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ISTANBUL AYDIN UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

FORECASTING HOUSE PRICE INDEX IN TURKEY USING ARIMA TRANSFER FUNCTIONS AND ARTIFICIAL NEURAL NETWORKS (ANN)

MASTER'S THESIS

MAHDI NASSER ABUANZEH

Department of Business

Business Administration Program

FEBRUARY, 2023

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Thesis Advisor: Asst. Prof. Dr. UĞUR ŞENER

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APPROVAL PAGE

DECLARATION

I hereby declare with respect that the study “Forecast of Housing Price Index with ARIMA Transfers Functions and Artificial Neural Networks in Turkey”, which I submitted as a Master thesis, is written without any assistance in violation of scientific ethics and traditions in all the processes from the Project phase to the conclusion of the thesis and that the works I have benefited are from those shown in the Bibliography. (…/…//2023)

Mahdi Nasser Abuanzeh

FOREWORD

All Praise be to Allah Who guided us to this, never could we have found guidance, had it not been for the guidance of Allah.

This thesis is dedicated to the memory of my great mother Salam Hiasat, the source of all the great meanings and values in my life. It was my promise to her that motivated me to persevere through the hardest days in order to reach the milestone. Although she is no longer with us, her memories will enlighten and guide me forever through my journey with the goal to make her always proud of me.

I would like to express My heartfelt thanks to my father, my greatest teacher and the reason behind everything good happens to me. Thanks are also extended to Siwar, Zaid, family and friends who have been a constant source of support, I am deeply grateful for their presence in my life.

Finally, I would like to acknowledge the contributions of my advisor Dr.

Uğur Şener, whose guidance has been instrumental in shaping my research and shaping me as a scholar. I am highly appreciated for his support and patience and pleased for the opportunity to learn from him.

Thank you all for being a part of the journey and I hope this thesis will make a positive impact in the world and be beneficial to everyone

FEBRUARY, 2023 Mahdi Nasser Abuanzeh

STRATEGIC PLAN TO IMPROVE MARKETING MANAGEMENT OF PRODUCTS

ABSTRACT

It is widely acknowledged that the Turkish economy was launched by the housing sector. As a result, both government policymakers and decision-makers in the building business are keenly interested in how housing prices change. Understanding the connections between changes in macroeconomic variables and changes in housing prices is crucial for properly tracking price changes in homes. With the use of autoregressive integrated moving average (ARIMA) and artificial neural network (ANN) models, the primary goal of this research is to predict Turkey's housing price index (HPI) with macroeconomic variables. Eleven macroeconomic parameters are chosen as the independent variables when predicting the housing price index (HPI). The quarterly time series data of these parameters are used for the time period between January 2010 to December 2022 to train the models. An in-depth analysis is done on the connection between these macroeconomic factors and changes in the housing prices index. 11 hypotheses are formed to test the model, from that GDP (β=0.001, p= 0.97), Gold prices (β=-0.00, p= 0.69), BORSA index (β=2.08, p= 0.52), monetary rate (β=-0.105, p= 0.27) and foreign trade (β=0.171, p= 0.26) are not affected on Turkey's HPI. Inflation rate (β=1.20, p= 0.000), an Exchange rate (β=0.09, p= 0.00), USD/TL (β=1.43, p= 0.000), Unemployment (β=-0.94, p= 0.005), Deposit interest rate (β=-0.42, p= 0.00) and money supply (β=-0.11, p= 0.04) are significantly affected in Turkey's housing price index. This study will help policy makers and investors who are taking investment decisions in Turkish real estate markets.

Key Words: ARIMA model, ANN Model, Housing Price Index, Macroeconomic Indicators.

TÜRKİYE'DE ARIMA TRANSFER FONKSİYONLARI VE YAPAY SİNİR AĞLARI İLE KONUT FİYAT ENDEKSİ TAHMİNİ

ÖZET

Türkiye ekonomisini konut sektörünün başlattığı yaygın bir kabuldür. Sonuç olarak, hem hükümet politika yapıcıları hem de inşaat sektöründeki karar vericiler, konut fiyatlarının nasıl değiştiğiyle yakından ilgileniyor. Makroekonomik değişkenlerdeki değişimler ile konut fiyatlarındaki değişimler arasındaki bağlantıları anlamak, konutlardaki fiyat değişimlerini doğru bir şekilde izlemek için çok önemlidir. Otoregresif entegre hareketli ortalama (ARIMA) ve yapay sinir ağı (YSA) modellerinin kullanılmasıyla bu araştırmanın temel amacı Türkiye'nin konut fiyat endeksini (HPI) makroekonomik değişkenlerle tahmin etmektir. Konut fiyat endeksi (HPI) tahmin edilirken bağımsız değişken olarak on bir makroekonomik parametre seçilmiştir. Bu parametrelerin üç aylık zaman serisi verileri, modelleri eğitmek için Ocak 2010 ile Aralık 2022 arasındaki zaman aralığı için kullanılır. Bu makroekonomik faktörler ile konut fiyatları endeksindeki değişimler arasındaki bağlantı üzerine derinlemesine bir analiz yapılır. Modeli test etmek için GSYİH (β=0.001, p= 0.97), Altın fiyatları (β=-0.00, p= 0.69), BORSA endeksi (β=2.08, p= 0.52), parasal oran (β=-0,105, p= 0,27) ve dış ticaret (β=0,171, p= 0,26) Türkiye'nin

KFE'sinden etkilenmemiştir. Enflasyon oranı (β=1,20, p= 0,000), Döviz kuru (β=0,09, p= 0,00), USD/TL (β=1,43, p= 0,000), İşsizlik (β=-0,94, p= 0,005), Mevduat faiz oranı (β=-0,42, p= 0,00) ve para arzı (β=-0,11, p= 0,04) Türkiye konut fiyat endeksinden önemli ölçüde etkilenmektedir. Bu çalışma, Türk gayrimenkul piyasalarında yatırım kararı alan politika yapıcılara ve yatırımcılara yardımcı olacaktır.

Anahtar Kelimeler: ARIMA modeli, YSA Modeli, Konut Fiyat Endeksi, Makroekonomik Göstergeler.

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ABBREVIATIONS

ARIMA **:** Auto-Regressive Integrated Moving Average

ANN **:** Artificial Neural Networks

GDP **:** Gross domestic product

GARCH **:** Generalized Auto-Regressive Conditional Heteroskedasticity

HPI **:** Housing Price Index

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I. INTRODUCTION

The current environment has changed everything, living standards of people around the world now the house is considered the most profitable asset for householders. It has higher rates, as compared to any other security they purchase. A few years ago, people just have the desire to acquire their own house (Wu et al., 2022). Nowadays people are prioritizing making investments in the real estate business. Not for buying the home, but to satisfy their shelter needs and to sell that house in the future at higher rates. The business is flourishing and highly demanded all across the world. It has been demanded a higher price. There has been a very low chance of price depreciation (Brambilla et al., 2022). The decision for making investments in the real estate market required a high level of market conditions understanding and knowledge about price fluctuations (Seifhashemi & Elkadi, 2022). Therefore, highly efficient forecasting techniques are required. The housing price index (HPI) is the most important tool, that highlights the affordability of the purchasers and for forecasting. It has been considered the most studied variable and researchers are studying the impacts of the different factors on the prices of houses (Piazzesi & Schneider, 2016).

In Turkey, the business of real estate and residential property is at its peak. The forecasting of the prices and masking estimations which are highly reliable and accurate is the top priority of the investors. Like the other economies, the Turkish economy is also developed by the real estate market. Majorly it is one of the most developing sectors, and that is the reason it has been analyzed the various scholars. Our study emphasized how macroeconomic indicators influence the Turkish residential sector. The housing price index is the most essential and fundamental tool that will highlight the affordability of the houses purchased by individuals (Fang et al., 2022). The housing price index or affordability is the bond that creates between individuals and houses (Judge et al., 2019). The calculation of the housing index has critical and complex procedures. Such procedures were admitted by the prior research and considered the most important tool for the purchasing of the house and

the decision-making. There must be some environmental factors that have the potential to create fluctuations in the price of real estate (Pataki-Bittó & Kapusy, 2021; Alzain et al., 2022). These cost constructs, the availability of resources, and high the demand for purchasing real state property. It will maximize the market capital, same as the case when the demand goes down the market capital decreases. However, there must be interferences of the regulatory authority. The financial crises affected the financial markets and other institutions. All financial institutions have shifted the interests of the investors, to take decisions with extreme care and proper knowledge. In that situation, forecasting is playing a fundamental role. The housing prices index is a highly influential factor in creating demand and declining demand as well (Taltavull, 2003). The major economic-related issues are created by the problem arising in the real estate markets and their fluctuations. Most of the authors have demonstrated that prices are interdependent upon demand and supply factors (Case & Shiller, 2003; Chen & Patel, 1998). Many crucial factors are responsible for making the changes in the environment of the real estate market and most important are the macroeconomic factors. The development of the economy is boosted by the development of the real estate market. The correct investment strategies and the proper planning lead investors towards higher returns which are the main motive behind making investments in residential properties. Economic growth is also affected the housing and residential market. It has been very beneficial for improving the performance of the other financial and the other commodities market (Akdogan et al., 2019; Cohen, 2022).

The houses prices index is considered essential for guiding the decision-makers to take the right and profitable decisions for the organizations. It also helps policymakers to design their policies in real estate markets. The decision according to the trend of the residential market helps them, to maintain their investing activity and predict economic stability (Cohen, 2022). Forecasting techniques are categorized in various forms and types and most prominent, among them multivariate and univariate forecasting models that are highly prioritized by various investors (Zietz, 2003; Ding et al., 2022). As the rate of returns is high similar to that, default risks are probable and reduce chances of future uncertainties; like the home lenders who are making decisions for real estate prices. Interest rate borrowings are also often affected by the housing price index (Shi et al., 2014). The housing market is working

with the proper functioning and the factors that are highly influencing the demand and the supply. The demands have been increasing day by day, and the need for the property is increasing. It has been creating more and more reunites for the builders and the investors. It will surely increase the competition in the real estate industry (Anim-Odame, 2022).

As the prices high of any commodity will surely decrease the demand. As the demand and price are inversely proportional to each other. But in the case of the real estate or housing markets the more there is the chance of a high amount of return the higher the demand will be. The environment has been changing dynamically (Fang et al., 2020). It is most difficult to cope with the challenges and the prices are changing rapidly. Forecasting has great importance with its correct techniques. Recently, the global market is shrunk and their profitability ratio has decreased, while other economic indicators are also affected the performances of the real estate markets (Daneshgar & Zahedi, 2022). As these indicators reflected the economic conditions & the current status of the country whether the country is developing are not. These indicators have their major role in determining the policies of the countries and how these policies are different from the economies or countries (Akça, 2022; Aliefendioğlu et al., 2022). Now housing is not limited to purchasing a house for the fulfillment of shelter needs, it is now the assets that have surely higher future returns. It is the most favorite asset for investments. Instead of saving money in the banks most individuals prioritizing to purchase a property or another house for selling at a double rate.

The real estate market has captured the attention of every investor because of its dynamic nature and fluctuations in prices. There has been a need for high-level expertise to handle the complexities in the market as well. The proper management of macroeconomic indicators is a real strength of investors and policymakers. As the macroeconomic indicators highlight all current trends happening in the real estate business and all the other sectors. Forecasting is a powerful tool for predicting the future outcomes of current investments. It provides the proper course of action of reversing the planned actions according to the changings that are caused by any of the factors. Most scholars have demonstrated that several crucial factors and indicators have a direct or indirect impact on housing prices (Xu et al., 2022; Chen and Patel, 1998). Macroeconomic is considered as the highlighted bundle of

indicators in those indicators. We have examined, the macroeconomic indicators are the most familiar ones and these indicators are the real techniques that can measure economic performance. There are no such formulae to calculate them exactly (Chen et al., 2022). We have given great importance to the macroeconomic indicators for our study, as these have been playing a pivotal role and support the economy to grow at a faster rate. Major economic factors are inflation, Gross Domestic Product (GDP), money supply, monetary rate, Foreign Direct Investment (FDI), etc. The environment has been changing dynamically, it's most difficult to cope with the challenges and the prices are changing rapidly. Forecasting has great importance with its correct techniques. Deciding the correct techniques for the projects is also crucial and has demanding focus and knowledge (Wang et al., 2022).

