---
title: "ANALYSIS"
sidebar: false

Overview of the Data

Our analysis will be based on the data set Economic Confidence Index set published by TÜİK. The ECI reflects the general sentiment towards the economy and is composed of various sectoral indices. The data set spans from January 2011 to October 2024 and provides information on the following indices:

- **Economic Confidence Index (ECI)**: Represents the overall economic outlook by combining data from multiple sectors.

- **Consumer Confidence Index (CCI)**: This shows how consumers perceive the current and future state of the economy, their financial situations, and their spending tendencies.

- **Real Sector Confidence Index (RSCI)**: Focuses on the manufacturing industry, providing insights into production levels, new orders, and business expectations.

- **Service Confidence Index (SCI)**: Highlights the performance and expectations within the service sector.

- **Retail Trade Confidence Index (RTCI)**: Focuses on sales trends, stock levels, and business activity in retail.

- **Construction Confidence Index (CNCI)**: Tracks sentiment in the construction industry, including current order books and employment plans.

This data set provides a comprehensive view of the Turkish economy through sectoral lenses, making it useful for analyzing trends, comparing sector performance, and evaluating economic resilience over time.

In the data set rows represent the data of that year with the belongings month, and the columns represent the different indices explained above. The column names are: "Year", "Month", "Economic_Confidence_ Index", "Consumer_Confidence_Index", "Real_Sector_Confidence_Index", "Services_Confidence_Index", "Retail_Trade_Confidence_Index", "Construction_Confidence_Index."

In the below, you can see the distributions and value types of the data. We found the variable type by using the str() function, and the distribution by looking at the histograms of it. You can see the all details about the data in the following table:

Variable	Meaning	Type	Value Distribution
Year, Month	The date when the data was recorded.	Numeric	This column will contain a range of dates from 2011 to 2024, likely at monthly intervals.

| | |
| (Discrete) | |
|
+---+---+---+---+
| Economic Confidence Index (ECI) | The composite index that represents overall economic confidence. | Numeric (Continuous) | Normal Distribution |
|
+---+---+---+---+
| Consumer Confidence Index (CCI) | A measure of consumers' confidence about their financial situations and expectations for the economy. | Numeric (Continuous) | Normal Distribution |
|
+---+---+---+---+
| Real Sector Confidence Index (RSCI) | Reflects confidence within the real sector, such as production levels, investments, and employment trends in manufacturing. | Numeric (Continuous) | Normal Distribution |
|
+---+---+---+---+
| Service Confidence Index (SCI) | Reflects the confidence in the service sector, considering factors like business activity and expectations. | Numeric (Continuous) | Normal Distribution |
|
+---+---+---+---+
| Retail Trade Confidence Index (RTCI) | Represents the sentiment in retail trade, including expectations of sales and stock levels. | Numeric (Continuous) | Normal Distribution |
|
+---+---+---+---+
| Construction Confidence Index (CNCI) | Reflects confidence in the construction sector, focusing on current orders and future business activity. | Numeric (Continuous) | Normal Distribution |
|
+---+---+---+---+

Time Series Analysis

Seasonal Analysis

The purpose of this analysis is to perform seasonal analysis for multiple economic indices and visualize their monthly patterns in a faceted plot. It provides insights into how each index fluctuates over the months of a year.

Check the following codes for the seasonal analysis line charts:

```{r message=FALSE, warning=FALSE}
#| code-fold: true
#| code-summary: "Show the code"

# Load necessary libraries

library(readr)
library(dplyr)
library(ggplot2)
library(knitr)
library(kableExtra)
library(tidyr)

# Import the dataset
data <- read.csv("Cleaned_Economic_Confidence_Index_Dataset.csv")

# Exclude 'Year' and 'Month' columns (~ AI ~)
columns_to_analyze <- setdiff(names(data), c("Year", "Month"))

# Perform seasonal analysis for all columns except 'Year' and 'Month'
seasonal_analysis <- data %>%
  group_by(Month) %>%
  summarise(across(all_of(columns_to_analyze), ~ mean(.x, na.rm = TRUE)))

# Reshape the data for faceted plotting, We learned the use of pivot_longer() function
from DataCamp courses.
melted_data <- seasonal_analysis %>%
  pivot_longer(cols = -Month, names_to = "Index", values_to = "Seasonal_Average")

# Set the order of facets to match the order in the Excel file (~ AI ~)
melted_data$Index <- factor(melted_data$Index, levels = columns_to_analyze)

# Plot using faceting to compare seasonal averages of different indices
ggplot(melted_data, aes(x = Month, y = Seasonal_Average)) +
  geom_line(aes(group = Index), color = "blue") +
  geom_point(color = "red") +
  facet_wrap(~ Index, scales = "free_y") +
  labs(title = "Seasonal Analysis of All Indices",
       x = "Month",
       y = "Seasonal Average") +
  scale_x_continuous(breaks = seq(2, 12, by = 2)) +
  theme_minimal()

