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FACTORS INFLUENCING PAKISTAN ESSENTIAL OIL IMPORT

Pakeeza Khalid

Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad, Pakistan

Corresponding author: pakeezakhalid797@gmail.com

ABSTRACT

This study analyzes the factors influencing the import of essential oils in Pakistan. It empirically investigates the factors affecting essential oil imports using annual time series data for the years 1965–2021 at the national level. The independent variables considered are population, production, area harvested, total supply, domestic consumption, national income, and official exchange rates, while essential oil imports are the dependent variable. The study employs unit root tests and the ARDL (autoregressive lagged distribution technique) to analyze the data. The results indicate that while the area harvested has a minor influence, total supply and domestic consumption play significant roles in the long term. On the other hand, population, output, and exchange rates are relevant in the short term.

***Keywords*:** Essential oil, economy, exchange rate

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1. INTRODUCTION

Essential oils are highly concentrated plant extracts that have been utilized for thousands of years in various cultures for their therapeutic and medicinal properties. These oils are derived from different parts of plants, such as leaves, flowers, stems, roots, and bark, using processes like steam distillation or cold pressing. They are renowned for their distinct fragrances and healing benefits. Essential oils can be found in a wide range of applications, including therapeutic, aromatherapy, personal care products, cleaning agents, cooking, industrial application, and animal/poultry rearing (Jugreet et al. 2020; Aljaafari et al. 2021; Ni et al. 2021; Salman and Imran 2022; Raza et al. 2023; Batool et al. 2023). Moreover, they are vital ingredients in producing perfumes, cosmetics, and pharmaceuticals, making them significant commodities in the global market (Raza et al. 2023).

France, India, China, and the United States are among the top essential oil-producing countries globally. France excels in producing high-quality lavender and rosemary oils, while India is known for its sandalwood and peppermint oils. On the other hand, the leading essential oil-exporting countries include the United States, Germany, China, and France. The United States stands as the largest exporter of essential oils, with a significant portion of its exports heading to Europe and Asia. Notably, the production of essential oils can offer economic opportunities for developing countries, especially those with robust agricultural sectors (Khan et al. 2023).

Pakistan has gained recognition for producing high-quality essential oils like rose, jasmine, lavender, and sandalwood. The main concentration of essential oil production lies in the northern regions of the country. The extraction process typically involves either steam distillation or cold pressing (Azra and Khan 2020). Small-scale farmers in Pakistan play a significant role in cultivating plants used for essential oil extraction, offering them a source of income.

The versatile uses of essential oils in Pakistan encompass aromatherapy, massage therapy, and the production of cosmetics and perfumes. Traditional medicine also employs these oils for treating various ailments such as headaches, respiratory issues, and skin conditions, as well as for their calming and relaxing properties.

Despite being a leading producer, the essential oil industry in Pakistan faces challenges. Chief among them is the lack of modern equipment and technology for efficient extraction. Additionally, limited awareness and education about the benefits and uses of essential oils have resulted in lower domestic demand (Zhang et al. 2022).

In recent years, the trend of importing and exporting essential oils has gained momentum in Pakistan. This growth is attributed to increasing awareness about the benefits of essential oils and the rising demand for natural and organic products. Pakistan's abundance of natural resources, including various plants used for essential oils, has contributed to this trend. As the wellness industry expands and interest in natural remedies grows, essential oils have become more popular across the country. People now use them for a wide array of purposes, from aromatherapy to treating skin conditions and digestive issues (Chatziantoniou et al. 2021).

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In 2021, the Pakistan essential oils market reached $10.3 billion, experiencing a 7.3% growth compared to the previous year. Consumption showed resilience despite a slight dip in 2020-2021. Notably, the most significant growth rate was recorded in 2015, with a 173% increase in production volume compared to the previous year (Chatziantoniou et al. 2021).