As the housing price index (HPI) is represented the willingness of the buyer to purchase the houses within their budget. As for middle-class individuals, there have been always issues with affordability and certain other factors are hindering them to buy their own house. How these other factors are interrelated and to what extent this now became the interest of this study? GDP has been also improved by the housing sector (Cheng & Teck, 2023). GDP highlights all the production of goods and services within the premises of the country. It is one of the major and most important economic indicators. It is associated with an increment in prices. There has been a direct relationship between them. As the prices increased the GDP is also increased. It's one of the major contributors to the housing price index (Gebeşoğlu, 2019).

It has the potential to lift economic conditions, specifically it influences economic growth which is the other macroeconomic indicator. It highlights that the level of economic activities is changed day by day and that has occurred by the bundle of the other elements (Azam et al., 2022). The economic crises that occurred in 2008, left the worst effects, and the housing bubble burst. After those crises, investors are more likely to focus on forecasting. The housing price index is utilized for getting a further understanding of the increment and decrement in the advance payments. HPI also helps other estimations regarding mortgage payments and future uncertainties (Alpha, 2023).

One of the most significant elements that have been considered as the safe and secure investing element as well the growth of the economy. Economic activities

are also associated with its prices (Kartal et al., 2021). Gold prices have a significant impact on the real estate sector as well. Their connectivity has been playing a major role in economic development. Gold has the potential to bring changes in the prices of commodities (Sumer & Ozorhon, 2021). Gold prices are a very essential and crucial factor. The affordability of houses and gold prices are having been closely interrelated. The real estate market and the gold prices are interrelated with each other. As gold has a direct impact on macroeconomic factors and housing prices as well. The most traded metal that has great importance is gold, which is the most demanded metal all over the world. It is the most precious asset as well the prices are always increasing as time passes. The increment in the price never decreases the ratio of the customers as well as higher the price (Bouri et al., 2020). Sometimes the demand remained unchanged and the customer's preferences have not been affected by the prices. Gold prices are impacted by macroeconomic factors as well and are considered essential trading assets for investors. Gold is considered a valuable asset and sustainable as scientifically presented by (Bahloul et al., 2022; Azam et al., 2022).

Gold is one of the assets or commodities that remained unaffected by macroeconomic factors like inflation and future risks that will be affected by other commodities rather than gold (Singhal et al., 2019). Gold prices have changed from the period of 2008. After the financial crisis, the survival of companies was suffering. Most of the values of the precious elements were reduced at a high rate during the financial crises (Bahloul et al., 2022). These crises affect significantly and hit all over the world. The gold prices are so volatile for investment, the investors must have enough knowledge of the environment and have to make the changes in the overall economies (Bouri et al., 2022). The future activities and the course of action are determined by the gold. Gold is considered a secure investment when there are the worst economic conditions. The rate of gold highlights the rate of inflation as well, then it has great importance for every era. It has been playing a pivotal role at the time of the crises (Korkmaz, 2019).

The fluctuations in the prices have a major influence on the investor's life. When individuals are willing to invest in the real estate sector, they utilize their savings according to their level of consumption. If the level of consumption will decrease, then the level of savings will increase. As it can say that real estate market

prices are highly influenced by one of the other major macroeconomic indicators (Sumer & ÖZorhon, 2020). That indicator is inflation, and the rate of inflation somehow decided the demand and supply factors of the real estate sector. It is somehow very obvious that the HPI highlights the purchasing power of individuals. The market stability has been determined by the inflationary policy. It also determined the relationship between the financial markets and housing markets. It has become a hot topic of research and has highly been verified by various scholars and now still working on the HPI sensitivity (Tang et al., 2019; Milunovich, 2020). Housing selling and buying all depend upon the current policies, that have been implemented in the economy. Most of the studies have shown that monetary rates and the money supply are the key factors for HPI. These factors have affected the demand for housing prices. As the monetary policy changes the demand also changes. The demand for the housing sector is highly interrupted by economic conditions. The literature has highlighted that these factors decide the future trends of the real estate market (Keely & Lyons, 2020).

Among them, inflation is one of the most crucial factors. Past evidence suggests that inflation has clear effects on HPI to some extent. There is a different concept available regarding the relationship between inflation, housing demand, and affordability (Keely & Lyons, 2020). Inflation is the increment in the prices of commodities and significantly affects their way of living. Also, reduce their capability to afford things at a higher rate, and usually, it reduces the purchasing power of the buyer. That is the reason why the consumption of goods and services has reduced and people only purchase the goods which are necessary for living. It also reduces the investing activities of individuals because of affordability. As inflation is reduced individuals avoid purchasing residential property and it significantly drops the demand in the housing sectors (Dias & Duarte, 2019). One of the reasons that stop individuals from buying a house is the unaffordable price of the mortgage. Inflation has also affected the rate of the mortgage before making the decision the selling and purchasing the house. People's priority is the amount of mortgage; they have to pay or receive. Recently most economies are facing higher financial and economic crises. It is a solid reason that the inflation rate is high in such economies. In many economies, post-COVID situations are still not satisfying the demand of customers. Most businesses are still suffering, which has decreased

productivity levels. Lesser production higher the demand which significantly leads to inflation as well. The real estate sector is also going through these challenges. The ratio of price increment is doubled in the past few years. Inflation brought increments in the prices that affect the level of affordability and increase the HPI (Kartal et al., 2021; Dias & Duarte, 2019).

Another indicator that can influence the performance of the real estate sector, and all other sectors as well as the rate of how many people are employed. That simply refers to the unemployment ratio, it has also connectivity with the HPI. Previous studies have demonstrated that there is a certain level of connectivity (Irandoust, 2019). Higher unemployment creates economic issues. It also affects the business of that economy. If the individuals have nothing to do with how they fulfill their basic needs. Unemployment is the reason why people are not able and willing to buy a certain property. Unemployment is a curse for the economies, and it hits every country differently. It is considered a barrier to economic growth. Unemployment is that condition when a person has nothing to do, and he/she will search for some job or work for the earning purpose which is a major problem in the world economy (Alqaralleh, 2019). Unemployment has always had the worst effects on the economy. It has been estimated for the twentieth century that unemployment become a more problematic issue for the economies (Maynou et al., 2021).

Unemployment has effects on the lives of individuals but also on their physical health and mental health. It has increased the level of stress and anxiety, and the individual suffers a lot from this. Unemployment has very worst impacts on the lives of individuals. It is responsible for many health issues as well. It slows down the economy and development as compared to economies; where the unemployment rate is low. That is also responsible for the changes in their lifestyle and preferences (Maynou et al., 2022). Lack of available resources and earning people are not able to take part in the investing activities. Therefore, an investor always has the desire to invest in a property, where the rate of return is high. So, that he/she can earn more than he/she invests. It is also beneficial in all aspects, where; past investments in real estate help them enjoy a great amount of return in present times (Alqaralleh, 2019).

The GDP and inflation are considered the most important variables to predict the economy. There is a bundle of ways to forecasting them, the economic growth of the country is calculated by the number of production of goods and services of the

country, which is indicated by GDP. Economic growth is measured in terms of GDP (Azam et al., 2022). The macroeconomic indicators are associated with each other and show the combined effects of the two factors. Like; GDP can be measured with the assistance and calculation of other factors. When inflation increased the rate of unemployment also increases. When the economy suffers from growth, then GDP goes down. This connectivity is making them powerful indicators for the economy (Gebeşoğlu, 2019).

Real estate markets and the financial markets collectively boost the economy. How these are interrelated will be defined in our research for knowing the connectivity between the financial markets and HPI. Borsa Istanbul BIST 100 index, presents the stock market of Turkey as concerned with the real estate sector (Bezgin & Başar, 2020). It has been necessary to check the impact on it as well. Financial assets are also very dynamic in nature where; the prediction about the future is very difficult, as like with the real estate markets. Forecasting of the housing price index (HPI) and stock market indices are interrelated. As the prices of the assets have been changed by the changing in the monetary policy of the economy. The investors also have to analyze current trends and changes with their forecasting techniques. Stock market securities should need all the information about the securities price fluctuations (Cagli, 2019). The housing price index and BSIT 100 index are interrelated with each other.

The exchange rate is one of the most important and popular macroeconomic indicators, that has a great impact on economic stability as well. In Turkey, it has been considered a very important factor in the real estate sector. Highly investing activities are concerned with the real estate market (Frenkel, 2019). As the exchange rate is very essential for analyzing future trends in the real estate market. Hence previous studies have been made to evaluate the impacts of the exchange rate on the real estate markets, but there is no evidence found which clarifies their relationship. As the dynamics in the foreign policies, the exchange rate is also not fixed. It also possesses dynamism, that's why it has the potential to affect the market and prices of the housing sector. The exchange rate is a major economic indicator and has a vital role in the activities related to international trade. The policies are decided by the government through which the government can evaluate the price stability of the exchange rate. The implementation of better policies in the economy can enhance

performance and can lead to a current account surplus which is highly effective (Singhal et al., 2019; Edwards, 2019; Charfi et al., 2020). The exchange rate has great importance for investors because of globalization. When the real estate market holders have an interest to expand their business and want to work with international investors. There has been a key factor that plays a pivotal role is the exchange rate. That enables them to trade and make their transactions easy and convenient (Charfi et al., 2020). Nowadays the exchange rate is considered the determinant of the prices of those economic resources that are being traded in the international market. It has to check the level of equilibrium between the demand and the supply of foreign exchange (Edwards, 2019). The exchange rate can estimate the situation that has been happening in the future.

The exchange rate is efficient for decision-making and enables one to choose which country is suitable for trade. Real estate prices are the agreement between the buyer and the seller's predetermined price. The real estate market does not have such liquidity as compared to the other markets where; the selling and purchasing of assets is not easy. A large amount of literature has been studied, on real estate pricing strategies, methodologies, techniques, and models, these are highlighted all concerning details to investors (Edwards, 2019). Every economic factor has the potential to change the overall deciding future course of action. Different scholars have presented their concepts according to their level of understanding. It is the domination of the currency in terms of other currencies and represents that one unit of international currency is equal to how much is in domestic currency (Frenkel, 2019). Like the inflationary effect, the exchange rate has an effective and major impact on housing prices. The high prices of the real estate market can lead to a high demand for foreign exchange. By applying the bootstrap multivariate panel, granger causality test to investigate the housing prices and the exchange rate relation where; the findings concluded that the housing price brought changes in the exchange rate (Huy et al., 2020). The exchange rate highlights the relationship between the two country’s currencies. It provides the ease of doing business internationally and creates opportunities for investors to gain high returns from those countries, where the exchange rate is high. As we are highly focusing on the macroeconomic indicators there has been another variable of our studies which is the leading factor and gaining attention.

Interest rates have also a major role in the economy, for all financial and all other markets. Interest rate fluctuation has also affected the housing prices index (HPI). Interest rate is one of the most prominent macroeconomic indicators, which has a high impact on housing prices. The term interest can be defined as the lender earning some amount from the money which he has given to someone (Hong et al., 2020). Previous studies have highlighted that the real estate market is closely interrelated with the interest rate. The housing bubble burst was one of the major events that have been occurred because of the monetary policy and the lower interest rates. There has been a lot of research has been carried out on the impacts of the interest rate. Those studies couldn't provide the proper relationship between the interest rate and HPI. This study will clearly have defined how these are interrelated to an extent (Stroebel & Vavra, 2019).

It is the key factor that determined the development of the GDP and other factors as the studies shows, that it increases the affordability of the buyers and they can easily manage to make investments in the real estate sector (Akdogan et al., 2019). Hence the growth of the real estate market and the determination of the prices are also associated with HPI. When it increased the purchasing power of people also increased (Anim-Odame, 2022). The gross domestic product is one of the major components that highlight economic activity. The production of the overall goods and the services in the boundary of the company within the period of a year. The concept has been arising in the early 1930s, at the time of the great depression to know the real working of economic activities. Also, evaluating the performance of the policies implemented by the government. The initial accounts were prepared by the Russion-America scientist Simon Kuzne and he combined the all productions in one account (Alpha, 2023).

There are millions of reasons behind investments in the housing markets. It is a very profitable business with the surety of less default risk. The risk of the buyer has been diversified by the portfolio investment and guaranteed higher returns. It increases the capital of the buyer, as the economy grows the income of the individuals also grows and that will lead to a higher rate of investments. It is the phenomenon when the income is high individuals shift to purchase residential properties with that expectation. When the prices go up they will be benefited from this and will sell that property (Muzindutsi et al., 2021).

