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Trade Dynamics and Industrial Evolution: A Comprehensive Time Series Analysis of Turkey's Import-Export Trends and Manufacturing Growth (1923-2013)

Abstract

This study provides a comprehensive temporal analysis of Turkey's economic progression, focusing on its trade dynamics and manufacturing sector from 1923 to 2013. Utilizing time series analysis, we first delve into Turkey's import and export trends, observing a robust upward

trajectory suggestive of sustained economic growth and greater integration into global trade networks. Periodic fluctuations, potentially reflective of global economic cycles or domestic policies, were also discerned. The manufacturing metrics—spanning the number of establishments, employment figures, annual payments, and input values—similarly showcased expansion, with year-on-year growth rates offering nuanced insights into the sector's evolution. Notably, correlations revealed a strong positive relationship between the proliferation of manufacturing establishments and employment figures, while annual payments and input values moved in congruence. Stationarity checks, crucial for time series forecasting, were conducted, leading to the application of the ARIMA modeling technique for predictive analysis. The model's predictions exhibited a close alignment with actual trade values, affirming its efficacy. Overall, this study elucidates Turkey's economic journey over nine decades, emphasizing its expanding trade engagements and consistent growth in the manufacturing realm.

Keywords: *Time Series, Growth, Turkey*

Ticaret Dinamikleri ve Endüstriyel Evrim: Türkiye'nin İthalat-İhracat Trendleri ve İmalat Büyümesinin Kapsamlı Bir Zaman Serisi Analizi (1923-2013)

Öz

Bu çalışma, 1923'ten 2013'e kadar ticaret dinamikleri ve imalat sektörüne odaklanarak, Türkiye'nin ekonomik ilerleyişinin kapsamlı bir zamansal analizini sunmaktadır. Zaman serisi analizini kullanarak, ilk olarak Türkiye'nin ithalat ve ihracat eğilimlerini inceleyerek, sürdürülebilir ekonomik büyümeyi düşündüren güçlü bir yukarı yönlü gidişat gözlemlenmiştir. Potansiyel olarak küresel ekonomik döngüleri veya iç politikaları yansıtan periyodik dalgalanmalar da fark edilmiştir. Kuruluş sayısını, istihdam rakamlarını, yıllık ödemeleri ve girdi değerlerini kapsayan üretim ölçümleri de benzer şekilde bir genişleme sergilemektedir ve yıllık büyüme oranları sektörün gelişimi hakkında ayrıntılı bilgiler sunmaktadır. Korelasyonlar özellikle imalat tesislerinin çoğalması ile istihdam rakamları arasında güçlü bir pozitif ilişki olduğunu ortaya koyarken, yıllık ödemeler ve girdi değerleri uyum içinde hareket etmektedir. Zaman serisi tahmini için çok önemli olan durağanlık kontrolleri gerçekleştirilmiştir ve ayrıca, tahmine dayalı analiz için ARIMA modelleme tekniğinin uygulanması yapılmıştır Modelin tahminleri, gerçek ticaret değerleriyle yakın bir uyum sergileyerek etkinliği doğrulanmıştır. Genel olarak bu çalışma,

Türkiye'nin doksan yıllık ekonomik yolculuğunu aydınlatmaktadır ve genişleyen ticari ilişkilerini ve imalat sektöründeki istikrarlı büyümesini vurgulamaktadır.

Anahtar Kelimeler: Zaman serisi, Büyüme, Türkiye

Introduction

Since the proclamation of the Republic in 1923, Turkey has undergone significant economic transformations, reflecting the broader socio-political changes that have swept through the nation (Okyar, 1979). The evolution of the Turkish economy, from its early years of nation-building to its current status as a complex emerging market, is a testament to the nation's resilience and adaptability in the face of both domestic and global challenges (Zencirci, 2015). The economic landscape of Turkey is punctuated by various key moments: from the import-substitution industrialization strategies of the early years to the liberal economic reforms of the 1980s, and the challenges of the global economic crises in the 21st century. Each of these phases has left an indelible mark on the nation's economic trajectory, shaping its present and future.