As the demand for essential oils continues to grow in Pakistan, many companies are turning to imports of high-quality oils from other countries. Some popular oils that are imported into Pakistan include lavender, tea tree, peppermint, and eucalyptus. In 2021, Pakistan's essential oil imports amounted to $10.3 million, making it the 50th largest importer of Essential Oils in the world. During the same year, Essential Oils ranked as the 476th most imported product in Pakistan. The primary sources of essential oil imports for Pakistan are the United States ($2.97M), China ($1.2M), Uruguay ($1.09M), Germany ($871k), and the United Arab Emirates ($626k). Notably, the fastest-growing import markets for Essential Oils in Pakistan between 2020 and 2021 were the United States ($373k), Germany ($330k), and the United Kingdom ($219k). In addition to importing, Pakistan has also begun exporting its own essential oils to other countries (Li et al. 2021). Rose, jasmine, and sandalwood are among the most popular oils being exported from Pakistan. This presents an opportunity for Pakistani farmers and distillers to showcase their products on a global scale and contributes to boosting the country's economy by generating revenue through exports. In 2021, Pakistan's essential oil exports reached $3.91 million, making it the 61st largest exporter of Essential Oils in the world. During the same year, Essential Oils ranked as the 296th most exported product in Pakistan. The main destinations for Essential Oils exports from Pakistan are the United Arab Emirates ($1.24M), the United Kingdom ($397k), Uruguay ($364k), the Netherlands ($331k), and Iraq ($309k). The fastest-growing export markets for Essential Oils from Pakistan between 2020 and 2021 were the United Kingdom ($266k), the Netherlands ($220k), and Uruguay ($170k) (https://oec.world/; Li et al. 2021).

This research aims to investigate the factors that influence Pakistan's essential oil imports, explore the economic implications of those imports, and assess their effects on the local economy. The study represents an initial step towards understanding the issue of substantial essential oil imports by empirically examining the impact of key factors on essential oil imports. Data was sourced from international trade maps (ITC), USDA foreign and agriculture services. The time series data for the relevant variables were retrieved from these sources, covering the period from 1965 to 2021 for the study. This approach enhances the possibility of identifying the true behavioral relationship between essential oil imports and macroeconomic factors, which may not be apparent at a macro level. In the literature review, it was found that most researchers utilize unit root tests and the ARDL model to investigate the relationship between essential oil imports and other independent variables, as this model is adept at capturing both the long-run and short-run effects of the independent variables on the dependent variable (Salisu and Isah 2017; Sek 2017; Olayungbo 2021; Jalal and Gopinathan 2022; Sreenu 2022).

2. MATERIALS AND METHODS

We developed numerous statistical models to analyze the combined impact of several possible drivers outlined in the scientific literature within a spatially explicit modeling framework to fulfill our goal of determining the causes of essential oil imports. Dewanta et al. (2016) used the ARDL model to explain palm oil export in the Indian market. The demand for Indonesian exports was influenced by palm oil prices, oil prices in the Chinese and Dutch markets, as well as palm oil prices, domestic pricing, and liberalization in the Indian market, according to (Rifin 2010) who also uses data from Indonesia from 1999 to 2007 and employs the ARDL technique. According to (Awad et al. 2007) study using the ARDL and ECM model approaches, the price of oil replacements, national income, and characteristics unique to each country all have an impact on import demand in MENA 1 nations. According to (Egwuma et al. 2016) who used data from 1970 to 2011 and Nigeria and an autoregressive model (ARDL), the Nigerian export palm oil industry was impacted by changes in palm oil prices, technology, income levels, and government spending on agricultural development.

2.1. Unit Root Test

In this study, the Unit Root Test will be used to determine if the data are stationary, and the ARDL model will be used to determine the short- and long-term effects of independent variables on the import of essential oil. With the autoregressive time series design in mind, the unit root test is an econometric technique test to see if the mean and difference change over the long term. It examines the stationary or non-stationary nature of the time-series data using the auto-regressive model. A popular test that is successful with big samples is the enhanced Dickey-Fuller test. In autoregressive models, Denis Sargan and Alok Bhargava developed the ideal limited example tests for a unit root. There is one more test, the Phillips-Perron test. There being a unit root is the null hypothesis for these tests.