```

[^1]

[^1]: Initially, we plotted each variable separately. However, we realized that this approach was inefficient, both in terms of space and clarity, as it required extensive code for minimal insight. To address this, we adopted faceting, which allowed us to present all variables in a single, well-organized visualization. This approach significantly improved the efficiency of our analysis, saving both time and space while enhancing interpretability. Our methodology was primarily guided by lecture materials and DataCamp assignments, with occasional assistance from AI tools. We annotated sections of code where AI provided input with the comment "(\~ AI \~)" for transparency

The seasonal analysis shown in the provided graphs highlights the monthly variations in multiple confidence indices across different sectors. Here's an interpretation of each index based on the graph's trends:

Economic Confidence Index: The index significantly drops close to April (Month 4), with a gradual ascent up to December. This suggests a seasonal dip, potentially due to

external economic or market-specific causes that stabilize later in the year.

Consumer Confidence Index: The index shows a relatively stable trend but retreats slightly in the middle of the year, especially over the summer months. In this regard, consumer confidence is susceptible to financial challenges or changes that may occur mid-year.

Real Sector Confidence Index: There is a sharp fall around April that almost mirrors the trend in the Economic Confidence Index, suggesting a link with broader economic trends and real-sector activity levels. The bounce-back in the latter part of the year implies improved performance or resolution of early challenges.

Services Confidence Index: Confidence exhibits a marked drop early in the year but then sees a strong recovery through the remainder of the year, exhibiting steady growth. This may indicate seasonal variation in service demand.

Retail Trade Confidence Index: The retail index also mirrors a similar trend as that of the Services Index—a slump in the early months followed by a steady climb upward. This aligns with consumer behavior, where retail activity picks up after initial low seasons.

Construction Confidence Index: The most pronounced seasonality is observed here, with a slump in March-April (Months 3-4) and then a recovery that plateaus in the second half of the year. This may be due to seasonal influences, like weather conditions affecting construction activities.

In conclusion, dips in the indices around the beginning of the year, especially March-April, indicate sector-wide impacts, possibly due to seasonal slowdowns or economic cycles. Recovery toward the end of the year in most indices suggests either resilience or increased activity due to year-end planning and execution. These trends can guide strategic planning and help businesses prepare for periods of low confidence and adjust their strategies accordingly.

Yearly Analysis

The purpose of this code is to perform a yearly analysis for multiple economic indices and visualize their annual trends using a faceted plot. It helps to identify how each index changes year by year, providing insights into long-term trends and patterns.

Check the following codes for the yearly analysis line charts:

```{r message=FALSE, warning=FALSE}
#| code-fold: true
#| code-summary: "Show the code"

# Load necessary libraries
library(readr)
library(dplyr)
library(tidyr)
library(ggplot2)
library(knitr)
library(kableExtra)

# Import the dataset
data <- read.csv("Cleaned_Economic_Confidence_Index_Dataset.csv")

# Exclude 'Year' and 'Month' columns (~ AI ~)
columns_to_analyze <- setdiff(names(data), c("Year", "Month"))

# Perform yearly analysis for all columns except 'Year' and 'Month'
yearly_analysis <- data %>%
  group_by(Year) %>%
  summarise(across(all_of(columns_to_analyze), ~ mean(.x, na.rm = TRUE)))
```

```
# Reshape the data for faceted plotting
melted_data <- yearly_analysis %>%
  pivot_longer(cols = -Year, names_to = "Index", values_to = "Yearly_Average")

# Set the order of facets to match the order in the Excel file (~ AI ~)
melted_data$Index <- factor(melted_data$Index, levels = columns_to_analyze)

# Plot using faceting with vertical x-axis labels for yearly analysis
ggplot(melted_data, aes(x = Year, y = Yearly_Average)) +
  geom_line(aes(group = Index), color = "blue") +
  geom_point(color = "red") +
  facet_wrap(~ Index, scales = "free_y") +
  labs(title = "Yearly Analysis of All Indices",
       x = "Year",
       y = "Yearly Average") +
  scale_x_continuous(breaks = unique(data$Year)) + # Ensure all years are shown (~ AI ~)
  theme_minimal() +
  theme(
    axis.text.x = element_text(angle = 90, vjust = 0.5, hjust = 1) # Rotate x-axis labels
  )