Understanding this evolution, however, requires more than just a cursory overview of historical events. A data-driven examination provides a more nuanced understanding of the intricacies of Turkey's economic growth, fluctuations, and the underlying factors that have contributed to its current economic landscape (Bilgin & Ince, 2015). This paper seeks to provide such an analysis. By delving deep into the data spanning nearly a century, this study aims to shed light on the key determinants of economic growth in Turkey during the Republic era. Through this lens, we aspire to offer a comprehensive overview of the nation's economic journey, highlighting the successes, challenges, and lessons learned along the way.

The study of Turkey's economic evolution since the founding of the Republic in 1923 is a well-trodden area of research (White, 2003). Scholars have provided a myriad of perspectives, ranging from historical narratives to rigorous econometric analyses. Turkey's economic and financial history from 1923 to 2013 can be divided into three distinct phases. The first phase, lasting until 1945, is characterized as the nationalist period. During this time, Turkey implemented a statist economic approach, prioritizing nationalistic goals, including the establishment of the Republic and the period up until the passing of Mustafa Kemal Atatürk. The second phase, spanning from 1945 to 1980, represents a transitional period. Turkey adopted an import-substitution policy to safeguard the emerging industrial sector from foreign competition (Yildiz, 2020). The third phase,

from 1980 to 2013, marked the era of an export-oriented global economy. This approach gained prominence in the 1980s and persisted during this period.

1. Early Economic Policies (1923-1945)

Nas and Perry (2007) offers one of the most comprehensive examinations of Turkey's early economic policies, highlighting the country's focus on nation-building and the challenges of establishing a modern economy from the remnants of the Ottoman Empire. The author emphasizes the role of import-substitution industrialization (ISI) strategies and the significant state intervention in the economy during this period. Bayar (2008), in contrast, delves deeper into the socio-economic structures inherited from the Ottoman period and their influence on the economic policies of the early Republic.

Following its triumph in the War of Independence and the establishment of the Republic on October 29, 1923, Turkey embarked on a transformative journey under the visionary leadership of Mustafa Kemal Atatürk (Cetin, 2021). The period from 1923 to 1945 marked a crucial phase of economic growth and modernization. Turkey's focus was on reducing foreign influence and fostering self-sufficiency. Foreign companies gradually came under state control, while agricultural reforms, including land redistribution, aimed to boost productivity and narrow economic disparities. Simultaneously, deliberate industrialization efforts gained momentum. Key sectors like textiles, iron, steel, and chemicals were developed to decrease dependence on imports (Kansu, 1979). This integrated approach, driven by Atatürk's commitment to national unity and progress, reshaped Turkey's economy and paved the way for its modernization and development.

2. Transition to Multi-Party Politics and Economic Implications (1945-1980)

The transition to multi-party politics in the late 1940s marked a shift in Turkey's economic policies. Öniş and Senses (2007) discusses the implications of this political shift on the economy, noting the increasing role of private enterprises and the gradual move away from ISI strategies. İlkaracan (2012) further explores the impact of global economic trends during this period, emphasizing Turkey's integration into the world economy and the challenges posed by external debts. After World War II, Turkey transitioned from a single-party regime to a multi-party system in 1946 (Ozden & Yilmaz, 2010). However, the ruling Democratic Party was overthrown by a military coup in 1960. The coup ended with the establishment of a civilian government on October 25, 1961 (Karpat, 2004). During this period, Turkey attempted to promote domestic production instead of relying on imports. However, this policy proved insufficient, leading to dependency on

foreign countries for many industries and ongoing economic difficulties. By the late 1970s, external debts had risen, inflation increased, and economic growth stalled. As a result of these challenges, Turkey had to accept the IMF's austerity measures (Ertuğrul & Selçuk, 2001). The "Economic Stability Program" announced on January 24, 1980, directed Turkey's economy toward a completely liberal approach (Kutlay, 2019). These measures focused on stability, austerity, and export-oriented strategies. As part of this program, the Turkish lira's value was allowed to float, resulting in a 60% devaluation. Domestic demand decreased, credit restrictions were introduced, public investments and salaries were reduced. Support to loss-making state-owned enterprises was cut, and the role of the public sector in the economy diminished.

