

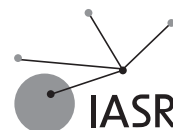


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Article

Dynamic Analysis of Korea's Crude Oil Import Demand: The Impact of Economic Growth, Oil Prices, and Major Economic Disruptions (1980-2023)

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Abstract

This paper presents an analysis of South Korea's crude oil import demand from 1980 to 2023. The analysis considers the impacts of economic growth, oil prices, and economic disruptions, including the Asian financial crisis (1997-1998), the global financial crisis (2008-2009), and the COVID-19 pandemic (2020-2021). The study employs an Autoregressive Distributed Lag (ARDL) approach to examine the short- and long-run relationships between crude oil imports, GDP, and oil prices. The results demonstrate that, in the long run, real GDP has a positive effect on crude oil import demand, while oil prices have a significant negative effect. This confirms that South Korea's crude oil demand is more elastic in income than in price. The Asian financial crisis and the COVID-19 pandemic show significant impacts on the long-term crude oil demand, while the 2008 global financial crisis does not have a significant effect. In the short run, the effects of oil prices, GDP and economic disruptions are not statistically significant. However, there is a rapid adjustment towards long-term equilibrium, indicating that long-term factors exert a predominant influence. The findings emphasise the significance of long-term economic fundamentals in influencing crude oil import patterns and propose policy measures to enhance energy security.

Keywords

Oil price, GDP, ARDL, Economic disruptions, COVID-19

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Introduction

South Korea's rapid economic growth over the past several decades has transformed the country into one of the world's most energy-intensive economies. Without domestic oil production capabilities, the nation has relied on imported crude oil to fuel its industrialization and economic development. This dependence has made South Korea sensitive to fluctuations in global oil markets, highlighting the strategic necessity of understanding the dynamics that shape its crude oil import demand. In the context of global economic interconnectedness and heightened energy security concerns, it becomes crucial to investigate how macroeconomic indicators and global economic disruptions influence Korea's import patterns.

This study aims to provide a comprehensive and detailed examination of South Korea's crude oil import demand from 1980 to 2023. Specifically, the analysis investigates the impacts of economic growth, volatility in international crude oil prices, and global economic disruptions, notably the Asian financial crisis (1997-1998), the global financial crisis (2008-2009), and the COVID-19 pandemic (2020-2021). These disruptive events have each tested the resilience of Korea's economy and energy policy frameworks, necessitating a deeper understanding of their short- and long-term impacts on crude oil import demand.

Employing the autoregressive distributed lag (ARDL) bounds testing approach, it captures both immediate short-term adjustments and stable long-term equilibrium relationships among these variables. This methodology allows for robust and nuanced analyses even in the presence of dynamics and mixed orders of integration in the data series (Abumunshar et al., 2020). By applying this approach, the research distinguishes between shocks and sustained structural changes in crude oil import demand.

By examining the interplay among economic growth, oil price elasticity, and major global economic disruptions, this study seeks to offer a perspective on the structural resilience and inherent vulnerabilities of South Korea's energy import strategies. The insights derived from this analysis have direct implications for policymakers and industry stakeholders. Specifically, the study aims to support the formulation of policies that enhance energy security, diversify energy sourcing, mitigate risks associated with global oil price volatility, and effectively manage the uncertainties arising from potential future global economic disruptions. Ultimately, the findings are intended to assist in fostering sustainable economic growth and stability through informed and proactive energy policy strategies.

Literature Review

This research contributes to the literature by offering a perspective on the interconnected dynamics of crude oil imports, economic growth, and global disruptions, particularly in the context of South Korea. While previous studies have examined South Korea's growing international influence from a broader diplomatic and geopolitical perspective (Kim & Lim, 2016; Patterson & Choi, 2018), there has been a relative lack of empirical research specifically analyzing the determinants of Korea's crude oil import demand within this strategic context. By addressing previously unexamined variables and extending the scope of analysis, the present study establishes a framework for understanding energy security in the face of unprecedented challenges.