```

[^2]

[^2]: Again we used faceted line charts for the yearly analysis and put "(\~AI\~)" sign on the comments to indicate where we got help from AI tools.

The yearly analysis of six confidence indices reveals key trends and sectoral distinctions, providing valuable insights into the broader economic landscape. Across all sectors, a general decline is observed from 2011 to 2020, with 2020 marking the lowest point due to the significant disruptions caused by the COVID-19 pandemic. However, the recovery patterns vary across sectors, highlighting their unique dynamics and resilience.

The Economic Confidence Index and Consumer Confidence Index both exhibit a steady downward trend over the years. While the Economic Confidence Index shows a slight stabilization after 2021, the Consumer Confidence Index maintains a relatively lower and flatter trend post2020, indicating continued challenges in restoring consumer sentiment.

The Real Sector Confidence Index shows more pronounced fluctuations compared to other indices, with brief recoveries in 2017-2018. However, it experiences a sharp decline in 2020, followed by a gradual downturn in subsequent years. Similarly, the Construction Confidence Index follows a steady and significant decline from 2011 to 2020, with a modest recovery post2021 that remains below historical levels, reflecting structural weaknesses in the sector.

Among the indices, the Services Confidence Index displays a marked recovery after the sharp dip in 2020, indicating a higher level of adaptability and resilience in this sector. In contrast, the Retail Trade Confidence Index showing smaller fluctuations compared to other indices. However, its recovery after 2020 remains modest and less pronounced compared to the services sector.

The pandemic's impact is most evident in 2020, where all indices reached their lowest points, but the recovery paths diverge significantly. The services sector shows the fastest recovery, underscoring its resilience, while the construction sector struggles to regain momentum. The overall trends highlight the importance of tailoring sector-specific policies, with a focus on supporting struggling sectors like construction while leveraging the recovery potential of resilient ones like services. This comparative analysis offers a comprehensive basis for informed policymaking and targeted economic strategies in the post-pandemic era.

Correlation Analysis

Comparison of Sub-Indices with Each Other

The purpose of this analysis is to provide a clear and concise representation of the relationships between the selected indices for better interpretation and decision-making.

We aimed to perform a correlation analysis on sub-indices of the Economic Confidence Index to evaluate the strength and direction of their linear relationships.

The results were presented in formatted tables ensuring that the findings are accessible and informative.

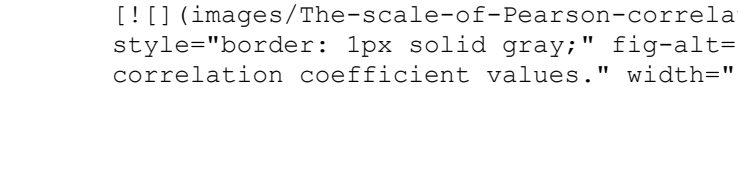
Check the following codes for the correlation matrix:

```{r message=FALSE, warning=FALSE}
#| code-fold: true
#| code-summary: "Show the code"

library(readr)
library(dplyr)
library(tidyr)
library(ggplot2)
library(knitr)
library(kableExtra)

# Import the dataset
data <- read.csv("Cleaned_Economic_Confidence_Index_Dataset.csv")

# Exclude 'Year', 'Month', and 'Economic_Confidence_Index' columns
columns_to_analyze <- setdiff(names(data), c("Year", "Month",
"Economic_Confidence_Index"))

# Perform correlation analysis using the selected columns (~ AI ~)
correlation_matrix <- cor(data[, columns_to_analyze], use = "complete.obs")

# Create a styled table and adjust column widths using column_spec (~ AI ~)
kable(correlation_matrix, format = "html", digits = 2,
      caption = "Correlation Matrix") %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"),
                full_width = F) %>%
  column_spec(1, width = "5em") %>%  # Adjust the width of the first column
  column_spec(2:ncol(correlation_matrix), width = "7em")  # Adjust the width of other
columns


```

[^3]

[^3]: We got help from AI tools for the use of "cor" and "kable" functions.