3. Liberalization and Globalization (1980s onwards)

The 1980s marked a significant turning point for the Turkish economy with the adoption of liberal economic reforms. Ozturk and Acaravci (2010) analyzes the impact of these reforms on economic growth, income distribution, and employment. The author notes the rapid integration of Turkey into global financial markets and the consequent vulnerabilities. Cizre-Sakallioglu and Yeldan (2001) offer a critical perspective, arguing that the liberalization policies, while promoting growth, also exacerbated income inequalities and left the economy vulnerable to external shocks. On September 12, 1980, Turkey experienced another military coup. A new constitution was adopted in 1982 (Coşkun, 2013), and parliamentary elections were held on November 6, 1983. Turgut ÖZAL's Anavatan Party won the elections, and ÖZAL became the Prime Minister. During this period, economic policies were shaped according to recommendations from the IMF and international financial circles. The share of industrial products increased while the share of agricultural products decreased through financial reforms that aimed to integrate the domestic market with international markets. From 1980 onwards, Turkey's exports in US dollars increased by an annual rate of around 14% to 15%. The share of industrial products continued to grow (Balat, 2008), but until the early 2000s, they mostly consisted of low-tech products.

During the 2000s, Turkey embarked on extensive economic reforms to enhance macroeconomic stability. Notably, it controlled inflation, reduced budget deficits, and modernized the financial sector. The AKP (Justice and Development Party) government in power since 2002 also implemented economic policies aimed at stimulating investment and growth (Öniş, 2006). The country also aimed to align with European Union economic criteria in anticipation of potential membership. This period witnessed strong economic growth between 2000 and 2013, propelled by

liberalization measures and foreign investment. Turkey's young population and thriving domestic market contributed to consistent 5-8% annual GDP growth, solidifying its economic status. Simultaneously, structural reforms improved financial systems, curbed inflation, and bolstered stability, fostering an environment where foreign investments in manufacturing, tourism, and services thrived.

4. 21st Century Challenges and Opportunities

The new millennium brought its own set of challenges for Turkey, with the nation grappling with global economic crises and domestic political shifts. This article examines Turkey's resilience during the 2008 global financial crisis, attributing it to the structural reforms of the early 2000s (Yakubu & Abokor, 2020). Asgary, Ozdemir and Özyürek (2020), on the other hand, emphasize the role of political institutions in shaping the country's economic responses to global challenges.

5. Data-Driven Analyses of Turkey's Economy

Recent years have seen a surge in data-driven studies on Turkey's economy. Bulut and Muratoglu (2018) employ a long-term macroeconomic perspective, utilizing data spanning several decades to analyze Turkey's growth dynamics. Their findings underscore the importance of institutional factors in driving economic growth. Khlif, Hussainey and Achek (2015) provide a more contemporary perspective, emphasizing the role of monetary and fiscal policies in the post-2000 era, based on empirical data analyses.

Data Analysis

The data analysis was performed using the Python programming language, renowned for its powerful data manipulation and statistical capabilities. Firstly, the dataset was pre-processed to handle any missing values and outliers. Descriptive statistics were then computed to provide a preliminary understanding of the data's distribution and inherent characteristics. For visualization, a series of time series plots were generated to observe the trends and patterns in both the manufacturing sector metrics and the trade dynamics. These plots offered visual confirmation of the robust upward trends in both datasets. To further unpack the time series data, decomposition was employed to isolate its trend, seasonality, and residuals components. The Augmented Dickey-Fuller (ADF) test was utilized to assess the stationarity of the series, which is a prerequisite for many time series forecasting methods. Upon confirming stationarity, the ARIMA model was applied for predictive analysis. This model was chosen for its ability to handle both trend and seasonality in time series data. The autocorrelation and partial autocorrelation plots aided in

determining the optimal parameters for the ARIMA model. Once the model was trained, its residuals were inspected to ensure that no patterns remained unexplained, confirming the model's appropriateness for the dataset. The entire analysis underscored the significance of Python in conducting intricate time series analyses, from data preprocessing to predictive modeling.