The evolution of crude oil import demand has long been a subject of sustained scholarly inquiry, particularly in the context of industrializing economies with high dependence on energy imports (Lv & Wu, 2022; Michieka et al., 2024; Salisu & Isah, 2017). In the case of South

Korea, the importance of this inquiry is magnified due to the country's complete reliance on imported crude oil and the centrality of energy-intensive industries to its post-war economic development. Since the 1960s, South Korea's rapid industrialization in export-led growth and large-scale manufacturing has intensified energy requirements (Kim et al., 2024), culminating in a persistent upward trajectory in crude oil consumption (An et al., 2020). This structural dependency on oil imports has positioned South Korea as a crucial case for examining the interplay between economic growth, international oil prices, and external shocks in shaping oil demand (Kim & Paik, 2024).

At the theoretical level, the demand for imported crude oil is frequently analyzed through the lens of elasticity, with particular attention to income elasticity, price elasticity and other economical index (Jibril et al., 2020; Skeer & Wang, 2007; Wang & Liao, 2022). Classical and neoclassical economic theories suggest that income growth leads to increased energy consumption in developing and industrializing economies, while higher energy prices tend to reduce demand (Weixian, 2002; Zhao & Wu, 2007; ZhiDong, 2003). However, a recurring theme in the literature is the asymmetry between income and price elasticities—wherein the former is generally found to be elastic or unitary, while the latter is typically inelastic. Studies such as those by Dahl and Sterner (1991), Bentzen and Engsted (1993) have provided estimates for a range of economies, noting that oil demand tends to be more responsive to macroeconomic expansion than to fluctuations in prices (Bentzen & Engsted, 1993; Chen & Sun, 2021; Dahl & Sterner, 1991; Ederington et al., 2021). This observation has been confirmed in empirical work spanning world markets (Krichene, 2002) and various countries, including India (Ghosh, 2009), South Africa (Akinboade et al., 2008; Ziramba, 2010), Indonesia (Sa'ad, 2009), and Barbados (Moore, 2011).

Empirical methodologies employed in this field have become sophisticated over time. While earlier studies relied on static regression models, the advent of time series econometrics has introduced tools such as cointegration analysis and autoregressive distributed lag (ARDL) models to assess both short- and long-run dynamics (Pesaran et al., 1998). The ARDL bounds testing approach, developed by Pesaran et al. (2001), has proven particularly robust in small-sample contexts and in cases where variables exhibit mixed orders of integration—a common feature in macroeconomic time series (Pesaran et al., 2001). The method's flexibility has led to its widespread adoption in energy economics (Raza & Lin, 2021; Raghoo & Surroop, 2020), allowing researchers to uncover relationships between oil demand and its determinants.

An emerging strand in the literature has extended beyond traditional elasticities to incorporate the role of structural breaks and external shocks (Chan & Lee, 1996). Researchers such as Crompton and Wu (2005), Von Hirschhausen and Andres (2000), and Kumar and Mallick (2024) have underscored the need to account for financial crises, geopolitical volatility, and, more recently, pandemic-induced disruptions (Kumar & Malik, 2024). These studies often reveal non-linear or asymmetric effects, suggesting that macroeconomic shocks can have both immediate and persistent effects on oil consumption patterns. For instance, Narayan (2022) demonstrated that the COVID-19 pandemic introduced significant volatility and clustering in oil price movements, affecting global energy trade.

In the South Korean context, empirical investigations into oil import demand remain comparatively sparse, often constrained by temporal or methodological limitations. Kim and Baek (2013) applied a linear ARDL model to quarterly data spanning 1980–2010, estimating long-run elasticities of 0.92 for income and -0.22 for price. While this study offered valuable insights into post-Asian financial crisis dynamics, it did not address the more recent global shocks that have significantly altered energy markets. Similarly, Shin et al. (2018) extended the analysis to include the 2008 financial crisis and applied an asymmetric ARDL framework,

revealing differential effects of positive and negative oil price changes. Nonetheless, this study was conducted prior to the COVID-19 pandemic and could not account for its unprecedented global economic impact.

Moreover, Korea's evolving energy landscape necessitates a reassessment of existing elasticity estimates. Over the past two decades, Korea has undertaken significant energy policy reforms, including strategic oil stockpiling, diversification of energy sources (e.g., liquefied natural gas, renewables), and the promotion of energy-efficient technologies. These developments have potentially altered the structural responsiveness of oil demand to both income and price variables. For example, Malik et al. (2020) suggest that such structural shifts can attenuate short-term sensitivity to shocks, a hypothesis that warrants empirical testing in the Korean case.

