represents the frequency of residuals falling within a specific range. The tallest bars are clustered around zero, indicating that most residuals are close to zero, which is desirable. - Gaps: Clear gaps are present between some of the bars, especially in the tails. 2. Descriptive Statistics (Right Panel): - Series: The title "Residuals" confirms that this analysis focuses on the model's errors. - Sample: The data covers the years 2002 to 2020. - Observations: A total of 19 data points were used to build the model. This is a relatively small sample size, which may limit the reliability of some statistical inferences. - Mean: The mean of the residuals is very close to zero (5.47e-06), which is desirable and suggests that the model is unbiased. - Median: The median (-2.12e+09) is also near zero, further supporting the idea of a roughly symmetrical distribution. - Maximum & Minimum: The maximum (3.98e+10) and minimum (-2.87e+10) values show the range of the residuals. The differing signs but similar magnitudes indicate a degree of symmetry. - Standard Deviation: The standard deviation (1.35e+10) measures the dispersion or spread of the residuals. A smaller standard deviation reflects a better fit. - Skewness: Skewness measures the asymmetry of the distribution. A value of 0.962326 indicates positive skewness, confirming the longer right tail observed in the histogram. - Kurtosis: Kurtosis assesses the "peaked Ness" of the distribution. A value of 5.816539 is higher than the normal distribution's kurtosis (which is 3), suggesting that the distribution has heavier tails and a sharper peak than a normal distribution. - Jarque-Bera Test: This test evaluates normality based on skewness and kurtosis.

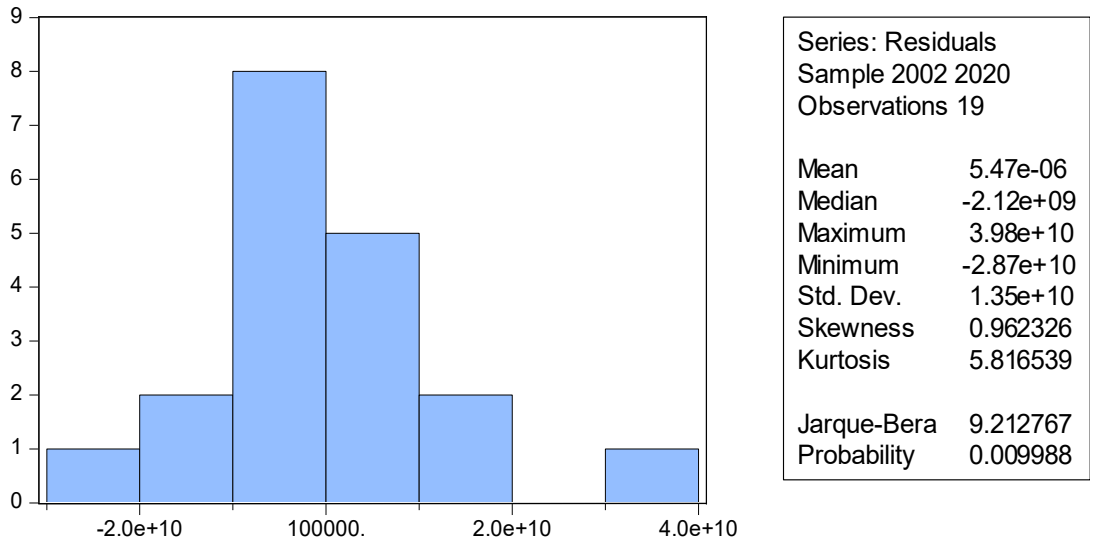

Figure1: Jarque-Bera test

All the VIF (Variance inflation Factor) values are well below 5, indicating that there is likely no significant multicollinearity issue among these variables. The values are close to 1, which suggests minimal correlation between

the independent variables. Since the VIFs are low, can proceed with regression analysis without worrying about multicollinearity distorting your results look at table 7.

Table 7: variance inflation factors test

variables	goods - imports	national-income	inflation	oil - price
Value	2.114681	1.242493	1.501423	0.730862

CONCLUSION

This study investigates the dynamic relationship between national-income and goods - imports in Saudi Arabia, considering the impacts of inflation and oil - prices within the framework of the Vision 2030 diversification plan. Using time series data from 2002 to 2023, the analysis reveals a long-term equilibrium relationship between these variables, indicating that while short-term fluctuations may occur, they generally converge towards a stable long-term trend. The regression model shows a positive association between goods - imports and national-income, inflation, and oil - prices. However, interpreting the relationships with inflation and oil - prices necessitates careful consideration of Saudi Arabia's context as a major oil exporter. Although the model demonstrated a good fit with a high R-squared value, residual diagnostics indicated some deviations from normality. These limitations should be taken into account in future research. Despite these challenges, the study offers valuable insights for policymakers in Saudi Arabia as they navigate the complexities of economic diversification. It emphasizes the importance of understanding the interplay between national-income, import patterns, and other macroeconomic factors in achieving sustainable economic growth. Future research could explore more nuanced relationships, incorporate additional variables, and employ advanced econometric techniques to enhance our understanding of these critical dynamics.

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