2.2. Autoregressive Distributed Lag

For non-stationary and mixed-order integration time series, an autoregressive distributed lag (ARDL) model can be applied. ARDL models are direct time series models in which the regressive and dependent components are

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simultaneously coupled over real (lagged) values as well. In a single-condition structure, ARDL models are widely employed to analyze dynamic relationships with time series data. The distributed lag component allows it to be influenced by the present and past values of extra explanatory variables, while the autoregressive part allows it to be influenced by the dependent variable's own prior realizations. The two types of variables—stationary and non-stationary—as well as a mix of the two are all valid for variables.

The ARDL model makes the following assumptions:
1. The absence of auto connection is the absolute first requirement of ARDL. The model assumes that the error components have no autocorrelation with each other.
2. There should be no heteroscedasticity in the data.
3. The data should be distributed normally.
4. Data must be steady on *I(0), I(1),* or both, but no variable should be stable on *I(2).*

$$L_nEI = f(L_nPOP, L_nAH, L_nPD, L_nTS, L_nER, L_nDC, L_nNI)$$

$$L_nE = \alpha + \beta_1 L_nPOP + \beta_2 L_nAH + \beta_3 L_nPD + \beta_4 L_nTS + \beta_5 L_nER + \beta_6 L_nDC + \beta_7 L_nNI + \mu$$

$$ECM = L_nI - (3.7304^* L_nPOP - 2.5285^* L_nPD - 7.4195^* L_nTS - 1.0278^* L_nER + 10.3411^* L_nDC + 0.3503^* L_nAH + 0.0001^* L_nNI - 17.5833)$$

2.3. Correlation Among Variables

The correlation matrix for the selected variables is presented in Table 1. The correlation test reveals that production shows a strong relationship with domestic consumption, total supply, area harvested, import, population, exchange rate, and adjusted net income. This implies that an increase in the independent variable corresponds to a simultaneous increase in the dependent variable. However, production exhibits a weak relationship with export.

Domestic consumption displays a weak relationship with export, while it shows a strong relationship with total supply, area harvested, import, population, exchange rate, and adjusted net income. On the other hand, export shows a weak relationship with total supply, area harvested, import, population, exchange rate, and adjusted net income.

Total supply exhibits a strong relationship with area harvested, import, population, exchange rate, and adjusted net income. Similarly, area harvested shows a strong correlation with import, population, exchange rate, and adjusted net income. Import demonstrates a strong relationship with population, exchange rate, and adjusted net income, as an increase in population can lead to an increase in the country's exchange rate relative to other countries, resulting in lower-priced imports and a subsequent increase in imports.

In summary, the correlation analysis indicates the strength and direction of relationships between the variables, with some variables showing strong correlations and others exhibiting weaker associations.

Table 1: Correlation matrix

	PD	DC	EX	TS	AH	ER	POP	NI
PD	1							
DC	0.93	1						
EX	0.37	0.25	1					
TS	0.92	1.00	0.25	1				
AH	0.86	0.72	0.30	0.70	1			
ER	0.78	0.95	0.12	0.95	0.53	1		
POP	0.92	0.99	0.24	0.98	0.72	0.94	1	
NI	0.81	0.95	0.14	0.96	0.59	0.95	0.9	1