Another critical limitation in the existing Korean literature is the insufficient consideration of the COVID-19 pandemic as an economic shock variable. While the pandemic has been incorporated into oil demand models for ASEAN countries (Nusair & Olson, 2021) and global oil price volatility studies (Narayan, 2022), its specific effect on Korea's oil import behavior remains largely unexplored. This omission is notable, given Korea's role as a major manufacturing and exporting economy highly integrated into global supply chains—conditions that made it especially susceptible to the pandemic's economic repercussions.

This study addresses these gaps by conducting a comprehensive analysis of Korea's crude oil import demand over an extended period (1980–2023), using the ARDL bounds testing framework to evaluate both short-run and long-run relationships. The study distinguishes itself by explicitly incorporating three major economic disruptions—the 1997 Asian financial crisis, the 2008 global financial crisis, and the 2020–2021 COVID-19 pandemic—into the analytical model as dummy variables. This enables a more rigorous assessment of the extent to which external shocks have altered demand behavior and whether structural adjustments have made Korea's energy demand more resilient over time.

Model

To examine the key factors influencing crude oil import demand in Korea, this study introduces a refined analytical framework that accounts for both traditional determinants and newly emerging variables, such as the economic impacts of the COVID-19 pandemic. This approach extends beyond existing models by integrating a broader temporal scope and incorporating recent global economic disruptions.

$$\log(IM_t) = \alpha_0 + \alpha_1 \log(RP_t) + \alpha_2 \log(GDP_t) + \alpha_3 DUM_1 + \alpha_4 DUM_2 + \alpha_5 DUM_3 + \epsilon_t$$

In this model, IM_t represents the volume of Korea's crude oil imports; RP_t denotes the real price of crude oil; GDP_t signifies real income of Korea and DUM_1 , DUM_2 , and DUM_3 are dummy variables capturing significant market shocks. Specifically, the value of DUM_1 is set to one during the period of the Asian financial crisis (1997 Q3 - 1998 Q4) and zero otherwise, DUM_2 represents the 2008 financial crisis period (2007 Q4 - 2009 Q2), while DUM_3 captures the period of the global pandemics caused by the COVID-19 (2020 Q1 - 2021 Q4).

An increase in the price of crude oil is expected to decrease the imported volume of crude oil, suggesting that the estimate of α_1 is negative. It is anticipated that economic growth in Korea, which is expected to result in increased economic activity, will lead to an increase in the demand for imported crude oil. Consequently, the estimate of α_2 is expected to be positive. The dummy

variables are expected to capture the effects of economic disruptions on crude oil imports. In particular, α_3 , α_4 , α_5 are expected to reflect the impact of the Asian financial crisis, the 2008 financial crisis, and the COVID-19 pandemic, respectively.

In order to implement the bounds testing procedure, as proposed by Pesaran et al. (2001), it is necessary to reformulate the initial equation as a conditional autoregressive distributed lag (ARDL) model:

$$\begin{aligned} \Delta \log(IM_t) = & \beta_0 + \beta_1 DUM_1 + \beta_2 DUM_2 + \beta_3 DUM_3 \\ & + \sum_{i=1}^p \eta_i \Delta \log(IM_{t-i}) + \sum_{i=0}^p \phi_i \Delta \log(RP_{t-i}) + \sum_{i=0}^p \xi_i \Delta \log(GDP_{t-i}) \\ & + \lambda_1 \log(IM_{t-1}) + \lambda_2 \log(RP_{t-1}) + \lambda_3 \log(GDP_{t-1}) + \mu_t \end{aligned}$$

In this formulation, Δ denotes the first difference operator, p represents the lag length, and μ_t is an error term that is assumed to be serially uncorrelated. The estimates of λ_1 , λ_2 , λ_3 represent the long-run (cointegration) relationship, while the coefficients of the summation signs (Σ) demonstrate the short-run relationship between Korea's imports of crude oil and its principal determinants.