The housing prices and the monetary rate are linked with each other and that has been clarified the scholars. According to (Cui et al., 2022; Robra & Heikkurinen, 2020), the housing bubble burst because of the expansionary rate, which created such convenience for householders. Most studies have identified that there is strong connectivity between the monetary rate and the house price index (Wang et al., 2020; Paul, 2020). It has been considered that the monetary rate has a significant role in determining the prices. If the monetary rate is not designed properly, the worst impacts can be seen in the economies. One of the factors increased affects the other variables as well, if the economy is experiencing an expansionary rate there has been an interesting rate also decreased. It increases the demand for houses and people are highly interested in their residential properties. Housing prices are closely associated with the monetary rate in developed economies. It has been depending upon the availability of the loan in developed economies (McDonald & Stokes, 2013). The change that has occurred in the exchange rate influences all economic activities and deviates from the economic equilibrium, which shows that there have been effects on the monetary rate (Frenkel, 2019). The monetary rate and interest rate have a significant relationship with each other in the real estate sector (Xu & Chen, 2012).

The set of those methods and objectives is designed by the central bank of the state to run the economy and the financial sector smoothly. It is considered that the monetary rate; is all about the management of activities related to the economic money supply as a whole.

How to bring change and development into economic activities? and leading to real economic growth (Lastrapes, 2002).

The monetary rate and HPI relationship are still mysterious and there have been a lot of researchers who are highly focused. To enrich the literature certainly, there are assumptions that somehow there has been interconnectivity (Zhou et al., 2014). It is also assumed that now efforts and major steps have been taken to differentiate, both monetary policy and the housing prices index. So, that again the situation of the financial crisis has been avoided by taking some advanced precautionary measures. Although, it is not yet clear. The money supply and the housing price index are closely interrelated. This indicator of the economic current conditions highlights the performance of the nation whether it is developing or not (Yahya, 2020). Their association has been identified by various scholars and

highlighted they are closely inter-connected (Jha, 2023). The bond between the money supply and the housing price has brought several other changes to the economic conditions, that enable the countries to adopt more authorized policies. The real estate market is an emerging market nowadays and has been proven very beneficial. It has been creating a bundle of opportunities for individuals. As this is the era, where financial markets are growing, stocks & bonds have already gained the attention of individuals. Nowadays real estate sector has its peaks and significantly growing than financial institutions and markets (Hoesli & Malle, 2022).

HPI is closely associated with the USD/TL rate fluctuations (Colak, 2021). Real estate markets in Turkey are growing at a faster rate also captured the interest of investors. Scholars believe that USD/TL conversion rate is one of the most crucial factors because this is not a stable one. Sometimes investors get a lot of profit. Sometimes they bear extreme losses in USD/TL. Economic policies influenced the HPI better the conditions higher the demand same the case with the USD/TL. The future of the real estate sector in Turkey is dependent upon the USD/TL fluctuations. USD/TL are always highly important factors it not only affected the performance of the economies as well the real estate markets. Internationally it decided the current trends of the business (Sumer & ÖZorhon, 2020). Turkish markets are flourishing and USD/TL rates have some significant impact on the HPI. USD/TL is the key factor in determining the purchasing power of individuals. Most of the past studies demonstrated that USD/TL has some impact on the prices of the real estate market (Gebeşoğlu, 2019).

The other most important that is concerned with the HPI is foreign trade (FT) (Hepşen & Vatansever, 2012). It is one of the most important economic indicators it has a major influence on economic growth and stability. Real estate prices increase and decrease are somehow concerned with foreign trade policies. Foreign trade policies have an impact on the GDP and HPI. Although there is no evidence found that clearly highlights the association between foreign trade and HPI (Lawrence et al., 1993; Mahalik & Mallick, 2011). Our study is going to investigate how foreign trade has a significant impact on HPI. Foreign trade is gaining more attention nowadays as the exchange of goods and services internationally. FT is the determinant of real economic growth and considers to contribute the development of the countries (Manova, 2013). And also influenced the business of that particular

economy as well. Like other economic indicators, foreign has also been associated with the HPI (Hepşen & Vatansever, 2012).

This competition has increased the complexities of forecasting techniques. The money supply is one of the most important variables of our research. It is considered for economic growth as well. Money supply and monetary rate both collaboratively contribute to determining the current development of the economies. Both of these have a very essential role in the real estate sector. Nowadays the most rapidly growing and developing industry is the housing industry. It has been considered one of the major sources of generating large revenues, as housing prices increase with time, despite that it has been providing several benefits (Frenkel, 2019). Investments in the real are not an easy task, one must have enough knowledge of the market condition and the current business trends. As there is speculation of the risk. The expertise and updated knowledge save anyone from the loss the better the understanding of macro-economic factors. It will helpful for making investments in international or global listed real estate securities. This study will provide a wide range of understanding of how all these above-mentioned variables can influence the HPI and how they can be forecasted accurately and transparently. The housing price index (HPI) is now a hot topic of research currently this emerging business is nationally and internationally flourishing at the fastest rate (Wen et al., 2019). These variables are still top trending variables that have an impact on the HPI and are clearly defined in our research.

A. Problem Statement

The demand for the housing market is certainly very high and almost every individual is eagerly investing his/her saving amount in the real estate market. In Turkey, it is the most successful investment portfolio for most investors. Majorly it is the largest contributor to economic growth and the GDP. Housing price forecasting has been floating nowadays, it is the most beneficial and flourishing business, where; investors are highly attracted to invest in the housing markets. The correct tools and techniques are the most crucial factors for investors to forecast their future course of action. Economists are eagerly working on checking the significant effects of different variables and their relation concerning HPI. But they could have studied the effects of the BIST 100 index (Cagli,

2019), GDP (Gebeşoğlu, 2019), Gold prices (Bouri et al., 2022), Money supply (Wen et al., 2019), Monetary rate (Cui et al., 2022), and USD/TL (Colak, 2021) on HPI in Turkey. There is a need for a better understanding of the impacts of the macroeconomic indicators on HPI in Turkey. There have been not many details available for the effective tool of forecasting the HPI.

That is the reason that these techniques of estimation have reduced the probability of uncertainties and default risk. The procedures and techniques that are being used in forecasting are very sophisticated. New and advanced techniques development have increased the complexity of selecting the right one. Some of the research has highlighted that traditional qualitative and quantitative methods are updated and certain new methods are also available for forecasting such as Artificial Neural Networks (ANN), Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH), Auto Regressive Moving Average (ARMA) and Auto-Regressive Integrated Moving Average (ARIMA).

Our study is based on advanced techniques, as well that have been adopted by most researchers. We used the ARIMA and ANN models for our study. We have selected the ANN that is considered because it has a higher rate of accuracy than the other techniques.

ANN model is used to analyze the association between the variables, which is designed in such a way, that the human biological system is associated with it (Hong et al., 2020). The data has been collected from various tools with the help of human brain cells. That cells are neurons and after that several operations have been performed on them.

Another model which we are using in our research is the ARIMA model. It is a highly preferred tool that is being implemented in most research. It is one of the most appropriate tools for estimating future trends and has proven very helpful for accurate estimation. This model is highly beneficial for the large set of time series stationary data in the long run (Abidoye et al., 2019).

B. Research Gap

Our study mainly highly focused on verifying the impacts of the macroeconomic indicators which are gross domestic product (GDP), inflation,

deposit interest rate, unemployment, money supply, monetary rate, and foreign trade on the housing price index (HPI). That is not explained in the prior research as this is one of the trending businesses around the globe. It is a highly profitable business in many economies. So, there is a need for an advanced level of study, to check the significant effects of such factors on HPI. There is a need to carry out research that systematically highlights the effects of how money supply affects the housing price index. Is there any relationship between HPI and money supply? Another main focus is how the monetary rate can affect the real estate market of Turkey (Wen et al., 2019). What changes will it have brought? Whether these changes are positive or negative for the economy of Turkey's real estate market. There are certain commodities as well that directly or indirectly influence the housing industry. The most famous commodity is gold (Bouri et al., 2022). How gold prices and HPI are essential in making investment decisions. The same is the case with the exchange rate (Colak, 2021) and other variables that are inflation (Tang et al., 2019), and unemployment (Irandoust, 2019) how these are making changes? How these are interrelated with each other is the real motive behind the research.

C. Research Objectives

Our main objective is:

- To compare the ARIMATF and ANN models as well as forecast the housing price index of Turkey.

Our other objectives are:

- To find out the impact of the gross domestic product on the housing prices index (HPI) of Turkey.
- To find out the impact of inflation on the housing prices index (HPI) of Turkey.
- To find out the impact of the exchange rate on the housing prices index (HPI) of Turkey.
- To find out the impact of the gold prices on the housing prices index (HPI) of Turkey.
- To find out the impact of the BORSA index on the housing prices

index (HPI) of Turkey.

- To find out the impact of the USD/TL on the housing prices index (HPI) of Turkey.
- To find out the impact of unemployment on the housing prices index (HPI) of Turkey.
- To find out the impact of the deposit interest rate on the housing prices index (HPI) of Turkey.
- To find out the impact of the money supply on the housing prices index (HPI) of Turkey.
- To find out the impact of the monetary rate on the housing prices index (HPI) of Turkey.
- To find out the impact of foreign trade on the housing prices index (HPI) of Turkey.

D. Significance of the Research

Forecasting is now become, the most efficient tool and it has been gaining great importance in real estate markets. Investors are highly focused on accurate techniques for forecasting. This research is highly beneficial for all investors in the real estate sector of Turkey. Providing them to estimate the advance payments, repayments, and mortgage amounts and deciding according to the correct forecasting techniques. It enables them to avoid future uncertainties and mitigate the risk (Irandoust, 2019; Bouri et al., 2022; Akdogan et al., 2019).

E. Limitations of the Research

There has been a certain limitation of this research. One of the major limitations is limited area. This research was carried out only in the Turkish real estate sector, with a limited period. It is only highlighting the impacts on the Turkish real estate markets.

Other limitations are given below:

- The study not studied with the key concept of these topics.

- The resources were limited.
- The procedures were time taking.
- The research is limited and a few variables are discussed only.

F. Motivation for the Research

After the housing bubble burst, a lot of mortgage lender was bankrupt. After that investors are taking decisions very wisely. New and advanced techniques have been created; more complexities emerge for the investors. For this reason, we have selected this, as our topic of research. To solve the complexities and provided a broader understanding of the real estate markets to investors. Another motive is how the combinations of different variables can fluctuate the housing prices index and how are these variables interrelated with each other. Another motive is what policy will be the suitable one for the real estate sector, also presenting the solutions and recommendations to the investors (Hoesli & Malle, 2022; Frenkel, 2019; Lastrapes, 2002).

G. Scope of the Research

The researcher has carried out this research to check the impact of macroeconomic variables. Providing the broader concept about their relationship and how these are interrelated as this is the most flourishing one all over the world (Azam et al., 2022).

In Turkey, the real estate markets are highly doing well and investors demand to know how certain variables affected the performance of the real estate markets. How to forecast accurately. This study will be in the real estate markets of Turkey from January 2010 to December 2022. The researcher will be using the second method for data collection. The main resources for the researcher are listed in the references part. The researcher will find more research, articles, and theses related to the topic generally on macro-economic variables and HPI. The researcher will find studies related to real estate forecasting in terms of price and demand aspects. Also, their relation to the use and carry out with macroeconomic indicators (Bouri et al., 2022; Bezgin, & Başar, 2020; Cheng, et al., 2023; Cohen, 2022).

H. Thesis Structure

The thesis comprises 05 main chapters that will highlight the all necessary information about the research in a detailed way. It highlights the results and provides a better understanding of the topic as well.

The 1st chapter is the introduction part, which presents all the concerned information about the thesis. It is subdivided into a few parts at the start the topics are defined with the help of the definition. It highlights the main key points of the research, and the reason behind taking these topics is also discussed. After that, the problem statement is defined as what the actual gap is and why the researcher has selected that particular topic for the research. After that, the research significance is clearly defined. The next is the motivation of the research, which presents the researcher's desire to face challenges and solved unsolved arising problems. The researcher's interest is in performing creative and innovative work. After that limitation of the researcher are also clearly defined. There is a certain limitation of every research. The scope of the research is all about what the study is going to cover and what it is focusing on. In the last chapter 1, the structure of the thesis presents the layout of the chapters.

A literature review is a 2nd chapter that presents the prior research about the topic starting with the definitions of the variables, which are used in this study. Secondly theoretical background of the study is presented. and then previous research work on the same topic is defined. After reviewing of literature, the conceptual framework has developed. Based on that framework hypotheses are developed and defined in this chapter.

The 3rd chapter is the research methodologies which is all about the methodologies and the techniques that are used in the research. Research design is defined as how the research has been carried out. which type of results it will? what will be the target population of the research? how the data will be collected? Which method for the analysis? Such as we have used ARIMA and ANN models. So we have presented the advantages, disadvantages, and importance of ARIMA and ANN models. Also formed the equations of our proposed research model.