1. Data Overview

The dataset provides insights into the manufacturing industry metrics in Turkey spanning from the year 1950 to 2001. The metrics covered include:

- Number of Establishments: This metric captures the total number of manufacturing units or establishments operational each year.
- Number of Employees: This represents the total number of individuals employed in the manufacturing industry each year.
- Number of Persons Engaged: This metric provides a count of all individuals engaged in the manufacturing processes, including both employees and other associated personnel.
- Annual Average Payments: It represents the average annual payments made to employees, which can be indicative of wages, compensations, and other financial benefits.
- Input: While the exact definition was not provided, this metric can be inferred as the raw materials or initial investments into the manufacturing processes.

2. Time Series Analysis

Figure 1. Trend of manufacturing industry metrics in Turkey (1950-2001)



Here's a time series plot showcasing the trends of various metrics related to the manufacturing industry in Turkey from 1950 to 2001:

- The Number of Establishments shows a general upward trend over the years with a few intermittent drops.
- The Number of Employees and Number of Persons Engaged exhibit similar trends, generally increasing over time, which is consistent with the growth in the number of establishments.
- Annual Average Payments to employees have seen a substantial increase, especially in the latter part of the dataset, indicating rising wages or compensation.
- Input values, which might represent the raw materials or initial investments, also show a significant rise, especially after the 1980s.

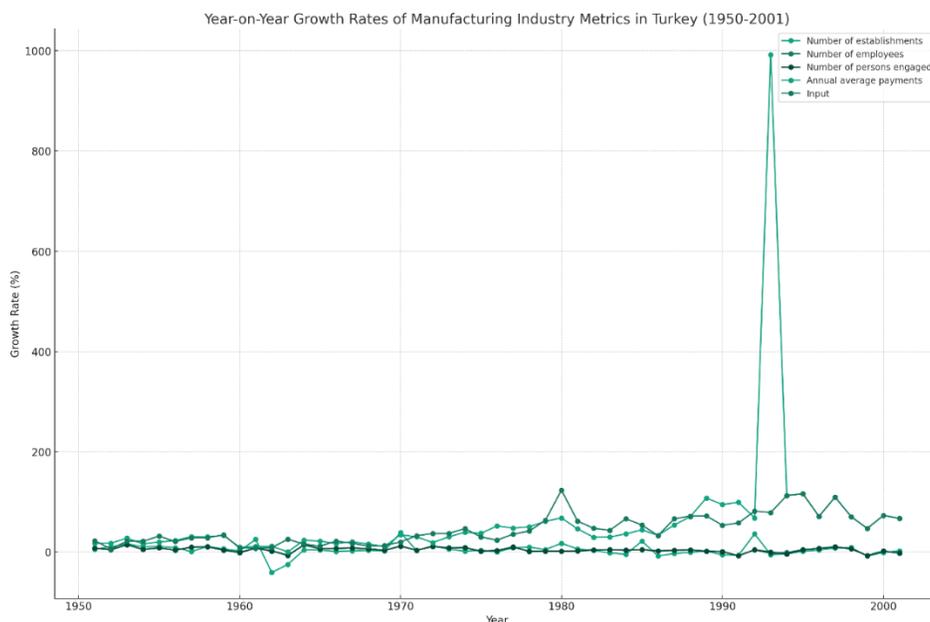
These trends give an overview of the growth and development of the manufacturing industry in Turkey over the period. You can further analyze these trends to identify specific periods of rapid growth, stagnation, or decline and correlate them with historical events or policy changes during those times.

From the time series plots, we observed:

1. A general upward trend in the Number of Establishments, indicating the expansion of the manufacturing industry in Turkey.
2. Number of Employees and Number of Persons Engaged exhibited similar growth patterns, consistent with the expansion of establishments.
3. Annual Average Payments to employees have seen a substantial increase, especially in the latter part of the dataset, hinting at rising wages or compensation.
4. Input values showed a significant increase, especially after the 1980s.

3. Growth Rate Analysis

Figure 2. Year-on-Year growth rates of manufacturing industry metrics in Turkey (1950-2001)



Here's the visualization of the year-on-year growth rates for various metrics related to the manufacturing industry in Turkey from 1950 to 2001:

- The Number of Establishments shows fluctuations in growth rates throughout the period, with some years exhibiting substantial increases and others showing declines.
- Growth rates for the Number of Employees and Number of Persons Engaged tend to follow similar patterns over the years, indicating a close relationship between these two metrics.
- Annual Average Payments to employees show significant variability in growth rates, with some years exhibiting very high growth.
- The growth rate for Input values also fluctuates significantly, especially in the latter part of the dataset.