Pesaran et al. (1998) demonstrate that in this type of specification, the selected variables are said to be cointegrated if all the lagged-level variables are jointly significant in the equation. This can be tested using an F-test with two sets of asymptotic critical values (upper and lower critical values). The upper critical value is based on the assumption that the variables are I(1), or nonstationary, while the lower critical value is based on the assumption that they all are I(0), or stationary. If the computed F-statistic exceeds the upper bound of the critical value, it can be concluded that the selected variables are cointegrated. It is notable that, in contrast to the standard cointegrated techniques (e.g., Engle & Granger, 1987; Kitamura, 1995), the ARDL is not constrained by the assumption that all variables are I(1) or I(0). Consequently, it can be applied irrespective of their order of integration, thus circumventing the pre-testing issues that arise when this assumption is violated. The model will permit the assessment of both the short- and long-run impacts of economic growth, crude oil prices, and significant economic disruptions (captured by the dummy variables) on Korea's crude oil import demand from 1980 to 2023.

Data

The data employed for this analysis encompass a 43-year period (1980 to 2023) with quarterly observations. The expanded data set encompasses a more recent period and provides a more comprehensive analysis of Korea's crude oil import demand.

The quantity of crude oil imports, expressed in thousands of barrels, is derived from the Petronet database, which is provided by the Korea National Oil Corporation (KNOC). The real crude oil price series, expressed in U.S. dollars per barrel, are averages of monthly West Texas Intermediate (WTI) spot prices and are sourced from the U.S. Energy Information Administration (EIA). The income of Korea is measured as gross domestic product (GDP), which was obtained from the Korean Statistical Information Service (KOSIS).

In this study, three dummy variables are included to capture significant market shocks. DUM1 represents the Asian financial crisis (from 1997 Q3 to 1998 Q4), DUM2 represents the 2008 financial crisis (from 2007 Q4 to 2009 Q2), and DUM3 represents the COVID-19 pandemic (from 2020 Q1 to 2021 Q4). The dummy variables are assigned a value of one during the

respective periods and a value of zero otherwise. Finally, as all variables have been converted to natural logarithms, the estimated coefficients can be interpreted as elasticities. This transformation permits the interpretation of the effects of the explanatory variables on the demand for crude oil imports in Korea.

Empirical Results

Prior to the application of the ARDL model, it is important to certain the optimal lag length for the model. Previous studies (Bahmani-Oskooee & Ardalani, 2006; Bahmani-Oskooee & Brooks, 1999) have demonstrated that the outcomes of the F-test can be significantly influenced by the selected lag structure of first differenced variables. In accordance with the methodology proposed by Pesaran et al. (2001), the lag structure (P) is identified through the application of the Akaike Information Criterion (AIC) and the conduct of diagnostic tests for serial correlation utilising the Lagrange Multiplier (LM) statistics (see Table 1).

Cointegration is essential as it indicates a long-term equilibrium relationship among variables, ensuring that they move together over time despite short-term fluctuations. This prevents the problem of spurious regression, where relationships may appear significant statistically but are meaningless. By confirming cointegration, we can apply the Error Correction Model (ECM) to simultaneously analyze short-term dynamics and long-term relationships, enhancing the accuracy

Table 1. Results of cointegration test among variables

Lag order	AIC	χ^2_{sc}	F-statistic
1	-252.89	12.81 ***	6.27 ***
2	-270.41	10.32 ***	2.76 **
3	-275.94	3.59 *	1.75 *

Note: χ^2_{sc} is Lagrange multiplier (LM) statistic for testing the hypothesis of no serial correlation. F-statistic is the test statistics for cointegration. F-statistic for the 5% critical value bound is (3.10, 3.87), which is obtained from Table CI(ii) in Pesaran et al. (2001).

*** An asterisk indicates significance at the 1% level.

** An asterisk indicates significance at the 5% level.

* An asterisk indicates significance at the 10% level.

Table 2. Estimated long-run coefficients and t-ratios of the crude oil imports in Korea

Variable	Coefficient	t-Ratio
Oil price (RP)	-0.06	-8.15**
Income (GDP)	0.27	18.00***
Asian financial crisis (<i>DUM1</i>)	0.08	5.07*
2008 financial crisis (<i>DUM2</i>)	-0.01	-0.07
COVID-19 pandemic (<i>DUM3</i>)	-0.09	-6.57**
Constant	9.49	18.31**

*** An asterisk indicates significance at the 1% level.

** An asterisk indicates significance at the 5% level.

* An asterisk indicates significance at the 10% level.

and reliability of our economic forecasts. Given these considerations, we selected a lag length of one quarter ($p = 1$) because the F-statistic for lag 1 significantly exceeds the 1% critical value on table 1, indicating a robust long-run relationship among the variables. This choice balances the need for low AIC and ensuring no serial correlation in residuals, while strongly supporting the existence of cointegration. Given the selected lag length and the AIC values, the ARDL approach suggests ARDL (1, 1, 1) as the optimal lag structure for the model.