Chapter 4th is research analysis and discussion, where; the results and discussion are discussed This chapter starts with descriptive statistics, where mean,

standard deviation, kurtosis, and skewness are presented. Then correlation analysis will be performed by the Pearson method. Later on, forecasting the economic variable on the HPI, ANN model and ARIMA models will be performed. T-statistics and P-values are helping in testing the hypotheses, that will be performed in this section by presenting the results and discuss with past studies.

In 5th chapter is about the conclusion and recommendation, where all research summarizes and defined the recommendation.

The last reference list is attached in that all cited work has been quoted using the APA 7th edition format.

II. LITERATURE REVIEW

A. Variable Definitions

1. Gross Domestic Product:

The gross domestic product is the overall representation of all produced goods and services in monetary terms for a particular period (Abelson et al., 2005). The gross domestic product is one of the major components that highlight economic activity. The production of the overall goods and services within the boundary of the company within a year. The concept has been arising in the early 1930s, at the time of the great depression, to know the real working of economic activities. Also, evaluating the performance of policies implemented by the government. The initial accounts were prepared by the

Russian-American scientist Simon Kuzne and combined all productions in one account

(Aliefendioğlu et al., 2022). The measurement of economic growth and stability of macroeconomic factors is determined by the production of goods and services (Alpha Kabine 2023).

2. Inflation

The inflation that has been associated with the housing price as well is concerned with the prices of commodities. Inflation is defined as the ability to purchase the commodities reduced the organizations minimize. The purchase of new capital as inflationary policy causes, an increase in prices (Dougherty & Van Order, 1982). Inflation is the increment in the money supply, that has a major impact on growth and development (Dias & Duarte, 2019). Inflation also affects the labor and supply decision-making process. (GAUTAM & KANOUJIYA, 2022) has concluded that inflation has to reduce the purchasing power and that will reduce the assets purchases and capital accumulation because that will be very costly for the firms.

3. Exchange Rate

The exchange rate is the amount of a country's currency for any other country. The exchange rate has a great influence on the monetary policy of the economy, the exchange rate appreciation has increased the value of the currency (Pradhan & Kumar, 2010). The exchange rate is a major economic indicator and has a vital role in the activities related to international trade and policies are decided by the government, through which that government can evaluate the price stability. The implementation of better policies in the economy can enhance performance and can lead to a current account surplus; this is highly effective (Sarangi et al., 2022). Like the inflationary effect, the exchange rate has an effective and major impact on the housing prices index. The high prices of real estate markets can lead to high demand for foreign exchange. By applying the bootstrap multivariate panel granger causality test to investigate the housing prices and the exchange rate relation and the findings concluded that the housing price brought changes to the exchange rate (Frenkel, 2019).

4. Gold Price

Gold prices have a major influence on economic activities. It is also considered the determinant of analyzing the rate of inflation in the economy (Singhal et al., 2019). That is the reason gold prices have a great impact on economic activities. Gold is considered the most traded and precious asset. Gold is the one whose characteristics and features are different from the other elements. It also plays dual roles as well somewhere; it is used as a special ornament and somewhere it is the medium of the exchange. It has great importance on the money supply and the monetary policy design in the economy. Gold has a significant effect on the Housing price index and it is researched by various researchers (Sumer & Ozorhon, 2021).

5. BORSA Index

The real estate markets in Turkey are now at their peak. Certain new policies are implemented across the countries. It enables the investors to get enough knowledge about the to fluctuate in the stock market indices. Stock market indices highlighted the calculations of the prices of the stock according to the market value of the share. We are using BORSA Istanbul Stock by taking BIST 100 index of the Turkish market. Indexes represent the performance of shares, bonds, and other

investments. These indices indicated the performance of the real estate sector as well as helps the investor to take better investment decisions (Bezgin & Başar, 2020; Cagli, 2019).

6. USD/TL

USD/TL is the most important factor that is also very essential for the determination of HPI. The demonstration of one currency to another. It has always been very important for the economies and playing key roles and collectively influencing the various factor. USD/TL is the exchange rate of Turkey. We are analyzing the role of USD/TL and their impact on HPI in Turkish real estate markets (Pradhan & Kumar, 2010). Price fluctuations are also a concern with it. Foreign investor investments and other activities are concerned with the fluctuations in it. Most of the time exchange rate benefits influence the performance and also the prices (Zahedi & Rounaghi, 2015).

7. Unemployment:

The term unemployment is the condition when a person has nothing to do and is in search of some job or work for earning purposes. It is a major problem in the world economy. (Irandoust, 2019) researched housing prices and unemployment by developing the search and matching model. The sample of Texas city level from the period of 1990, 2000, and 2010, concluded that the unemployment rate decreases the housing price index.

8. Deposit Interest Rate

The deposit Interest rate is one of the most prominent macroeconomic indicators that have a high impact on housing prices. The term interest can be defined as the lender earning some amount from the money which he has given to someone (Shi et al., 2014). Previous studies have mentioned that interest rate is the most essential factor. Most of the researchers have presented different concepts about deposit interest rates. (Tham et al., 2022) have investigated how housing prices are impacted by the interest rate both in terms of inflationary and deflationary. It has concluded that in the inflationary period, the housing prices and inflation are indirectly proportional, lower housing prices cause the maximum or increase in the interest rate. Deflationary period there is no correlation between them and there has

been no change observed (Hamdar et al., 2022).

9. Money Supply

The money supply is another factor that is linked with HPI and the overall performance of the industry. It simply referred to the whole money that is available and rotation in the overall country. It is a key determinant of price fluctuations, as the money supply decided the future trends of the economy (Lastrapes, 2002). The money supply in the country influences the demand of the real estate market. It also highlights the purchasing power of the individuals. Instability in money supply has the potential to fluctuate the prices, which will directly or indirectly be concerned with economic growth. Although, there are no clues available that represent their inter-relatedness with them (Yang et al., 2022; Zhou et al., 2014).

10. Monetary Rate

One of the most important factors for the HPI decide the overall course of action of the particular economy. The monetary rate is the collection of the techniques and special policies that are designed by the central bank of the country. To decide the future mobilization of money across the country. The monetary rate has a significant impact on the HPI in various markets (Aoki et al., 2004). Real estate market fluctuations are highly affected by the monetary rate. (Charfi et al., 2020) paying attention to the relationship between the HPI and the monetary policy. It suggests that the monetary rate has a significant effect on the housing prices index.

11. Foreign Trade

It is referred to the exchange of goods and services across the premises of a domestic country. Foreign trade influences the GDP and HPI. The economic transactions determine the financial stability of the country (Lawrence et al., 1993). That is also concerned with the real estate sector and HPI. It demonstrates the level of productivity in the country and how internationally have maintained their relations with other countries as refers as foreign trade (Edwards, 2019).

12. Housing Price Index

The housing price index is a fundamental tool that will highlight the affordability of the houses purchased. (Ge et al., 2003) concluded that the housing

price index or affordability is a bond that creates between individuals and houses. The calculations of the housing price index are critical and complex procedures admitted by prior research. It is considered the most important tool for purchasing houses and decision-making. Housing prices are changing with market conditions and economic conditions.

(Gebeşoğlu, 2019) studied housing prices at large and come to the point. Sometimes pricing is locational based, also added that housing prices in metropolitan cities are high as compared to the rural areas. The findings are interdependent on income, population growth, material, and construction. Real estate prices are the agreement between the buyer and seller's predetermined price in the real estate market. It does not have such liquidity as compared to the other markets and selling and purchasing assets is not easy. A large amount of literature has been studied on real estate pricing strategies, methodologies, techniques, and models, that highlighted all concerning details to investors**.** (Sumer & Ozorhon, 2021) The researchers used the GARCH-M model to examine the correlation between different types of volatilities and REIT returns. Their findings indicated that higher volatility positively affects REIT returns, as investors demand greater returns on their investments. This increased demand can lead to higher returns and a greater demand for real estate sectors. While the conventional approach to managing real estate risk has been to combine REITs indices with various equity indices, this approach overlooks the fundamental issue of determining when to purchase or sell real estate assets.

(Alqaralleh, 2019) The researchers employed nationwide data for their analysis, using Granger causality tests to determine short-term causal relationships, and Wald test statistics in a level VAR approach to assess long-run causality. Their findings indicated that the UK property market was fragmented rather than unified. Additionally, they recommended that diversifying across various property classes could assist investors in lowering portfolio risk while maintaining a constant expected return. Nevertheless, the researchers cautioned that risk reduction was restricted due to the high level of positive correlation among asset classes.

(Anim-Odame, 2022) The authors noted that portfolio theory's diversification concept could facilitate precise predictions of regional prices. They contended that when forecasting techniques were applied in regional property markets, both exogenous and endogenous variables should be taken into account. The study by

Anim-Odame (2022) concluded that when the series were co-integrated, long-term relationships must be considered to improve accuracy.

(Brambilla et al., 2022) The study discovered that a significant reduction in risk is achievable if the returns on individual properties exhibit low correlation. According to Brown, it is challenging to create a highly diversified portfolio due to this correlation. He suggests that a portfolio's returns can be divided into two parts: systematic and unsystematic. His research highlights the fact that as the portfolio expands and approaches market expectations, the variability in its returns will approach the systematic level or exhibit a decreasing function between portfolio size and standard deviation. He concluded that whether investors can successfully predict positive abnormal returns is an empirical issue. Brown also observed that if perfect forecasting is unattainable, some diversification strategy may be advantageous for investors to achieve positive returns (Bhunia, 2013).

(Cadenas & Rivera, 2010) has examined the association between the real estate and the stock market in the Mexico and concluded that there is positive inter-relation among the stock return and the prices of the real estate. And also they have been mentioned that there is no any change occured on the rent due to stock returns. In Mexico there has been weak association between the real estate and the stock markets, and that is considered as the most important tool for the investors to diversify their range of investments. (Markowitz, 1959) stated that although modern portfolio theory is generally regarded as a groundbreaking development in the realm of finance, some researchers in real estate have expressed reservations regarding its application. The process of selecting and constructing portfolios frequently relies too heavily on historical performance, according to these experts. To make informed investment decisions, investors must instead consider three essential elements: expectations for future returns, projected correlation, and anticipated volatility (Bhunia, 2013).

(Cagli, 2019) It has been noted that the best way for investors to anticipate future prices is by monitoring market trends and analyzing past data. In addition, over the past ten years, there has been a growing interest in gaining a deeper understanding of how this asset class performs relative to a benchmark. Knowledge of risk and return and their characteristics of commercial real estate can be very helpful to us more fully understand the future performance features of this type of

asset. Macroeconomic indicators have a major influence on real estate pricing. The literature is equipped with the relationship between housing prices and the key role of macroeconomic indicators. (Abidoye et al., 20129) has examined that demand is the most important factor, that tends to affect housing prices in Hong Kong. (Ge et al., 2003) has researched macroeconomic factors and their influences on housing prices. They investigated which macroeconomic factor has a more significant association with housing prices. It also studied the effects of cultural and environmental factors, the variables were unemployment rate, current account, GDP, and industrial production by applying the multiple regression model. The economies such as; Slovenian, Greek, French, Polish, and Norwegian found that there are correlations between the macroeconomic indicators and the housing price index. The finding of results concluded that Poland, Norway, France, and Greece are significantly affected by unemployment but not the case with Slovenia. There are associations with the share index in Paris Stock Exchange (Abidoye et al., 2019).

(Aliefendioğlu et al., 2022) analyzed the impacts of five major and essential macroeconomic indicators on housing prices that indicators were crude oil price, 30-year mortgage interest rate (IR), Consumer Price Index (CPI), Dow Jones Industrial Average (DJIA), and unemployment rate (UR). Calculated the prices by housing price index and taking the sample of the Town of Amherst, New York State, USA from the period of 1999-2008. The results of the analyses indicate that the housing price index is significantly impacted by both the 30-year interest rate and the HPI. The interest rate has the greatest effect, accounting for 5.0 percent of the variance in the first month, increasing to 8.5 percent in the twelfth. The next most significant influence is the unemployment rate, followed by the DJIA and CPI. The HPI itself causes the most variability in future prices, accounting for up to 92.7 percent of variance in the first month and around 74.5 percent in the twelfth. This finding highlights the strong influence of people's expectations of future prices on current house price changes. The overall impact of the error variance of the macroeconomic indicators ranges from 7.3 percent in the first month to 25.5 percent in the twelfth.