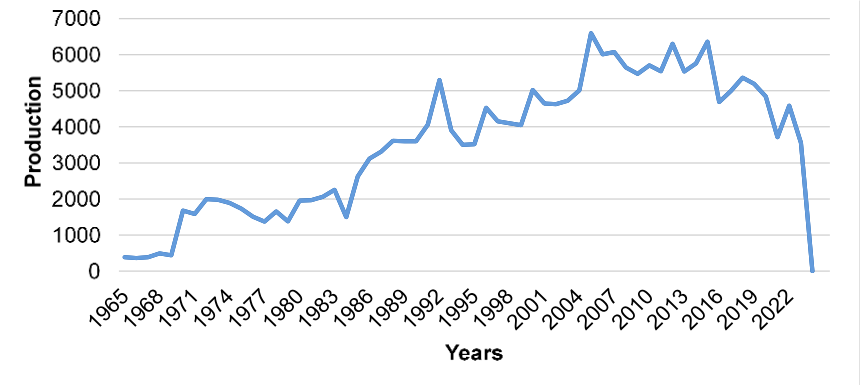

Fig. 1: Displays the production of essential oils in Pakistan. The graph presents data from 1965 to 2022 and showcases the fluctuating trend of production. It reveals a gradual increase in production from 1965 to 2020, followed by a sudden slowdown and decline in production.

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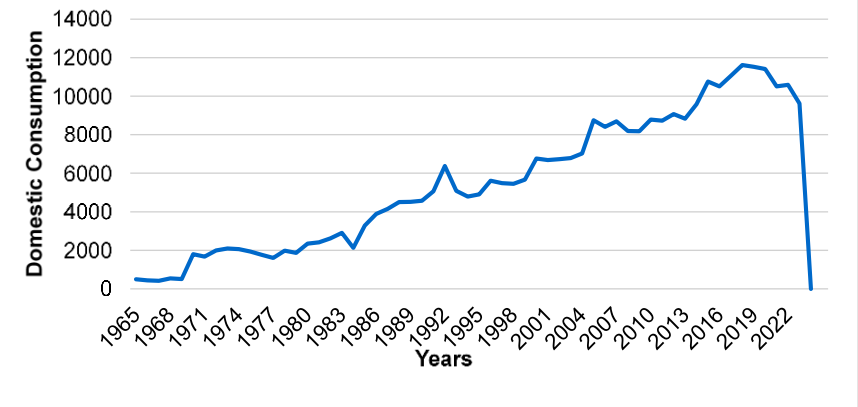

Fig. 2: Depicts the domestic consumption of essential oils in Pakistan. The graph illustrates a clear increasing trend in domestic consumption from 1965 to 2022, with a few exceptions in the recent past where a decreasing trend is observed.

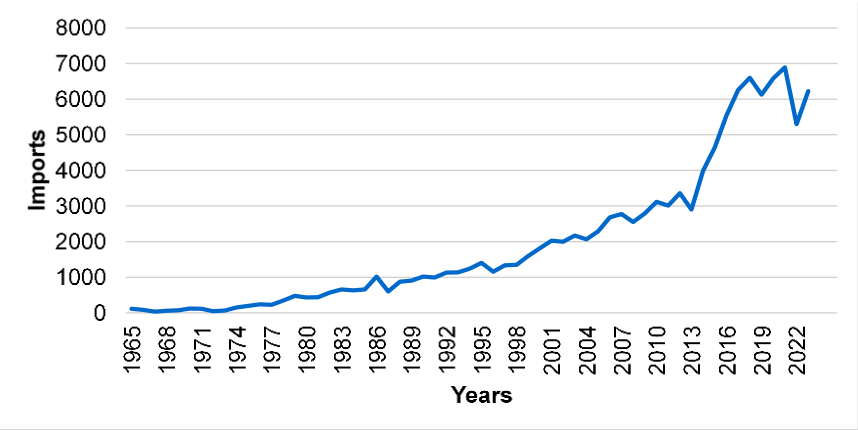

Fig. 3: Illustrates the import of essential oils in Pakistan. It demonstrates a consistent and continuous increase in imports over the past years (1964-2022).