The long-run analysis confirms that income and oil prices significantly influence Korea's crude oil import demand, with income having a more pronounced effect (Table 2).

This study additionally demonstrates the influence of major economic occurrences, such as the Asian financial crisis and the global pandemic caused by COVID-19 pandemic, on the patterns of crude oil importation. The results of the long-run coefficient estimate of Korea's import demand for crude oil indicate that the majority of variables are statistically significant at the 5% level and exhibit the expected signs on Table 2. Firstly, there is a positive long-run relationship between income (GDP) and crude oil import demand. The coefficient for income (GDP) is 0.27, with a t-ratio of 18.00, indicating a high level of statistical significance. This indicates that as Korea's real income increases, economic activity rises, resulting in an increase in crude oil import demand.

Conversely, a negative long-run relationship is observed between oil prices (RP) and crude oil import demand. The coefficient for oil price (RP) is -0.06, with a t-ratio of -8.15, which is statistically significant at the 5% level. This suggests that a 1% increase in oil prices is associated with a 0.06% reduction in crude oil imports. This relatively low-price elasticity indicates that Korea's crude oil demand is inelastic, likely due to the country's heavy reliance on imported crude oil given the lack of significant domestic reserves.

The influence of disparate economic disturbances on crude oil import demand is also noteworthy. The Asian financial crisis (DUM_1) exhibits a pronounced positive impact, with a coefficient of 0.08 and a t-ratio of 5.07. This suggests that crude oil imports increased during the crisis, likely due to Korea's assertive export promotion policies and industrial growth, which necessitated substantial energy inputs.

In contrast, the 2008 financial crisis (DUM_2) had a negligible impact on crude oil imports. The coefficient is -0.01 with a t-ratio of -0.07, indicating that the 2008 crisis did not exert a notable influence on Korea's long-term crude oil import demand. However, the impact of the global pandemic caused by the COVID-19 pandemic (DUM_3) has been significant and negative, with a coefficient of -0.09 and a t-ratio of -6.57. This suggests that the pandemic resulted in a decline in crude oil imports, potentially due to the global economic downturn and reduced industrial activity. Lastly, the constant term is 9.49 with a t-ratio of 18.31, which is also significant at the 1% level. This represents the baseline level of crude oil imports in the absence of other influencing factors.

The results of the short-run analysis indicate that short-term fluctuations in oil prices, changes in income, and economic events such as the Asian financial crisis, the 2008 financial crisis, the COVID-19 pandemic do not have a statistically significant impact on Korea's crude oil import demand. However, the significant error correction term indicates a rapid adjustment towards long-term equilibrium, thereby underscoring the relevance of long-term factors in influencing crude oil import patterns. The short-run coefficient estimates of Korea's crude oil imports indicate that the most variables do not exert a statistically significant impact, as presented in Table 3.

On table 3, the change in oil prices (ΔRP) has a coefficient of -0.08 with a t-ratio of -1.44, indicating that short-term fluctuations in oil prices do not significantly affect Korea's crude oil imports at any conventional levels of significance. Similarly, changes in income (ΔGDP) demonstrate a coefficient of 0.10 with a t-ratio of 0.74, which is not statistically significant

Table 3. Estimated short-run coefficients and t-ratios of the crude oil imports in Korea

Variable	Coefficient	t-Ratio
ΔRP	-0.08	-1.44
ΔGDP	0.10	0.74
Asian financial crisis (DUM_1)	-0.01	-0.22
2008 financial crisis (DUM_2)	-0.04	-0.86
COVID-19 pandemic (DUM_3)	-0.02	-0.44
ec_{t-1}	0.89	4.99***
Constant	0.02	2.18*

*** An asterisk indicates significance at the 1% level.

* An asterisk indicates significance at the 10% level.

ec_{t-1} represents the error correction term.