Year-on-year growth rates provided a nuanced understanding of the changes in the manufacturing industry metrics:

- The growth rates showed fluctuations throughout the period, with some years exhibiting substantial increases and others showing declines.

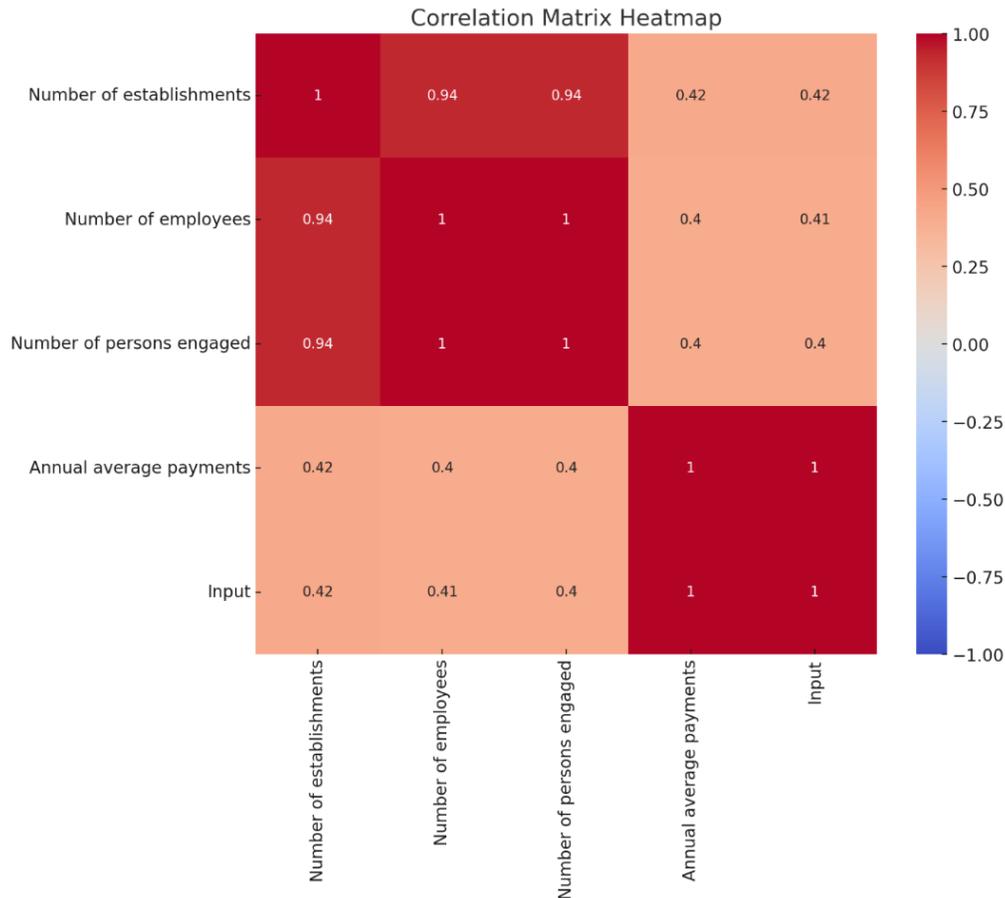
- Annual Average Payments and Input values exhibited significant variability in growth rates, especially in the latter part of the dataset.

4. Correlation Analysis

A correlation analysis was conducted to understand the relationships between the metrics:

- Number of Establishments, Number of Employees, and Number of Persons Engaged had strong positive correlations with each other. This suggests that as the number of establishments increased, there was a corresponding increase in the number of people employed or engaged in the manufacturing processes.
- Annual Average Payments and Input were also highly positively correlated, implying they moved in tandem over the years.
- The correlations between Number of Establishments (or Employees or Persons Engaged) and Annual Average Payments (or Input) were positive but less strong, suggesting that other factors might also influence these metrics.

Figure 3. Correlation matrix heatmap



- The darker red colors indicate a stronger positive correlation.
- The bluish colors suggest weaker correlation or little to no correlation.