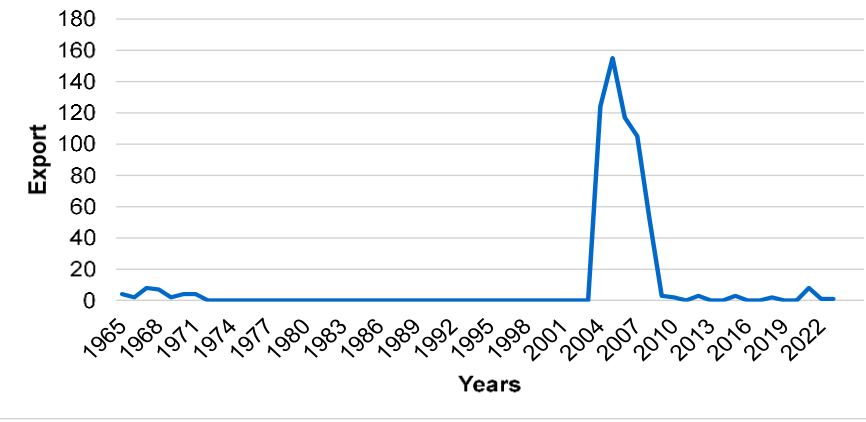

Fig. 4: Depicts the export of essential oils from Pakistan (1964-2022). It indicates that there were no exports recorded between 1965 and 2000. However, starting from the year 2001, there is a noticeable and steady increase in export trends until 2010. Following this period of growth, the export figures begin to decline once more.

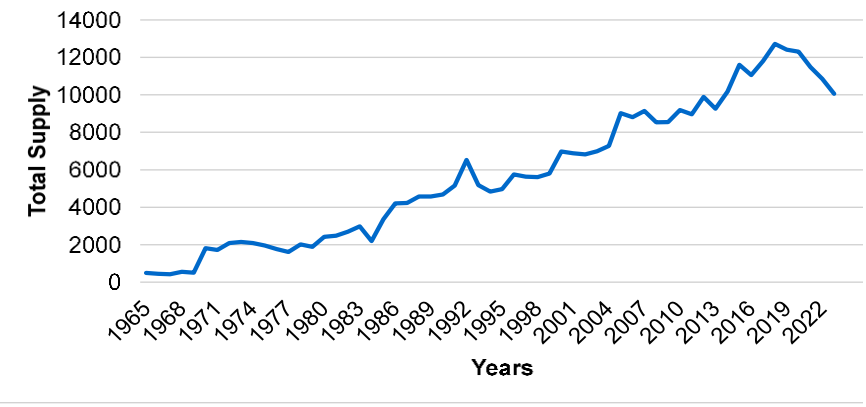

Fig. 5: Displays the total supply of essential oils in Pakistan (164-2022). The graph demonstrates a consistent and continuous increase in the total supply over time.

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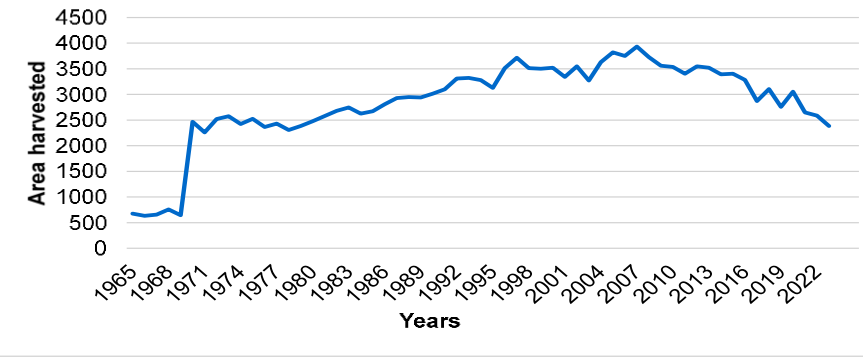

Fig. 6: Illustrates the area harvested for essential oil in Pakistan (1964-2022). Initially, it shows a decreasing trend in 1965, but from 1968 onwards, there is a noticeable shift towards an increasing trend in the area harvested. Subsequently, the trend continues to show growth over time.