at any conventional level. This indicates that short-term fluctuations in income do not exert a notable influence on crude oil import demand. The variable representing the Asian financial crisis (DUM_1) has a coefficient of -0.01 with a t-ratio of -0.22, indicating that there is no significant impact on crude oil imports in the short run. The variable representing the 2008 financial crisis (DUM_2) also demonstrates no significant effect, with a coefficient of -0.04 and a t-ratio of -0.86. This suggests that the 2008 financial crisis did not exert a notable influence on Korea's crude oil import demand in the short term. Similarly, the coefficient for the variable representing the impact of the COVID-19 pandemic (DUM_3) is -0.02, with a t-ratio of -0.44. This indicates that the pandemic did not significantly affect crude oil imports in the short run. Notwithstanding the global economic downturn precipitated by the pandemic, the data do not demonstrate a significant immediate impact on crude oil import demand.

Nevertheless, the error correction term (ec_{t-1}) is of considerable importance, with a coefficient of 0.89 and a t-ratio of 4.99, which is significant at the 1% level. This indicates a robust adjustment process towards long-term equilibrium, with approximately 89% of the short-term disequilibrium corrected within a single quarter. These findings highlight the pivotal role of long-term factors in shaping crude oil import demand. The constant term has a coefficient of 0.02 with a t-ratio of 2.18, which is significant at the 10% level. This represents the baseline level of crude oil imports, which accounts for factors not included in the model. The 2013 study revealed that Korea's crude oil import demand exhibited elastic behaviour in response to price changes in the short term (Kim & Baek, 2013). However, the result of this study indicates that, in the short term, none of the variables have a significant impact on crude oil imports. This shift can be attributed to a number of factors, including changes in market structure, policy and regulatory adjustments, economic factors, and external shocks. Considering the structural changes that have occurred in the global oil market since 2013, it can be posited that crude oil plays an indispensable role in meeting Korea's energy needs and supporting industrial processes. Consequently, it is less susceptible to short-term economic fluctuations. Furthermore, the government's intensified stockpiling strategies may have diminished the short-term elasticity of oil demand. It is also possible that the stabilisation and continuous growth of the Korean economy, the adoption of energy-efficient technologies and changes in industrial structure have been significant factors. The global economic impact of the COVID-19 pandemic was felt across the market, with ramifications for oil demand. As the global economy gradually recovered from the pandemic, the short-term price elasticity of oil demand is likely to have decreased. This has

Table 4. Comparative long- and short-run price and income elasticities of crude oil import demand across countries and studies

Researcher (Year)	Country	Dependent Variable	Independent Variables	Long-term Price Elasticity	Long-term Income Elasticity	Short-term Price Elasticity	Short-term Income Elasticity
Ghosh (2009)	India	Quantity of crude oil import	Real GDP, Price of imported crude	-0.63	1.97	-0.07	0.19
Akinboade et al. (2008)	South Africa	Gasoline consumption	Real per capita income, Real gasoline price	-0.47	0.36	-0.12	0.14
Sa'ad (2009)	Indonesia	Petroleum consumption	Real GDP, Real petroleum price	-0.16	0.88	-0.05	0.09
Moore (2011)	Barbados	Oil imports	Real GDP, Oil price	-0.55	0.91	-0.18	0.22
Raza and Lin (2021)	Pakistan	Oil import demand	Real GDP, Oil price, Exchange rate	-0.17	0.73	-0.09	0.15
Raghoo and Surrop (2020)	Mauritius	Oil import demand	Real GDP, Oil price, Industrial production	-0.3	0.67	-0.1	0.12
Nusair and Olson (2021)	ASEAN countries	Oil imports	Real GDP, Oil price, Terms of trade	Asymmetric	1.21	Asymmetric	0.3
Kim and Baek (2013)	South Korea	Oil imports	Real GDP, Oil price, Asian financial crisis	-0.22	0.92	-0.1	0.12
Shin et al. (2018)	South Korea	Oil imports	Real GDP, Oil price, Asian financial crisis, 2008 financial crisis	Asymmetric	1.09	Asymmetric	Not significant
Kim and Paik (2025) – This study	South Korea	Oil imports	Real GDP, Oil price, Asian financial crisis, 2008 financial crisis, COVID-19 pandemic	-0.06	0.27	-0.08 (Not significant)	0.1 (Not significant)

resulted in a more stable oil demand in Korea, which is now primarily determined by long-term economic fundamentals. The demand pattern is therefore inelastic and less sensitive to short-term price fluctuations.