To evaluate these values we used the scale of Pearson correlation coefficients. We analyzed and interpreted the correlation matrix for sub-indices of the Economic Confidence Index using a provided scale to classify the strength of relationships. The analysis involved categorizing the correlation coefficients into predefined ranges (very low, low, moderate, high, and very high correlation) and commenting on the nature of these relationships.


[](images/The-scale-of-Pearson-correlation-coefficients-40-01.png){height="auto" style="border: 1px solid gray;" fig-alt="We used this scale to make comments on our correlation coefficient values." width="70%"}]

(https://www.researchgate.net/publication/370300503_Challenges_in_Agile_Software_Maintenance_for_Local_and_Global_Development_An_Empirical_Assessment)

The scale of Pearson correlation coefficients. Source: [Click here to see the source] (https://www.researchgate.net/publication/370300503_Challenges_in_Agile_Software_Maintenance_for_Local_and_Global_Development_An_Empirical_Assessment)

Pair of Indices	Correlation (r)	Strength (Pearson scale)	Comment
Consumer_Confidence_Index - Real_Sector_Confidence_Index	0.27	Low Correlation	Minimal linear relationship between these indices.
Consumer_Confidence_Index - Services_Confidence_Index	0.40	Moderate Correlation	A noticeable but modest positive relationship.
Consumer_Confidence_Index - Retail_Trade_Confidence_Index	0.49	Moderate Correlation	Shows a modest alignment, suggesting a slightly stronger relationship.
Consumer_Confidence_Index - Construction_Confidence_Index	0.54	Moderate Correlation	Shows moderate alignment between consumer confidence and construction.
Real_Sector_Confidence_Index - Services_Confidence_Index	0.72	High Correlation	Indicates a strong, meaningful relationship between the real sector and services.
Real_Sector_Confidence_Index - Retail_Trade_Confidence_Index	0.68	Moderate Correlation	Shows significant alignment, nearing strong correlation.
Real_Sector_Confidence_Index - Construction_Confidence_Index	0.61	High Correlation	Suggests a clear relationship between these sectors.
Services_Confidence_Index - Retail_Trade_Confidence_Index	0.83	Very High Correlation	A very strong positive relationship; these indices are closely linked.

Services_Confidence_Index - Construction_Confidence_Index	0.70	High Correlation	Strong interconnection between services and construction sectors.
Retail_Trade_Confidence_Index - Construction_Confidence_Index	0.73	High Correlation	Suggests significant alignment and interdependence.

: **Comparing the sub-indices based on correlation values**

We created a correlation heatmap to visualize our correlation values. It provides a quick, visual summary of the strength and direction of relationships between variables.

Check the following codes for the correlation heatmap:

```{r message=FALSE, warning=FALSE}
#| code-fold: true
#| code-summary: "Show the code"

library(readr)
library(dplyr)
library(tidyr)
library(ggplot2)
library(knitr)
library(kableExtra)
library(corrplot)

# Import the dataset
data <- read.csv("Cleaned_Economic_Confidence_Index_Dataset.csv")

# Exclude 'Year', 'Month', and 'Economic_Confidence_Index' columns
columns_to_analyze <- setdiff(names(data), c("Year", "Month",
"Economic_Confidence_Index"))

# Create a correlation heatmap (~ AI ~)
corrplot(correlation_matrix, method = "color", type = "upper",
         tl.col = "black", tl.srt = 45, addCoef.col = "black",
         title = "Correlation Heatmap of Confidence Indices",
         mar = c(0, 0, 2, 0))
```

[^4]

[^4]: We got help from AI tools to create correlation heatmap.

In conclusion, the strongest positive relationships exist between indices related to services, retail trade, and construction. These sectors appear highly interconnected, reflecting their mutual influence on overall economic confidence.

Consumer Confidence Index has weaker correlations with other indices, indicating it is influenced by broader, possibly external factors rather than being directly tied to specific economic sectors.