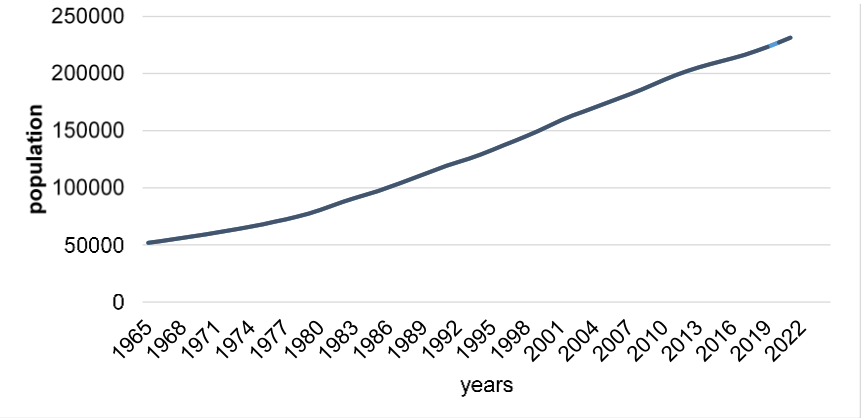

Fig. 7: Provides the population growth trend in Pakistan (1965-2022). The graph illustrates that the nation's population has been steadily increasing over time and does not show any indications of slowing down or declining in the foreseeable future.

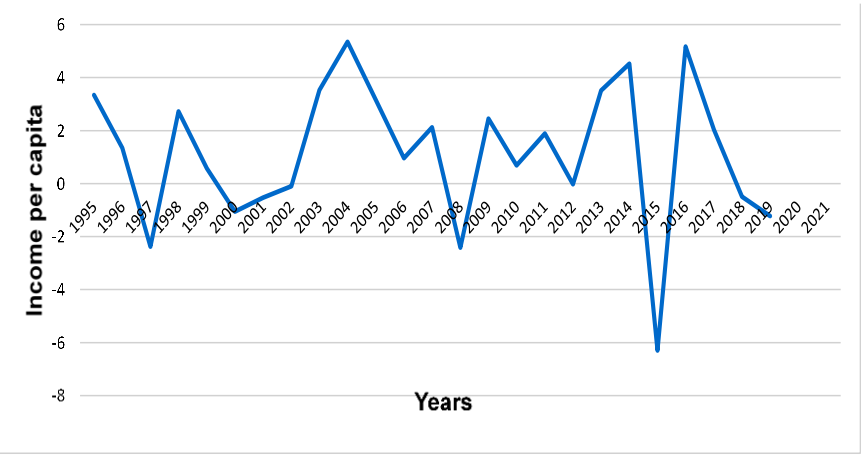

Fig. 8: Showed Pakistan's adjusted net national income per capita (2065-2021). The income figures showed to include rising and falling patterns on a regular basis. However, there was a severe fall in 2015, and the per capita income fell below zero. Following that, the per capita income may be observed moving in positive numbers once more due to a strong slope.