(Cui et al., 2022) investigated the hedonic and macroeconomic indicators impacts in Beijing. By applying the VAR model to check the dynamism in the variables. Does the effect show how housing prices get infected by macroeconomic indicators? what fluctuations have been made? The GWR model is used for the

hedonic approach. The finding from the VAR mentioned clearly, that macroeconomic indicators are associated with housing prices. The reason for the change and money supply has a direct impact on the housing price. The interest rate has indirect impacts. Urban housing prices are negatively impacted by the size of the house, especially in downtown areas, and by the age of the house, particularly in the suburbs. Furthermore, the impact of the number of bedrooms' changes from positive in downtown areas to negative in the suburbs. A hedonic analysis of housing prices reveals that this has significant implications for policy-making related to urban planning, building design, and public services construction. Therefore, it is recommended that policies be implemented to update and enhance urban planning and public services construction to introduce more governmental offices, job opportunities, high-quality schools, commercial facilities, and infrastructures in the suburbs. Additionally, the design of new residential buildings in downtown areas should consider floor area ratio and internal structures to accommodate more residents and create a better living environment. These policy suggestions can provide guidance for addressing urban issues in China and other countries experiencing development. (Daradi et al., 2018).

B. Theories that are Inter-Related with Pricing

1. The quantity theory of money

Considered one of the oldest ones and has presented the most important clarification regarding money mobilizing. The theory stated that the change that has been observed at a minor level in the prices. It also brought the same amount of change in the quantity of money that is mobilizing (Deb et al., 2022). Friedman also enhances that concept and presented the model, that analyzes the effects of how the money supply is related to the pricing and further broader the theory by providing some other evidence (Fan et al., 2010).

2. The Monetary Theory of Inflation

Monetarism considered the money supply as the most important factor of all. Apart from that view, monetary policy is the most important variable for the economies rather than fiscal policy. It further classifies that monetary policy is the determinant of checking the level of output and pricing (Fang et al., 2020).

3. Modern Pricing Theory

Milton Friedman's stated that inflation can never be ignored, almost it is present every time and the change. These occur in the monetary policy-making process due to rapid increases in the prices causing expansion and also in the

4. Demand Pull Theory

John Maynard Keynes has presented that an increase in demand will also increase demand-pull inflation. The factors that are included are; consumption, investment, and government expenditure. According to the demand-pull theory those components which are effective in lower demand also beneficial and effective in reducing inflation (Ghritlahre et al., 2020).

5. Cost-Push Theory

The cost-push theory stated that inflation is generated because of an increase in the wages at fastest rate than the amount of production. The cause of cost-push inflation is the increment level in profits. The high prices create imperfect competition thus leading the organization to maximize the price of their commodity at a faster rate. Hence it is also known as administered inflation (Hepşen & Vatansever, 2012).

6. Structural Inflation Theory

The structural theory has presented that some economic factors accelerate the supply. That will also change and increase the level of demand-push. If there are certain factors like the rate of unemployment is impossible to decrease. The national income is one of the most important factors that are behind the increment in inflation (Hong et al., 2020).

7. Hedonic Price Models

The hedonic price model is taken from the consumer's theory. This concept is further explained and enhanced by (Aminuddin et al., 2022). The residential market has become now more popular. It used tools and techniques for the residential and urban analysis of the market. The decision regarding the prices of houses is considered as most important for all individuals and investors in real estate. So correct methodology and enough knowledge are required for this purpose. Scholars

have determined the hedonic price functions or hedonic model (Ashraf et al., 2021).

(Aminuddin et al., 2022) is highly focused on elements that have some influence on housing prices and have noticed the impact of some socioeconomic factors.

8. Modern Portfolio Theory

Modern portfolio theory advocates for diversification as a means of reducing overall investment risk, provided that the correlations between assets are low or negative. In the real estate portfolio, REITs are widely recognized for their strong performance, as noted by Sumer and ÖZorhon (2020). Real estate investment terms can yield impressive returns for investors who have the potential to diversify their risk across different portfolios. Sumer and Ozorhon (2021) suggest that the optimal mix of stocks, bonds, and real estate in a portfolio depends on the expected returns of REITs and their correlation with stocks. The proportion of REITs in the portfolio should be determined based on their correlations with stocks and bonds, with preference for lower or negative correlations that can improve the risk-adjusted returns efficient set.

C. Previous Studies (Relationship between Variables)

The GDP and inflation are considered the most important variables. There is an array of forecasting them. The economic growth of the country is calculated by the number of production of goods and services of the economy, which is indicated by GDP. Economic growth is measured in terms of gross domestic product GDP. (Zou et al., 2020) has investigated the impact of inflation and economic growth and concluded that there is a positive relationship between them. He suggested to the central bank that they must modify the monetary policy. (Tham et al., 2022) stated that, an increase in the federal government debt causes. GDP to increase by one percent and other factors will have positive impacts. It also shows that the real interest rate will increase by three basis points (Mahalik & Mallick, 2011) The general consensus is that economic growth is a significant concern that requires a favorable interplay of various socioeconomic and institutional factors. Recent analysis indicates that countries can promote growth by utilizing a new catalyst. The determinants of economic growth appear to include a country's ability to combine

suitable governance and institutions with education levels, export activity, and non-income dimensions of human development (such as life expectancy growth and infant mortality reduction). Countries that have managed to improve their non-income dimensions of human development from 1970 to 2000 through effective institutions have achieved sustainable economic growth.

(Saymeh & Orabi, 2013) study examined whether there exists a threshold effect of inflation on the economic growth of Azerbaijan from 2000-2009. The approximate threshold model showed that there is a nonlinear correlation between the growth of the economy and the rate of inflation in Azerbaijan. The research discovered that the threshold level for inflation, which allows for GDP growth, is 13 percent. When the rate of inflation falls below the threshold, it has a considerable positive impact on the growth of the economy. However, this positive correlation transforms into a negative one when the inflation rate exceeds 13 percent. (Mangaleswaran, S., & Vigneshwari, 2020) It has been observed that injecting additional funds into the most promising sector can lead to the creation of new economic activities, as investors typically prefer investing in specific companies. In their study of foreign direct investment inflows in developing countries from 1990 to 2007, (Maynou et al., 2021) identified the determining factors for such inflows. Similarly, (Taltavull, 2003) examined the implications of financial reform and interest rate behavior on the economic growth of Nigeria, and found that financial reforms and interest rates significantly affect economic growth in Nigeria. The study further suggests that reducing interest rates is crucial for enhancing economic growth. Lastly, (Saymeh & Orabi, 2013) investigated the effects of GDP, interest rates, and inflation on the real economic growth of Jordan from 2000 to 2010. Unit root test (Augmented Dickey-Fuller test) has been conducted to check the stationery integration order of the variables. A co-integration analysis with four variables (economic growth, interest rate, GDP, and inflation rate) was employed, and the study adopted the Johansen test. Findings indicated that both trace test and max eigenvalue static showed that the four equations have significant existence at 1% or 5%. It means that all variables have a longterm equilibrium relationship. The study adopted the same four variables to discuss the Granger Causality relationship; findings indicated that inflation causes interest rates. On the other hand, all other variables are independent of each other. Regression was conducted to test the effect

of interest rates on HPI. It showed that the inflation rate has effective control over the growth rate. Finally, to test the GDP, interest rate, and inflation rate altogether; results have shown that the current GDP and one lag GDP have effective control over the growth rate. One of the economic indicators inflation has also been associated with the pricing and the return of the real estate sector. It can be said that real estate developments, improvements, and overall performance can be evaluated and calculated with inflation. (Zahedi, J., & Rounaghi, 2015) studied the effects of inflation on real estate and concluded that the return will be get affected by the fluctuation in the pricing and that will create huge risks. Whenever the individual is intending to purchase any property, the interest rate is the most important factor, the mortgage payment is somehow associated with the interest rate. The choice of individual changes with a change in interest rate has occurred. If it is said there is a positive linkage between interest rates and mortgage loan payments, the demand for houses increases. When the interest rate decreases and if it goes up or increases the demand for the property. However, these changings can affect housing pricing and explain the housing price index (Zhao et al., 2019; Sarangi et al., 2022; Robra & Heikkurinen, 2020). Follows by the prior study it has also been distinguished that the real estate investment trust has a direct relationship with interest rate and inflation. Interest rate is considered one of the growth macro-economic factors. (Shaikh et al., 2021) considered the exchange rate as one of the sensitive subject's exchange rates have the association and linkage with some other variables that will present its level of sensitivity. More clearly those variables include the macro-economic indicators and other trading and financial components such as money supply, monetary rate, and foreign trade. The consistent fluctuation in the exchange creates an asymmetric relationship between the exchange rate with the countries and the investors as well. The exchange rate is one of the macroeconomic indicators that have a great influence on the economies and their stability. It influences the different sectors of the economy including the banking sector, real estate, and others. It has changed with the period. Its fluctuation can measure with economic, financial, social, and political elements (Zhao et al., 2019). Many other variables are directly or indirectly interrelated with the exchange rate. It is a complex process to determine the impacts of ER on HPI (Sarangi et al., 2022). The change that has occurred in the exchange rate influences all economic activities. It also deviates from the economic equilibrium. There have been effects on the monetary rate (Wen et al., 2019; Xu et

al., 2012). The foreign exchange market is considered one of the largest markets because there is liquidity available at a faster rate and the working processions are more efficient (Hepşen & Vatansever, 2012). New and updated literature has emerged which is providing secondary data based on the exchange rate and is predicting these providing the estimation based on the market panel. Some of them utilize these measures to explain the fluctuations in the exchange rate (Charfi et al., 2020). The previous literature has pointed out that the exchange rate policies have been modified. It has also pointed out the key factors that are challenging for organizations and businesses as well. The fluctuations in the exchange rate and imperfect relationship with the currency derivatives. (Robra & Heikkurinen, 2020) had concluded that, it is one of the major components of the success of East Asian countries. They suggested that if economies want to develop they must have a competitive exchange rate. The exchange is the bond between the internal economy and the international economy. Unemployment is considered the most crucial macroeconomic indicator that has influenced almost every sector of the economy. It has major impacts on the housing and real estate sector. The term unemployment is that condition when a person has nothing to do. The person is in search of some job or works for the earning purpose which is a major problem in the world economy (Cheng et al., 2023).

Unemployment has always had the worst effects on the economies and it has been estimated for the twentieth-century unemployment become more problematic. This issue has been a matter of concern (Colak, 2021). Employment has effects on the lives of individuals but also their physical health and mental health. It has increased the level of stress and anxiety. The individual suffers a lot from this (Cui et al., 2022). An array of theories has been examined to explain the European rate of employment (Bouri et al., 2020; Bourassa et al., 2006) and discussed the causes of behavioral differences between employed and unemployed individuals. (Case & Shiller, 2003; Barbu et al., 2017) thought the higher rate of cost has been inducted for the recruitment and selection process and firing them is the major cause of unemployment. (Darity et al., 2018) has proposed that the scarcity of resources is the main reason behind the increment in labor costs and higher rate of interest rates. (Fan et al., 2010) stated that the economic condition remained stable when the employment rate is on the same path. (Egrioglu et al., 2022)

examined the term: “hysteresis”, that the recent rate of employment is dependent upon the previous rate. (Hamdar et al., 2022) stated that by defining the term indigenizing as the natural rate of unemployment. He proposed the model in that which he discussed the structural factors in the economy which are taxation supplies, technology, the real rate of interest rate and the real rate of exchange have impacts on employment. Several studies have investigated unit root hysteresis in unemployment (Darity et al., 2018; Cui et al., 2022; Bouri et al., 2020).

(Kim & Park, 2005) predicted the unemployment equation with a lagged unemployment rate and a time trend while allowing for a moving-average component of the error term. (Keely & Lyons, 2020), follow up the idea that previous experiences of individuals regarding unemployment can cause a change in their tests that preferred things, which is also beneficial in estimating the recent rate of unemployment.