Comparative Analysis of Crude Oil Import Demand and Implication

This study examined the crude oil import demand of South Korea from 1980 to 2023, considering significant economic occurrences such as the Asian financial crisis, the 2008 global financial crisis, and the global pandemic caused by COVID-19. The long-term analysis demonstrated that real GDP and oil prices exert a considerable influence on South Korea's crude oil import demand. In contrast, the short-term analysis indicated that these events have a negligible impact on crude oil import demand of South Korea.

Long-term Elasticity Comparison

In comparison to South Korea (0.27), all the countries show higher long-term income elasticity include India (1.97), ASEAN countries (1.21). These countries demonstrate a more pronounced correlation between economic growth and oil imports. South Africa (0.36), Mauritius (0.67), Barbados (0.91), and Indonesia (0.88) also exhibit higher income elasticity than South Korea. With regard to long-term price elasticity, countries such as Barbados (-0.55), South Africa (-0.47), Mauritius (-0.30) display greater elasticity than South Korea (-0.06), indicating a higher degree of sensitivity to price fluctuations. Similarly, Indonesia (-0.16) and Pakistan (-0.17) demonstrate comparable or more elastic responses.

Short-term Elasticity Comparison

In terms of short-term income elasticity, countries that outperform South Korea include India (0.19), Barbados (0.22), South Africa (0.14). These countries demonstrate a greater responsiveness to short-term economic growth. In terms of short-term price elasticity, countries such as Barbados (-0.18), South Africa (-0.12), Mauritius (-0.10), display greater elasticity than South Korea (-0.08). Both Indonesia and Pakistan exhibit a similar sensitivity to price changes, with Indonesia displaying a price elasticity of -0.05 and Pakistan showing a price elasticity of -0.09.

Comparative Analysis with Previous South Korean Studies

In comparison with previous studies conducted on South Korea's crude oil import demand, the results of this study reveal a notable structural shift in both long-term and short-term elasticities over time. Kim and Baek (2013) estimated the long-run price elasticity at -0.22 and the income elasticity at 0.92, Shin et al. (2018) reported an asymmetric price elasticity and a long-run income elasticity of 1.09, while the short-run elasticities were not statistically significant. In contrast, the current study finds that the long-run price elasticity has declined markedly to -0.06, and the income elasticity has similarly fallen to 0.27. This steady decline over the past decade indicates that Korea's crude oil import demand has become significantly less responsive to changes in oil prices and income levels. Such a transformation may be attributed to several key structural developments, including the improvement of energy efficiency across industrial sectors, the advancement of energy substitution technologies, and the diversification of Korea's energy portfolio through the adoption of renewable sources and liquefied natural gas (LNG). In addition, the expansion of government-led strategic petroleum reserves and hedging mechanisms has likely contributed to mitigating the sensitivity of oil import behavior to international price volatility.

This trend of declining elasticity is also evident in the short-run dynamics. While the 2013 study reported short-run price and income elasticities of -0.10 and 0.12, and the 2017 study reported values of -0.09 and 0.10 respectively, the current findings suggest even lower responsiveness with a short-run price elasticity of -0.08 and an income elasticity of 0.10. The declining short-run elasticities imply that crude oil import demand has become increasingly stable in the face of temporary economic shocks and market disturbances. This could be a result of several interrelated factors, including macroeconomic stabilization, a more mature and predictable domestic industrial structure, and Korea's experience in navigating past crises such as the 1997 Asian financial crisis, the 2008 global financial crisis, and the COVID-19 pandemic. Furthermore, the observed inelasticity in both time horizons reflects a broader evolution in

Korea's energy strategy—shifting away from reactive import behavior toward a more forward-looking, buffered, and policy-driven approach.