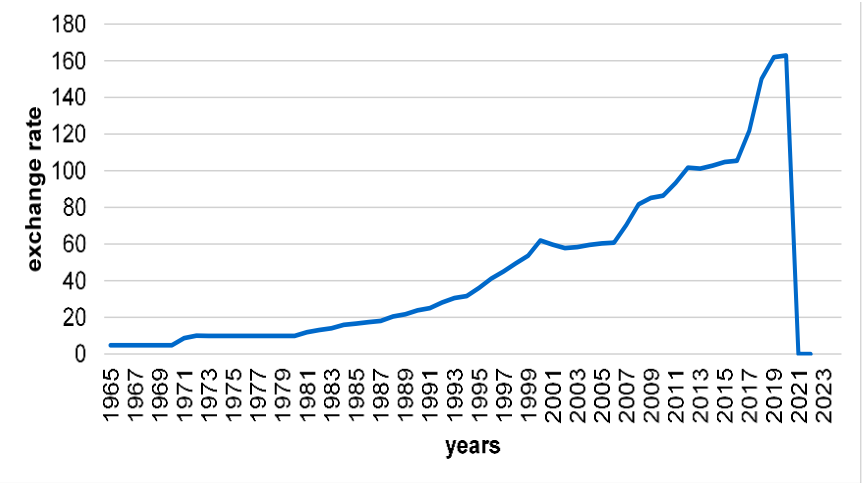

Fig. 9: Graph of the exchange rate illustrates the pattern of variations in Pakistan's official exchange rate value (LCU/US$) from 1965-2022. Over a period of time, the value of the currency rate in Pakistan has increased gradually. Small patterns of the value collapsing can also be seen at points but overall, the value has increased over the years and is still increasing at a very high rate.

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2.4. Variance Inflation Factor (VIF)

The multiple regression model suffers from multicollinearity since all of the inputs influence each other. As a result, it is difficult to tell how much the combination of the independent variables influences the regression model's dependent variable or outcome. A variance inflation factor (VIF) is used in regression analysis to calculate the level of multicollinearity (Table 2). Multicollinearity develops in a multiple regression model when numerous independent variables are interrelated. This can have a negative impact on relapse outcomes. As a result, the variance inflation factor may be used to assess the multicollinearity-induced inflation of a regression coefficient's variance.

Formula to calculate VIF is:
$VIF = 1/1-r^2$
Where 'r' is the value of the correlation calculated.

Table 2: VIF values of variables

	PD	DC	EX	TS	AH	ER	POP	NI
PD	I							
DC	0.13	I						
EX	0.86	0.93	I					
TS	0.153	0	0.93	I				
AH	0.26	0.48	0.91	0.51	I			
ER	0.39	0.0975	0.97	0.09	0.71	I		
POP	0.15	0.019	0.92	0.03	0.48	0.11	I	
NI	0.34	0.09	0.98	0.07	0.65	0.09	0.19	I

3. RESULTS AND DISCUSSION

3.1. Outcomes of Unit Root Test

Any econometric research should begin with an examination of stationarity in time series data. This step is essential to avoid the problem of spurious regression. In this study, two commonly used techniques, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, were employed to determine the stationarity of the series. Previous studies (Hatemi and Irandoust 2002; Ziramba 2010) have shown that these methods have limited control.

The results of both statistical techniques are presented in Tables 3 and 4. Most of the variables exhibit a unit root at the level, but they become stationary after taking the first difference, as confirmed by both tests (Raza and Lin 2021). Specifically, domestic consumption, exchange rate, import, total supply, and adjusted net income are considered different stationary or first-order integrated series. However, the unit root analysis reveals that area harvested, export, production, and population are stationary at the level. Based on these findings, the empirical study will utilize the ARDL approach, focusing on whether the variables are stationary at the level or become stationary after the first difference. This selection is essential to properly investigate the relationships between the variables of interest.

Table 3: Unit Root Test Result

Variables	Model	ADF Stats(Prob.)		PP Stats(Prob.)	
		Level	1st Diff.	Level	1st Diff.
LnAR	Constant	-4.004 ***	-	-3.55 ***	-
LnDC	Constant	-2.323	-9.17 ***	-2.68 *	-
LnER	Constant and Trend	-3.47 **	-	-2.96	-6.24***
LnEX	Constant	-2.87 **	-	-3.018 **	-
LnIM	Constant and Trend	-2.70	-7.93***	-2.82	-11.05***
LnPD	Constant	-3.31 ***	-	-3.10***	-
LnTS	Constant	-2.31	-9.52***	-2.66	-9.67***
LnNI	Constant and Trend	-1.84	-5.36***	-1.50	-5.25***
LnPOP	Constant	-2.38	-	-3.02 ***	-

Source: Authors' own calculations, Note: ***, **, and * represent 1%, 5%, and 10% levels of significance.