According to (McDonald & Stokes, 2003) there must be some environmental factors that have the potential to create fluctuations in the price of real estate. These costs are associated with construction, the availability of resources, and the higher demand for purchasing real state property. It will maximize the market capital and the same is the case when the demand goes down. The market capital decreases. However, there must be interferences of the regulatory authority. The UK property industry alliances (PIA) data report presents how beneficial the real estate industry is. The report concluded that shortly real estate demand will increase. The industry will be very helpful in generating large revenues. There will be no such risk, also stated that housing unit demand in the UK will increase, that is more and shifted towards residential units. While there will be no particular indicators that will estimate the demand for future sales. Real estate is a matter of concern for investors because there are no small investments made. There are large investments so the investors need proper techniques and methods. It is necessary to calculate the return on real estate investments (Ozdemir & Tokmakcioglu, 2022; Parrikar, 2019; Piazzesi, & Schneider, 2016)**.**

1. The Macro-Economic Indicators and the Real Estate Market

The age that has everything is highlighted with the indicators, which shows the growth and performance. Likewise, economic indicators are the tool to formulate

policies and make them different from the other economies as well (Pradhan & Lee, 2010). A bundle of indicators has been examined but macroeconomics is the most familiar one. These indicators are the real techniques that can measure economic performance and there is no such formula to calculate them exactly (Rehman et al., 2020). Economic history (Shaikh et al., 2021) and anthropology (Robra & Heikkurinen, 2020) have deeply studied such indicators and provided all related information and their benefits. The outcomes as well, that what impact that may create on the economies. Nowadays the most rapidly growing and developing industry is none other than the housing industry. It has been considered one of the major sources of generating large revenues as housing prices increase with time despite that it has been providing several benefits (San Ong, 2013). The real estate or the housing society business is one of the most important factors in the development of the economy. It plays a pivotal role in the growth of nations and it has captured almost 54 percent of the global financial capital (Shinde & Gawande, 2018). The competition has increased day by day in this sector as investors are highly searching for highly beneficial programs (Sin & Wang, 2017).

(Keely & Lyons, 2020), studies show that the Dublin example is the key indicator for reflecting the real economic conditions. The amount of borrowing with help of housing sales. Housing sales have not remained fixed for a longer period. It remains changed and there are always fluctuations has been observed. It varies or fluctuated with the market condition and instability (Lee & Ryu, 2021). The demands have been increasing day by day as the need for residential property. Its increases have been creating more and more opportunities for house builders and investors. This will surely increase the competition in the real estate industry (Gebeşoğlu, 2019). As the prices are high it will surely motivate the builders to provide such services, that not only satisfied the needs of the customers but also create more attractiveness for new buyers (Daradi et al., 2018).

(Wang et al., 2020) concluded that the housing prices eventually went up because of the people's choices, which create the speculation bubble. They have a view that in the coming days, prices go up and that will not create instability in HPI. The housing sector also creates a crisis because, most people purchase, houses without taking proper information regarding the price but also without analyzing the current market trends and situation.

(Coskun & Jadevicius, 2017) investigated the real estate market of Turkey by applying the methodology that has been created by (Bezgin & Başar, 2020) for co-moving systems with explosive processes. By taking the indices of housing prices monthly wise from January 2010 to December 2017 of the unit prices of the housing. They concluded the existence of explosive behavior in the countrywide price index as well as the regional price indices. Analysis of the prices index and the regional prices indices reflected that; most of the regions have aggressive market demand as compared to the whole market. (Cui et al., 2022) examines the impact of the real estate prices of houses in Turkey. They have evaluated the effects of the pandemic, macroeconomic indicators, loans, and some other variables on the housing sector of Turkey. Their study was dependent upon the three major steps which are; (i) the abnormal returns of the residential real estate prices, that has been taken by using an event study after the effect of the COVID-19 pandemic, (ii) abnormal returns of residential real estate prices were estimated by panel data analysis for regional and city levels and in last (iii) the results have shown the negative impacts on the city level and positive and the direct impact at the regional level.

Many scholars like (Seifhashemi & Elkadi, 2022) had examined the Korean market and the UK market. He has concluded that economic indicators are key components of capital gain and generated good returns. Recently globalization and digital transformation have created so many opportunities for investors to diversify their portfolios from direct investments to indirect real estate investments (Alqaralleh, 2019). A vast amount of literature has been available on the real state trading market that has analyzed the performance of the sector. Prior studies have shown that there has been a positive correlation between productivity and property trading (Seifhashemi & Elkadi, 2022). As the economy grows and developed assets of property demand more their positive correlation has impacted the prices of the property positively. The macroeconomic indicators and the real estate market are interrelated with each other. The real estate sectors are not working dominantly without the interdependence of other factors. It is associated with the performance and stability of the economy. The sample was drawn from secondary trading markets and capital markets of the economy (Alzain et al., 2022; Aoki et al., 2004). Investments in the real are not an easy task one must have enough knowledge of the market condition. The current business trends as there is the speculation of risk

expertise. The updated knowledge save anyone from loss, and a better understanding of macro-economic factors will help in making investments in international or globally listed real estate securities (Bahloul et al., 2022, Barbu et al., 2017). Most of the theories and past studies have concluded that macroeconomic indicators are affecting real estate prices and the main source of making fluctuations is the market itself. Most of the studies have suggested that real estate investment trusts help determine the real-time pricing that presents the real market value (Brambilla et al., 2022). Real estate investment trusts are providing diversified portfolios (Ćetković et al., 2018). Strong economies can flourish and increase the ratio of investments (Chen et al. 2022). The economic indicators which are GDP, unemployment, inflation, and stocks are the major factors influencing the rate of return on the real state (Hoesli & Malle, 2022). One of the strategic variables that have been part of the real state decision-making process so far is GDP per capita (Huy et al., 2020). Inflation, bond yield, and interest rate are macroeconomic factors, that impacted the real estate market return (Akça, 2022). At the global level, the real estate market is dynamically affected by financial risks and macroeconomic indicators (Alpha Kabine, 2023).

The studies suggested that domestic housing prices are strongly hit by economic cycles. Which are GDP, income, growth, and unemployment. (Alzain et al., 2022) calculated the fluctuation in the US housing region. They come to point that unemployment, default risk, economic expansion, and inflation are major factors that have short-term and longterm impacts on the real estate market. Moreover, (Azam et al., 2022) evaluated 15 countries' results over 30 years suggesting that, if there is only a minor 1 percent change occurs in the economic activities of the country, housing goes up. Similarly, (Akça, 2022; ÇOLAK, 2021) studies the real state sector of Turkey and comes agreed with that point: the macroeconomic factors are highly involved with HPI. (Colak, 2021) presented a model that has been using the panel regression methodology with help of the six most important factors. That portrayed the real image of the real estate market. It highlighted that real state opportunities can be created. Most importantly the collaboration of any economic operation is considered as most important. It has a significant effect and also demonstrates the penetration of the capital market. How do investors get the services and legal rights of the protection, the taxation and the regulatory framework, the social and the political environment stability? Most of the prior studies reflected that

there are some other factors rather than the economic factors and those factors are corporate governance, the legal system, and accounting standards (Ghodsi et al., 2010; Han et al., 2018; Judge et al., 2019; Irandoust, 2019).

(Khalafallah, 2008) researched evaluating the performance and position of the real state, concluded that the macro-economic and monetary policies have a positive effect on the real state sector using ANN modeling. Macroeconomic indicators are such which possess qualities and features that are unique and make them different from other indicators they are collectively a mixture of different factors. It enhances the stability and transparency of the economy as well (Ho et al., 2012). The macroeconomic indicators are associated with each other and show the combined effects of the two factors. GDP can be measured with the assistance and calculation of other factors like inflation increasing, and the rate of unemployment also increasing. When the economy suffers the growth and GDP goes down this connectivity makes them powerful indicators for the economy. Nowadays the exchange rate is considered the determinant of the prices of those economic resources that are being traded in the international market. It has to check the level of equilibrium between the demand and supply of foreign exchange (Korkmaz, 2019). The exchange rate can estimate the situation that has been happening in the future. (Lastrapes, 2002) has presented the assumption about the exchange rate, that like other commodities as the price is concerned with current market analysis and future expected price that will be in future. Maybe it increases further adding a higher chance of the expected exchange rate. Lowering the currency and vice versa. The most essential determinants of exchange rate are money supply, foreign interest rate, and price level. Housing investment is almost considered one of the most important factors and large investment-creating factors which are majorly contributed to the economy. It is the most beneficial sector for the economy (Muzindutsi, et al., 2021). Based on the above literature review hypothesized model has been developed (See Figure 1).

D. Hypothesized Model

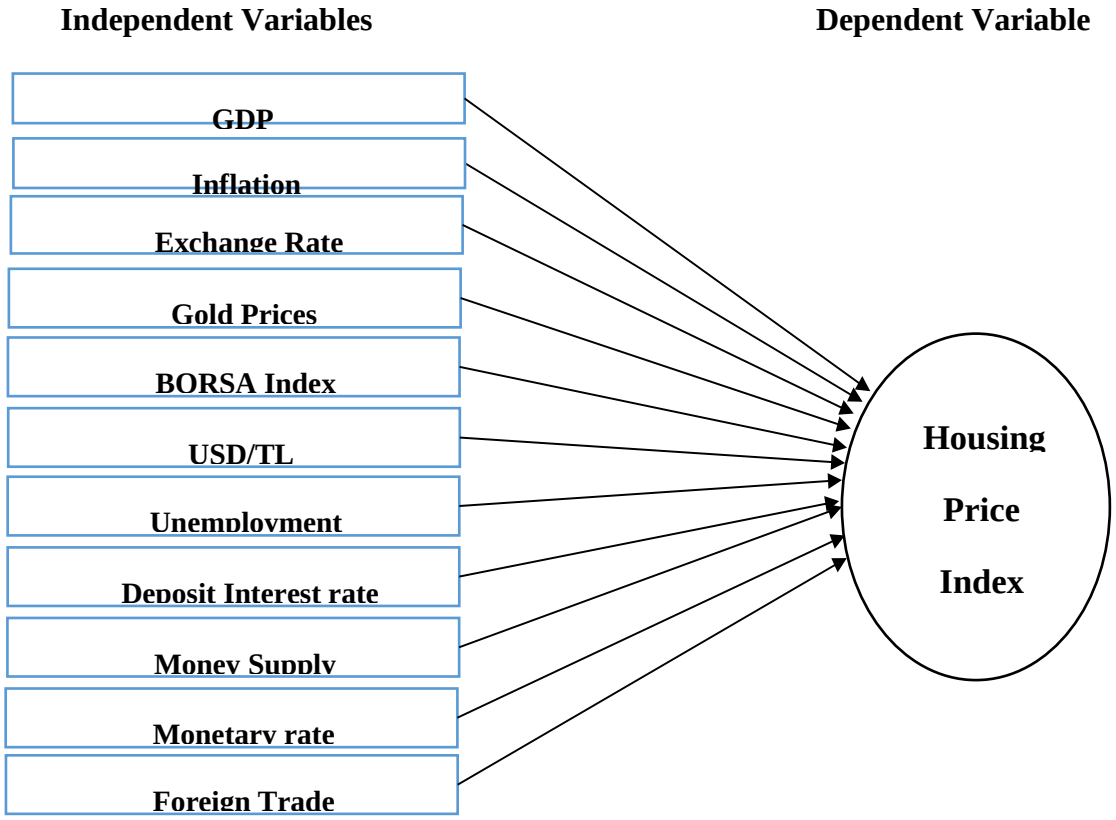

Figure 1 Hypothesized Model

Source: Author's Compilation

1. Hypotheses:

H1=GDP has a significant effect on the housing prices index in Turkey.

H2= Inflation has a significant effect on the housing prices index in Turkey.

H3= Exchange rate has a significant effect on the housing prices index in Turkey.

H4=Gold Prices have a significant effect on the housing prices index in Turkey.

H5=BORSA index has a significant effect on the housing prices index in Turkey.

H6=USD/TL has a significant effect on the housing prices index in Turkey.

H7=Unemployment has a significant effect on the housing prices index in Turkey.

H8=Deposit interest rate has a significant effect on the housing prices index in Turkey.

H9=Money Supply has a significant effect on the housing prices index in Turkey.

H10=Monetary rate has a significant effect on the housing prices index in Turkey.

H11=Foreign trade has a significant effect on the housing prices index in Turkey.

III. RESEARCH METHODOLOGY

A. Introduction

Research is the method of presenting facts and figures and testing certain data again and again to investigate the truth. Research has been carried out to define certain issues more accurately and find the solutions to the problems. It is highly involved with the analysis and interpretation of certain problems. Research is highlighting the association between the problem and its solution (Bourassa et al., 2006). All types of research are not the same, some of the research is related to investigation work, and some highlight only the details of the problem. It is the way that revealed the unidentified and unresolvable problems, that can be resolved by applying the correct and accurate methodologies and techniques. The methodology defines all the used tools techniques and models regarding the research problems in this section (Rehman et al., 2021).

Our study is a combination of updated models and highly specifies statistical techniques. We have opted for a different collection of tools, techniques, and models for the accuracy of the results. Our selected models are according to the nature of the research problems and fulfill the research objectives.