Implication and Discussion

This study examined the long- and short-run determinants of South Korea's crude oil import demand over the period 1980 to 2023, utilizing the autoregressive distributed lag (ARDL) model. The empirical results confirm a statistically significant long-term relationship between crude oil imports, real GDP, and international oil prices. Specifically, income elasticity (0.27) remains positive and significant, whereas price elasticity (-0.06) is negative but relatively small in magnitude, suggesting that South Korea's crude oil import demand is highly inelastic in the long run. In contrast, the short-run dynamics indicate that fluctuations in real income and oil prices, as well as major economic shocks, including the Asian financial crisis, the 2008 global financial crisis, and the COVID-19 pandemic, do not significantly affect crude oil imports in the short term. However, the significance of the error correction term indicates a rapid adjustment toward the long-run equilibrium, reinforcing the relevance of long-run economic fundamentals.

These findings provide a new perspective when compared to earlier studies. For example, Kim and Baek (2013) estimated a long-run income elasticity of 0.92 and a price elasticity of -0.22 . In contrast, Shin et al. (2018) found an asymmetric price elasticity and a long-run income elasticity of 1.09, while short-run elasticities were not statistically significant. Taken together, the downward trend observed in both income and price elasticities over time points to a structural evolution in South Korea's energy consumption behavior. Several explanations are plausible. First, South Korea has intensified efforts to diversify its energy sources and enhance energy security by investing in strategic stockpiling, energy efficiency improvements, and renewable alternatives. Second, the maturation of Korea's industrial structure and technological advancements in energy-saving equipment have likely contributed to reduced sensitivity to both price and income changes. Third, policy efforts aimed at insulating the domestic economy from external energy shocks—especially during crises—may have muted the short-run impacts of macroeconomic disruptions.

Another key insight from this study is the negligible short-run response to global economic shocks. Although these events significantly disrupted global trade and energy markets, Korea's oil import demand remained largely unaffected in the short term. This outcome diverges from earlier literature, where such shocks were shown to generate temporary but notable declines in oil demand. The difference can be attributed to Korea's enhanced crisis resilience, more sophisticated hedging mechanisms, and improved macro-financial policy coordination.

By extending the time horizon to include more recent data and incorporating major global shocks such as COVID-19, this study fills a crucial gap in the literature and provides updated evidence on the evolution of South Korea's energy demand structure. Moreover, the application of the ARDL model—well-suited for small-sample, mixed-integration datasets—adds methodological rigor by enabling simultaneous estimation of long- and short-run elasticities.

The broader policy implication is clear: South Korea's crude oil import demand is primarily driven by long-term structural variables rather than short-term shocks. This insight is crucial for policymakers designing energy security frameworks, hedging strategies, or long-term climate and energy transition policies. The findings suggest that price-based interventions may be insufficient to influence crude oil import volumes in the short term. Instead, long-term planning focused on economic growth trajectories, energy diversification, and consumption efficiency will be more effective in shaping future energy demand patterns. Finally, the declining elasticities observed

over the last two decades may also signal the early effects of South Korea's ongoing transition toward a low-carbon economy and reflect the need to integrate energy policy more tightly with industrial and environmental planning.

Concluding Remarks

This study not only updates the existing body of knowledge with recent data and events but also offers insights that are relevant to policy. By grasping the intricate relationship between economic growth, oil prices and substantial market shocks, policymakers can devise strategies to reinforce energy security and resilience against prospective disruptions. This comprehensive approach, coupled with the incorporation of the ongoing pandemic as a pivotal variable, serves to underscore the originality and relevance of this research in the context of Korea's energy policy and economic planning.

The findings of this study have significant implications for the government policy. An understanding of the dynamics of crude oil import demand in the context of significant economic disruptions can assist policymakers in the development of strategies to enhance energy security and resilience. The results indicate that policies designed to stimulate economic growth will lead to an increase in crude oil demand, whereas measures aimed at stabilising oil prices may serve to mitigate the impact of price fluctuations. Furthermore, the considerable impact of the global pandemic underscores the necessity for policies that can insulate the energy sector against comparable future disruptions. Further research could examine the asymmetric effects of oil price changes and investigate the role of alternative energy sources in reducing dependency on imported crude oil. In light of the ongoing global energy transition, it is also imperative to evaluate how the transition towards renewable energy sources will impact Korea's energy mix and import patterns in the long term. By incorporating a more comprehensive dataset and taking into account recent economic occurrences, this study provides insights into the factors influencing Korea's crude oil import demand, offering a robust framework for understanding the complex interrelationship between economic growth, oil prices, and significant market shocks.

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