The alignment of the real sector with services and retail trade suggests that these are key drivers of economic activity.

This analysis can help prioritize which indices to focus on for understanding sectoral interdependencies and guiding economic policy or decision-making.

Comparison of Sub-Indices with the ECI

The purpose of analyzing correlations between the Economic Confidence Index (ECI) and its sub-indices is to gain insights into the relationships and dynamics between overall economic confidence and specific sectors or components of the economy.

Check the following codes for the correlation matrix:

```{r message=FALSE, warning=FALSE}
#| code-fold: true
#| code-summary: "Show the code"

library(corrplot)
library(readr)
library(dplyr)
library(tidyr)
library(ggplot2)


# Import the dataset
data <- read.csv("Cleaned_Economic_Confidence_Index_Dataset.csv")

# Select relevant columns
selected_data <- data[, c("Economic_Confidence_Index",
                          "Consumer_Confidence_Index",
                          "Real_Sector_Confidence_Index",
                          "Services_Confidence_Index",
                          "Retail_Trade_Confidence_Index",
                          "Construction_Confidence_Index")]

# Compute correlation matrix
cor_matrix <- cor(selected_data, use = "complete.obs")

# Extract correlations with Economic Confidence Index
economic_confidence_correlations <- cor_matrix["Economic_Confidence_Index", ]

# Print the results
kable(economic_confidence_correlations, caption = "Correlations with Economic Confidence Index")


```

We evaluated the correlation results in the following table:

Sub-Index	Correlation (r)	Strength (Pearson Scale)	Comment
Consumer Confidence Index	0.631	High correlation	Indicates a significant influence of consumer sentiment on economic confidence.
Real Sector Confidence Index	0.840	Very high correlation	Highlights

			the strong impact of the real sector (e.g., manufacturing, industry).
Services Confidence Index	0.915	Very high correlation	Shows that the services sector is a major driver of overall economic confidence.
Retail Trade Confidence Index	0.860	Very high correlation	Suggests that retail trade has a substantial role in shaping economic sentiment.
Construction Confidence Index	0.797	High correlation	Reflects a significant, though slightly less dominant, influence of construction activity.

We created a correlation bar chart to visualize the correlation values between the Economic Confidence Index and its sub-indices. This chart provides a clearer and more understandable representation of the values in numerical order.

Check the following codes for the correlation bar chart:

```{r message=FALSE, warning=FALSE}
#| code-fold: true
#| code-summary: "Show the code"

# Load necessary libraries
library(ggplot2)

# Select relevant columns
selected_data <- data[, c("Economic_Confidence_Index",
                          "Consumer_Confidence_Index",
                          "Real_Sector_Confidence_Index",
                          "Services_Confidence_Index",
                          "Retail_Trade_Confidence_Index",
                          "Construction_Confidence_Index")]

# Compute correlation matrix
cor_matrix <- cor(selected_data, use = "complete.obs")

# Extract correlations with Economic Confidence Index
economic_confidence_correlations <- cor_matrix["Economic_Confidence_Index", ]

# Convert to a data frame for visualization (~ AI ~)
cor_df <- data.frame(
  Sub_Index = names(economic_confidence_correlations),
  Correlation = economic_confidence_correlations
)

# Create a bar plot of the correlations
ggplot(cor_df[-1, ], aes(x = reorder(Sub_Index, Correlation), y = Correlation)) + # Remove self-correlation (index 1)
  geom_bar(stat = "identity", fill = "steelblue") +
  coord_flip() + # Flip the coordinates for better readability (~ AI ~)
  theme_minimal() +
  labs(title = "Correlations with Economic Confidence Index",
       x = "Sub-Indices",
       y = "Correlation") +
  geom_text(aes(label = round(Correlation, 2)), hjust = 1.2, color = "white") #(~ AI ~)

```

[^5]

[^5]: We got help from AI tools to understand how we can visualize the data and for adding some ggplot functions.

The services, retail trade, and real sectors are the primary contributors to economic confidence, with their high and very high correlations suggesting they should be prioritized in policy and business strategies.

Construction activity also plays a meaningful role in shaping economic sentiment.

While consumer confidence is important, its impact is slightly lower compared to other sub-indices, suggesting its influence on economic confidence might be indirect or mediated by other sectors.