B. Research Design

Another important part of the studies is where the researcher chooses how further process is to be carried out. and which techniques are suitable for the entire research? (Abbasi et al., 2022). It is the part where the researcher designs the whole process initial first step to the last step. How to start the data collection and how to interpret the results? Although, every researcher designed the research according to the nature of the studies. They focused on research design because it represents the truth and highlights the facts and figures of the research model (Shaikh et al., 2022). This section represents why this research has been carried out and why the selected area is taken rather than the other topics. It highlights the main motive of the

researcher to choose a certain topic. This study is concerned with the real estate market of turkey with the influence of certain macroeconomic variables. The researcher has selected this topic to enhance the understanding of the housing price index and their association with the macroeconomic variables. As the real estate market is growing and influencing economic performance as well there is no evidence available that highlights their interconnectivity. So the purpose of the research is to highlight the role of macroeconomic indicators in the HPI and also shed light on which leading factors create the demand and also influence the prices (Fan et al., 2010; Zou, 2020).

C. Research Methods

An important part of the research is gathering the data by selecting the accurate method (Shaikh et al., 2022). The researcher selected the method. The selection of the methods for the studies is according to the type of research. Primarily there are two methods for data collection and these are the two major ways of gathering the information for the analysis. First is the collection of data by itself and in this type the researcher has chosen to take the unexplored data that has not been collected ever before and firstly it is collected by him (Raza et al., 2021). This type of collection method is preferred in exploratory research and is known as the primary data collection method. And it is the most secure and authentic method considered by scholars as there is no misrepresentation of data. It highlights the true and exact facts and figures. The second method is taking the already collected set of data which is already been gathered by someone else. And can be utilized according to the requirement of the research (Haiyun & Yizhe, 2020). We have taken the secondary method for data collection as it is convenient for our research and according to the requirement of our research problem. Type of the research is also concerned with the research problem. As the research problem type would be selected according to that. Whether it is carried out for the first time and there is no previous data available or it is carried out to enhance the further understanding and enrich the literature. Many researchers preferred exploratory research and considered it is very essential for presenting new and updated facts and easy to make changes. And also concerned with the exact motive of the researcher (Karsoliya, 2022; Ashraf, et al., 2022).

Our studies are concerned with determining the relationship between the

different macroeconomic factors with the HPI. The researcher also wants to explore the real, exact, and facts and figures to enrich the understanding, the researcher has selected the explanatory type of research.

D. Data Collection

This study will be in Turkey. The sample is taken from the real estate markets of Turkey from January 2010 to December 2022. The project is not applied. Secondary data download from, World bank development indicators, TURKSTAT, and Turk Cumuhuriyet Bankasi online websites. This project requires no funding or finance because all of the data is easily available on the above-mentioned websites (Yildirim, 2021; Egrioglu et al., 2022). In this part, we examined the relationship between macroeconomic indicators, and the Turkish house price index such as; GDP, inflation, exchange rate, BORSA index, gold prices, unemployment, deposit interest rate, money supply, monetary rate, USD/TL, and foreign trade. This study uses 15 years, of quarterly data covering 1-1-2010 to 31-11-2022. The data set is taken from Turk Stat WDI, and CBRT; the description of the data set is presented in Table 1.

$$HPI = \alpha + \beta 1\ GDP + \beta 2\ INF + \beta 3\ ER + \beta 4\ GP + \beta 5\ BI + \beta 6\ UT + \beta 7\ UE + \beta 8\ DIR + \beta 9\ MS + \beta 10\ MR + \beta 11\ FT + \mu \quad (1)$$

Whereas; HPI is Housing Price Index is the dependent variable in the proposed model, GDP is Gross Domestic Product, INF is Inflation, ER represents the exchange rate, GP is Gold Prices, BI is BORSA BIST 100 index, UT is USD/TL conversion rate, UE presents the unemployment, DIR is the Deposit interest rate, MS is Money Supply, MR is Monetary rates and FT is the Foreign trade.

Table 1 Data Description

Variable	Code	Unit	Source
Gross Domestic Product	GDP	GDP (Constructions) %	WDI
Inflation rate	INF	Consumer Price Index	Turk Stat
Exchange rate	ER	(USD) US Dollar (Buying)-Percentage Change &(USD) US Dollar (Selling)-Percentage Change	Turk Stat
Gold Prices	GP	Gold prices against USD	Yahoo Finance
BORSA Index	BI	BIST 100 index	Investing.com
USD/TL	UT	Conversion rate Turkish Lira in US dollars	Yahoo Finance
Deposit Interest rate	DPI	Interest rate (%)	WDI
Unemployment	UE	Unemployment (%)	WDI
Money Supply	MS	Money Supply (%)	WDI
Monetary Rates	MR	MR (Government) in (%)	WDI
Foreign Trade	FT	Imports and Exports in (%)	WDI
Housing Price Index	HPI	Residential Property Price Index (RPPI)-Percentage Change	CBRT

E. Analysis

1. ARIMA Model

ARIMA was introduced by (Box & Jenkins, 1973). For issues with time-series forecasting, it has been demonstrated that ARIMA models may be trusted in certain situations (Fan et al., 2010). In this section, we are going to discuss the ARIMA model which we have selected for our research. ARIMA Model which is Autoregressive Integrated Moving Average one of the most implemented models for research currently and considering the best forecasting model as well. Recently scholars are highly interested in the forecasting base models among them ARIMA Model has great importance because of its simplicity model (Zou, 2020). It is used for linear data and is highly preferred by scholars. It has been proven highly efficient for testing the variable's future outcomes. ARIMA Model is a new upgraded technique for prediction and forecasting and this research is concerned with the forecasting of housing prices. Analyzing the time series data with the previous data (lag) values. There has been no need for a theoretical review for analyzing the variables and predicting them. ARIMA model has been considered a highly

beneficial model and provides accurate results.

Analyzing time series is one of the key techniques in research and development as a result (Sin & Wang, 2017; Kumar & Thenmozhi, 2014). In characterizing and predicting, simple, multidimensional, and hierarchical time series modeling have all been beneficial. Among the most commonly used models for time series prediction evaluation is the ARIMA method. Whenever the time series is steady when there is no missing data in the dataset, the ARIMA technique can be employed. To create multivariate regression equations, only the data from the series is used. As a result, models are created as kernel functions of earlier series data and/or random disturbances or errors. (Abidye et al., 2019) expectations are created just on premise that historical data can be used to make predictions. established 3 phases to formally represent the ARIMA modeling approach: model description, parameter prediction, and model validation. These approaches apply to normalized stationary processes (time series with no systematic change in average or deviation).

Most important two specific reasons are given which highlight why ARIMA has been gaining lots of attention from researchers. Firstly, there has been the use of the numerical data of the variables from the past to predict the future so that there has been a linkage between the results of the past and the near future. And secondly, expressing the autoregressive and moving average models. It is well known for predicting models. Certain components are used in the model that is the important factor that highlights the statistics of the whole model and these are replaced by the integer values following are some special parameters.

$$yi=\mu+ \varphi 1\ yt-j+ \varphi 2\ yt-j +\cdots\ldots\ldots\ldots+ \varphi p\ y_{t-p} +\mu_t \quad (2)$$

in which the time series of something like the parameter y_i itself influence the current value of the parameter $y_{t-p.}$ μ_t is the error term, p: which represents the lag values that are considered as the lag orders for the models. μ is constant, and φ presents the autoregressive parameter. j presents the differentiation of the sample period.

Equation (2) is the ARIMA modeling equation. We put Equation (2) in equation (1) equation (3) will be,

$$HPIt = \mu + \varphi 1 GDPt-j + \varphi 2\ INFt-j + \varphi 3\ ERt-j + \varphi 4\ GPt-j + \varphi 5\ BIt-j + \varphi 6\ UTt-j +$$

$$\varphi 7\ UEt-j + \varphi 8\ DIRt-j + \varphi 9\ MSt-j + \varphi 10\ MRt-j + \varphi 11\ FTt-j + \quad (3)$$

ARIMA models are designed in a way that is very convenient for forecasting by taking past values. And are highly critical to use but efficient to solve the complexities of the data set easily. Following are the assumptions of ARIMA Modelling.

1. Testing the time series data.
2. There has not been a change occurring through time, so the selected data set is too stationary.
3. If it is found that data is not stationary, then it has to be converted into stationary after implementing the different tools and techniques.
4. Analytical data is the requirement of other steps to confirm the state that the data is analytical or not if it is not then the process is not carried out further.
5. Selection of the structure of the model how and which type of modeling style is suitable for testing the data. The selection of the statistical tools is determined by deciding the structures and the characteristics of the data.
6. The other most important thing is the determination of the parameters for the significant ARIMA model implementation, if there may be any error found then it should be rectified by using the current parameters.
7. Another step is testing the analytical presence in the data if the test results are not in favor then the model should be changed and updated according to that.
8. And in the last after applying and changing it is time for developing the ARIMA Model for estimating the short-term period exceeding six months.

ARIMA model of forecasting has several different and particular conditions that are necessary to care of and these conditions are concerned with.

If the parameter p=0 then the model is considered as the moving average model and when the value of the parameter q=0 then the model is considered as the autoregressive model. ARIMA Model is basically, the functionality of the (p, q). ARIMA model is specifically used by researchers who are investigating and

predicting the future trends of the variables and there are all the model calculations are based on the previous records.

We have selected the ARIMA model for our research studies as far as our study is concerned with the forecasting of the housing prices index and the correct selections of tools and techniques are highly important for interpreting the correct, accurate, and errorfree results. As ARIMA is proven good for short-term forecasting.

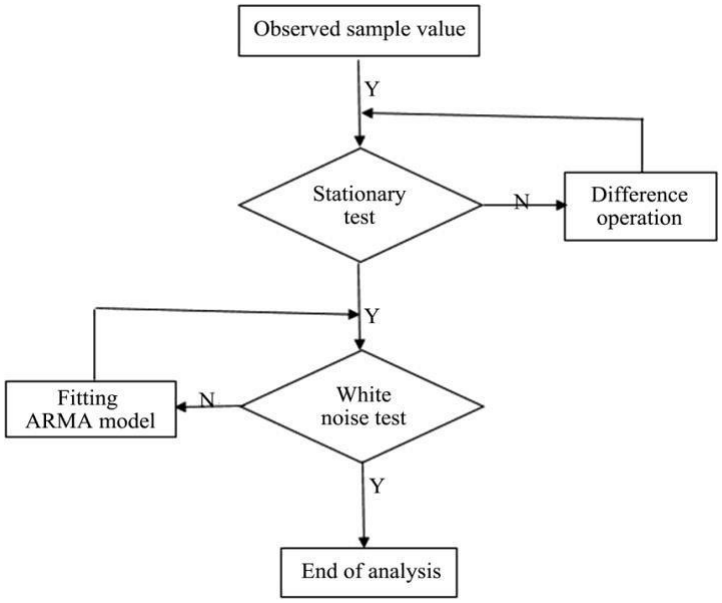

Figure 2 ARIMA Model Modeling Process.

Non-linearity highlights that there has been an unpredictable association between the variable and data sources are unmanageable. Non-linear modeling has been created nowadays and is highly preferred by researcher non-linear models are critical and when plotted they highlight the curves. Graphical representation of the data shows the curves. Among various models, the most common and now highly applicable model is none other than the ANN model. And for our studies, we have also selected the ANN model for testing the non-linear set of data. For the implementation of such models in the research, the applicant must have the expertise and know the correct use.

2. ANN Model:

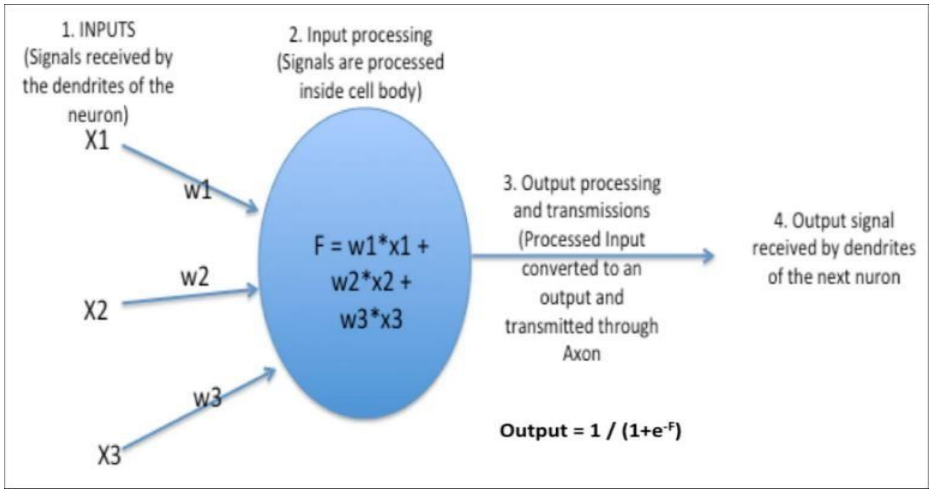

Figure 3 ANN Modelling Process

Artificial Neural Networks (ANN) have great importance nowadays and are considered the most appropriate model. The data that is used of both types is seasonal and nonseasonal time series. Easily modifications can be made and prioritized by the researchers as well. ANN model was first presented by (McCulloch & Pitts, 1943), ANN is presenting the functioning of the neurons where there is data can be stored as well. This is a properly unique and different program which particularly designed to substitute the other programming and other forecasting models. There is the interconnectivity of the neurons like chains which are collectively called the axons. This basically, contains two major portions are sections which is the inner layer and the outer layer by the name. Using for the forecasting of the data with the functioning of the brains and proven very helpful for analyzing complex and non-linear data. The neurons are used here because it has been designed according to the functioning of the brain. There are fixed and predetermined rules for the development of the neurons. The very fundamental model has one inner layer, another medium layer and which is also called hidden, and another outer layer.