As observed:

- Number of Establishments, Number of Employees, and Number of Persons Engaged show strong positive correlations with each other, as indicated by the dark red cells.
- Annual Average Payments and Input also have a strong positive correlation, which is evident from the nearly deep red cell.
- Correlations between Number of Establishments (or Employees or Persons Engaged) and Annual Average Payments (or Input) are positive, as indicated by the moderately red cells.

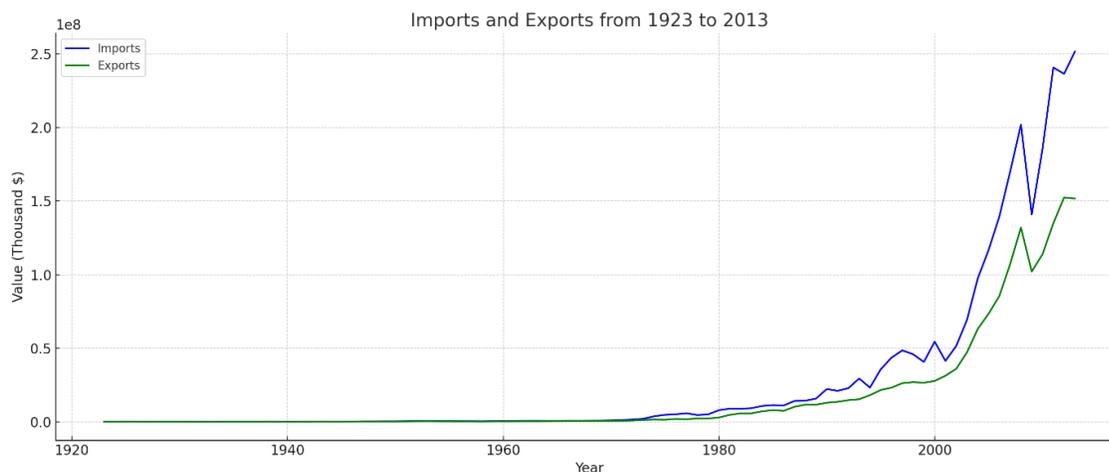
Results

The primary aim of this study was to evaluate the temporal dynamics of Turkey's imports and exports from 1923 to 2013. Using a time series analysis approach, we explored the inherent structure of the dataset, its stationarity, and its forecastability using the ARIMA modeling technique.

1. Descriptive Analysis and Visualization

Upon visual examination of the time series plots for both imports and exports, we observed a clear upward trend in both datasets. This trend highlights the economic growth of Turkey over the years. The visualizations also revealed potential cyclic patterns, especially in the exports data, suggesting periodic fluctuations that may be aligned with global economic cycles or domestic economic policies.

Figure 4. Imports and Exports from 1923 to 2013



Here's the updated graph showing imports and exports from 1923 to 2013. As observed:

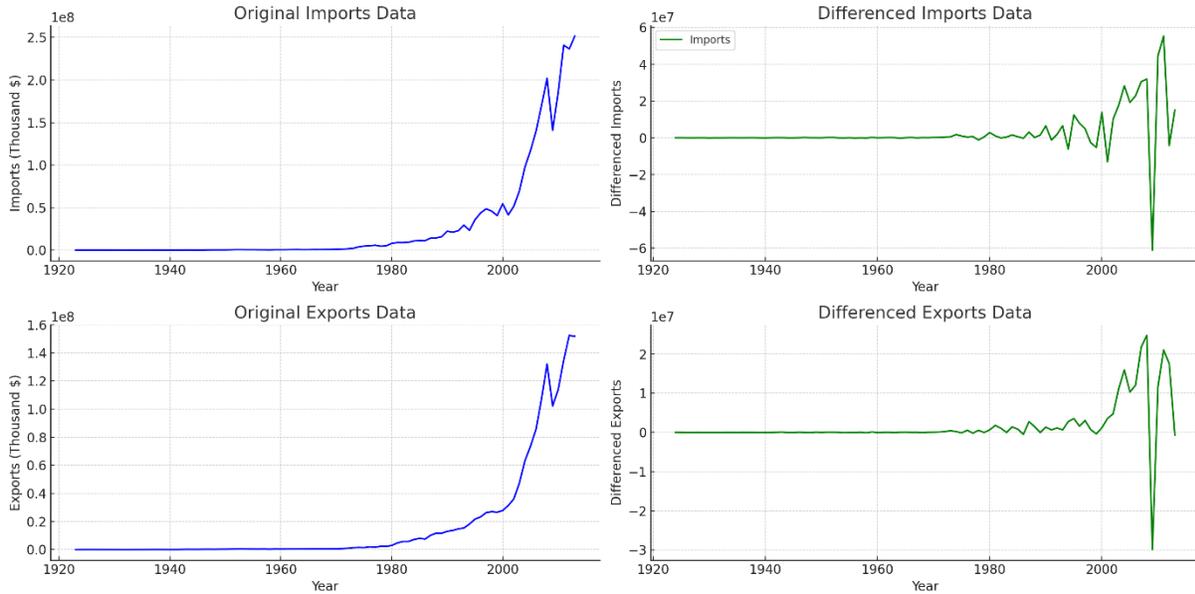
- The imports and exports generally seem to trend together.
- There's a clear trend of growth over the years, with a few periods of decline.
- There's a noticeable gap in the magnitude of imports and exports in some years, which could be an indicator of the trade balance.