According to economic theory, the variables under study are expected to have a long-term relationship, indicating that the connection's qualities remain constant over time. In practice, however, empirical research often finds that time series data do not exhibit consistent means and variances. This inconsistency can lead to erroneous application, calculation, and interpretation of most cointegration approaches.

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Table 4: ARDL Estimates

Panel A: Short-run estimates		
DLnPOP	17.72***	6.12
DLnPD	-2.59***	0.45
DLnTS	1.74	2.02
DLnER	-0.80***	0.33
DLnDC	1.47	1.97
DLnAR	-0.20	0.29
DLnNI	0.00	0.00
CoinEq(-1)	-0.79***	0.13
Panel B: Long-run Estimates		
LnPOP	3.73***	0.73
LnPD	-2.52***	0.51
LnTS	-7.41*	4.03
LnER	-1.02***	0.31
LnDC	10.34***	4.01
LnAR	0.35	0.34
LnNI	0.000059	0.000
Panel C: Diagnosis test		
Adj R2	0.656190	
F-test/bound test	6.064170	
ECM_{t-1}	-0.79***	0.13

Source: Authors' own calculations, Note: ***, **, and * represent 1%, 5%, and 10% levels of significance.

One widely used technique to address this issue is the Autoregressive Distributed Lag (ARDL) cointegration approach, also known as the bound cointegration technique. The ARDL approach is particularly useful when dealing with variables that have different integration orders (I(0), I(1), or a mix of both) and when there is a single long-term relationship between the variables, especially in small sample sizes (Raza and Lin 2021). The F-statistic is employed to determine the presence of a long-term relationship between the variables, and this is confirmed when the F-statistic surpasses the critical value band (Table 4).

The ARDL model results are presented in three panels: Panel A displays the short-run results, Panel B shows the long-run results, and Panel C provides diagnostics for the ARDL model. The significant ECM value of -0.79 indicates that the import of essential oils is influenced by the independent variables in the long term, confirming a long-term relationship between the dependent and independent variables. The results of the bound test, with an F-statistic value higher than the upper bound or I(1) value, further support this conclusion. Significant values in the long-run estimates suggest that the dependent and independent variables are related over the long term. Thus, we accept the null hypothesis that the independent variables have a long-term impact on the import of essential oils into Pakistan.

In the short run, all other factors are deemed insignificant, except for population, production, and the exchange rate value, which are significant. The model's R2 value is 65% significant, as noted in previous studies (Ahmad et al. 2022; Raza and Lin 2021).

4. CONCLUSION AND RECOMMENDATIONS

The demand for essential oil in Pakistan has led to a significant increase in the importation of these oils. This study empirically examines the various factors that influence essential oil imports in Pakistan and demonstrates how macroeconomic factors impact essential oil imports at the national level, using a time series analysis spanning 56 years from 1965 to 2021. The factors evaluated include national income, the official exchange rate, production, total supply, domestic consumption, area harvested, and the population of all ages.

The research findings indicate that some of these factors have a long-term effect on Pakistan's imports of essential oil. Over time, these independent factors have a substantial impact on essential oil imports, indicating a long-term relationship between the dependent and independent variables. This finding suggests that the series has a long-term connection.

Interestingly, the study reveals that the area harvested is the only variable that does not affect oil imports in any significant way. The lack of essential oil production could be attributed to several factors, such as limited technology, inadequate areas for cultivation, and low awareness of the industry.

Based on the study's conclusions, it is suggested that rather than focusing solely on altering macroeconomic factors, efforts should be made to expand the area of cultivation and increase essential oil production. This approach is deemed crucial in reducing the dependence on imports of essential oils. This contradicts the notion that domestic production alone can sufficiently reduce the nation's import costs for essential oils.

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