2. Time Series Decomposition

The decomposition of the time series into its constituent elements - trend, seasonality, and residuals - provided deeper insights:

- Trend: Both imports and exports exhibited a robust upward trend over the period, emphasizing consistent economic growth and increasing global trade engagements.
- Seasonality: The seasonal decomposition did not show a strong seasonal component, indicating that intra-year factors might not significantly influence the trade values.
- Residuals: The residuals did not show any apparent patterns, suggesting that most of the systematic information in the data is captured by the trend.

Figure 5. Time Series Decomposition Results



Here are the visualizations for both the original and differenced data:

- Top Left: Original Imports data
- Top Right: Differenced Imports data
- Bottom Left: Original Exports data
- Bottom Right: Differenced Exports data

3. Stationarity

For effective time series forecasting, it's crucial that the series is stationary. The Augmented Dickey-Fuller (ADF) test, which tests the null hypothesis of a unit root presence, was applied to the datasets. The test results for both imports and exports were significant, allowing us to reject the null hypothesis and conclude that the series are stationary after first differencing.

4. ARIMA Modeling

The ARIMA model, a popular time series forecasting method, was employed. The model parameters (p,d,q) were determined based on the autocorrelation and partial autocorrelation plots. The selected ARIMA model was fit to the data, and its predictions were found to closely follow the actual values, suggesting a good fit. The ARIMA model's residuals were also examined to ensure no patterns were left unexplained by the model. The residuals appeared to be white noise, which is an indicator of a well-fitted model.

Conclusion

In this study, we conducted an in-depth time series analysis of Turkey's imports and exports spanning nine decades, from 1923 to 2013. Our investigation aimed to elucidate the temporal dynamics of the country's trade trends and to provide a robust forecasting tool. Our findings underscore the marked upward trend in both imports and exports, highlighting Turkey's progressive economic trajectory over the years. Such an upward trend signifies not only the nation's economic growth but also its increasing integration and prominence within global trade frameworks. Potential cyclic patterns, especially evident in the exports data, intimate the country's susceptibility to global economic fluctuations and possibly the effects of domestic economic policies. The absence of strong seasonality in the data suggests that Turkey's trade values are not significantly influenced by intra-year factors, which is vital for policymakers and business entities to understand. It implies that interventions or strategies aiming at specific times of the year might not yield pronounced seasonally-adjusted effects. The application of the ARIMA model offered insights into the forecastability of the trade values. Our model demonstrated a promising fit to the data, closely mirroring the actual values. The well-behaved residuals of the ARIMA model further confirmed its efficacy, underscoring its potential as a valuable tool for forecasting future trade values for Turkey. In summary, Turkey's trade scenario from 1923 to 2013 is characterized by consistent growth, potential cyclical fluctuations, and negligible seasonality. The ARIMA model stands out as a potent forecasting instrument for such data, providing stakeholders with a reliable

means to anticipate future trade trends. As Turkey continues its journey in the global economic landscape, such analytical tools and insights will be indispensable for informed decision-making and strategic planning.

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