All the processes take place with the help of these three layers. Its functioning is quite similar to the working process of the brain. It has unique characteristics and helps them in the whole process of data capturing to analyzing. Their storage process is not similar to other models. Data set collected in the storage devices and ready for further processes. Its data can be collected in a separate unit and there is a need for a complete set of data for the process doesn't affect half of the knowledge. The error and the faults have not affected the performance of the ANN model to create the

results. It is an artificial process and the process of decision-making is automated and depends upon the data assembles. This model is highly convenient to make changes and adopt changes as well. Literature has been suggested with the working capabilities of the ANN and highlights how it performs different operations with the variances in the data set. Most scholars have suggested that it is suitable for seasonal variations and some oppose it.

The ANN approach works by simulating the interplay of synapses discovered in the human mind (Trichakis et al., 2011). The intake, concealed, & activation functions of a cloud infrastructure typically have three layers—are the foundation upon which the ANN model is built (Haiyun & Yizhe, 2020). A research model's input layer is where the independent parameters for the factor under investigation are added. While the final value is determined at the output nodes, the load components of the input parameters are handled just at the convolution layer by a convolution operation. Prior comparable studies frequently used multiple structures. This happens because an ANN can give good results with just one convolution layer (Karsoliya, 2012).

(Ashraf et al., 2021) described in detail the procedure of constructing an ANN model. Furthermore, the starting values affect the assumptions made by an ANN model. To overcome this issue, an artificial neural iterative procedure was used in the research, as well as the mean of each forecast was determined (Kim & Kang, 2010).

F. Sampling

The study uses data from Q1, 2008 to Q4, 2022, the models were developed (60 observations) including the data during and after the global financial crises. While the model was evaluated using a retention sample of data from Q1, 2020, and Q4, 2022 (52 observations) just after the global financial crisis period. The data's modest study sample may be caused by the fact that it uses quarterly time-series dataset rather than the crosssectional data that was typically utilized in earlier research of a similar nature. Additionally, it ought to be mentioned that the predictions could be tested using tiny holdover data (Abidoye and Chan, 2017). The study sample, which spans a period of 13 years after the global financial crisis, falls within the limit suggested by the research (Kitapci et al., 2017; Abidoye et al., 2019; Sin and Wang, 2017). Additionally, it's been demonstrated that ANN methodologies

could work flawlessly with a small amount of data (Wang et al., 2016).

1. Forecasting effectiveness of the proposed models

The current evidence set had one detailed macro-economic data classifiers' development and testing to be evaluated. Throughout the research, there have been no guidelines for such a splitting ratio of modeling data (Park & Bae, 2015). The dividing ratio should be decided by the expert's judgment (Selim, 2009). The forecasting effectiveness of proposed models will test by utilizing the estimations methods. Mean Absolute Error (MAE) (Pradhan & Kumar, 2010), normalized mean absolute error (NMAE) (Cadenas & Rivera, 2010), the root-mean-square error (RMSE) (Pham et al., 2020), and r2 (Ghritlahre et al., 2022). These methods were found to be reliable indicators of how well models forecast the future. According to (Khandelwal et al., 2013), an accurate estimate has MAE, NMAE, and RMSE values that are near 0, and an r^2 that trends approaching 1 indicates a significantly improved fit. To allow for an unbiased foundation of evaluation, it ought to be highlighted that the identical collected data such as the number of explanatory variables) were employed for the building of the equations. Additionally, each variable used in the equations had eleven timing differences. This is due to earlier experiments with a comparable quantity of lags having remarkable results (Abidoye et al., 2019; Wang et al., 2016).

$$r^2 = 1 - \frac{\sum_{i=1}^{n} \left(\mathrm{P_i} - \hat{\mathrm{P}}_\mathrm{i}\right)^2}{\sum_{i=1}^{n} \left(\mathrm{P_i} - \overline{\mathrm{P}}\right)^2} \tag{4}$$

$$\mathrm{MAE} = \frac{1}{n} \sum_{i=1} \left(\mathrm{P_i} - \hat{\mathrm{P}}_\mathrm{i}\right) \tag{5}$$

$$\mathrm{NMAE} = \frac{\mathrm{MAE}}{P_H - P_L} \tag{6}$$

$$\mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\mathrm{P_i} - \hat{\mathrm{P}}_\mathrm{i}\right)^2} \tag{7}$$

Where n is the number of observations, Pi represents the actual housing price index, and $P^{\wedge}$ is the forecasted value of the housing price index. P is the average value of the housing price index. PH represents the highest targeted value and PL represents the smallest targeted value in our proposed ANN research models.

IV. . RESEARCH ANALYSIS AND DISCUSSIONS

A. Descriptive Statistics

The objective of our studies is to identify how HPI is influenced by GDP, INF, ER, GP, BI, UT, UE, DIR, MS, MR, and FT, and also demonstrate the fluctuations in HPI whether they are symmetric or asymmetric.

This chapter has started with the descriptive statistics of data, which is the important and initial phase of analysis. It quantifies and explains the overall features of the data set. It explains the data with two main aspects which are central tendency and measure of spread. This highly important part of studies simply the association among the variables and also presents the distribution of the data. All the brief explanations and graphical representations have been presented in this section.

Table 2 represents the descriptive statistics of the dataset. We have one dependent variable which is HPI and other GDP, INF, GP, BI, UT, UE, DIR, MIS, and FT, below mentioned table presenting the mean, standard deviation, maximum, minimum, Kurtosis, and skewness. The table also indicates, that all variables are dispersed in high values and have a high standard deviation. It also highlights the flatness and peak point.

Starting from the mean, here in this table mean highlights the average value of the variables. The dependent variable is HPI which has a mean value of 5.715 which is not the highest average value among the other variable. It possesses the highest value range of 40.541 and the lowest value starts from -1.191. HPI has a standard deviation of 8.342. The other thing about the data is the value of skewness that highlights the symmetry of the data. The skewness value of HPI is 2.890 which shows that it is positively skewed and has a long right tail. That simply demonstrated the value is higher than the normal value that simply referred to the right-skewed. The other thing in the table is the kurtosis, and the value of the kurtosis of the HPI is 8.290. It is peaked curved as its value is higher than normal distribution which is known as positive kurtosis leptokurtic.

GDP is our 1st independent variable that has a mean average value is 5.303 and a maximum value ranging from 23.122 and the minimum value equal to -9.961. The dispersion of values from the mean is equal to 8.714 and the other skewness value of the GDP is equal to .373 it is considered as the normal skewed value that is symmetric around its mean. The kurtosis value of GDP is -.827 that lesser than the normal distribution that is the reason. It is called the flatted curve and named negative kurtosis which is commonly knowns as the platykurtic.

INF another independent variable of our studies, its mean value is equal to 3.719 with the highest value which is 28.286, other lowest value that is starting from -.2997, and a value standard deviation is 4.519. The Skewness value is 3.818 which is higher than the normal value is and known as positive skewness because of that it has a long right tail. The kurtosis value of the INF is equal to 17.951 which is the maximum value of than normal distribution and known as positive kurtosis leptokurtic.

ER, the next independent variable, and its average value are more than the previous variable which is equal to 10.32 including the lowest value ranges from -12.31 and highest value of 61.754 and the standard deviation of the ER is 15.74. The Skewness value of the ER is equal to 1.354 that highlights the data is rightly tailed and known as positive skewness. The value of the kurtosis is equal to 2.231 that lesser than the normal distribution and is the negative kurtosis that is named the platykurtic.

GP has an average value that is equal to 1433.6 and the standard deviation is equal to

256.6. Along the minimum value of 1060.3 and the maximum value of GP is equal to 1967.6 and the skewness value is equal to 0.491, which is equal to the normal value and that is for the skewness of the GP is symmetric around its average value. The kurtosis value of the GP is equal to -1.139 which is lower than the normal value of the kurtosis that is for it is known as the negative kurtosis (flatted curve) which is generally called the platykurtic.

BI is another value that is being studied and has a mean value of 1.188, and the value of standard deviation is equal to 15.08, with the lowest value that is equal to -95.0 and the highest value which is equal to 25. 120. The symmetric value is

equal to -5.176, which is a lower value than the normal value and long left side tail and known as the negative skewness. The Kurtosis value is 33.668 which is positive kurtosis (peaked curved) and knowns as the leptokurtic. The next variable for the description is UT which possesses a mean value of 4.618 & possesses the lowest value of 1.4200 and the maximum value is equal to 18.573 along with a standard deviation value of 4.048. After that, the skewness value of the UT is equal to 2.039 which is greater than the normal value and highlights that it is the long right tail and is considered as positive skewness. The kurtosis value is equal to 4.116 is higher than the normal value of the distribution which is known as the positive kurtosis (peaked curve) that is leptokurtic.

UE is the other variable for the description that has an average value of 10.53, with the highest value of 14.200, the lowest value of 8.4000, and a standard deviation equal to 1.038. After that skewness value is equal to 1.081 which is higher than the normal value representing that it is the long right tail and positively skewed. The kurtosis value of UE is equal to 3.311 which is equal to the normal distribution that is simply referred to as mesokurtic.

DIR is another independent variable and possesses a mean value of 18.12 along with a maximum value of 25.700 and a minimum value equal to 13.356 with a standard deviation of 3.919 which is not very high. It highlights that the dataset is not very far from the mean value. The skewness value of the DIR is .867 which is also equal to the normal value of the distribution and known as the normal skewness. It also highlights that this distribution is symmetric around the mean. The kurtosis value of DIR is -.732 highlighting the negative kurtosis (flatted curve) and this is called platykurtic.

MS has a mean value of 18.09, the highest value is equal to 34.242 and the lowest value is equal to 10.422 along with the standard deviation of 5.508, which that reflects the dataset is not too far from the mean value. The skewness value of MS is .751 which is equal to the normal skewed value and highlights that the data set is symmetric around the mean. The kurtosis value of the MS is equal to .364 which is lesser than the normal distribution value and reflects the curve is flatted and specifically which is called platykurtic.

MR has an average value of 55.82 which is the highest mean value among all variables along with a minimum value of 30.892, the highest value of 74.700, and a

standard deviation value is 12.47. It is the highest value among the variables that reflects the data set is far away from the mean and spread out the wide range. The Skewness value of MR is -.599 that reflects, the value is negatively skewed and it has a long left tail. The Kurtosis value is equal to -.884 which is negative, which referred that the curve is flattening which is usually platykurtic.

The final description is of FT which is our last independent variable, which has a mean value equal to 51.856 which is the second-highest mean value among the other variables. The maximum value is 71.212 and the minimum value is 46.694, its standard deviation is 4.875, which is not so high value that highlights the dispersion of data is not too far from the mean value. The degree of skewness is equal to 1.697, which is higher than the normal value that is reflected in that it is positively skewed and it has a long right tail. The kurtosis value is equal to 4.083 which is higher than the normal distribution which is peak curved and referred to as the leptokurtic.

Table 2 Descriptive analysis of studied variables

Variable	N	Min Stat	Max	Mean	Std.Dev	Skw	Kurtosis
HPI	52	-1.191	40.541	5.715	8.342	2.890	8.290
GDP	52	-9.961	23.122	5.303	8.714	.373	-.827
INF	52	-.2997	28.286	3.719	4.519	3.818	17.951
ER	52	-12.31	61.754	10.32	15.74	1.354	2.231
GP	52	1060.3	1967.6	1433.6	256.6	.491	-1.139
BI	52	-95.0	25.120	1.188	15.08	-5.176	33.468
UT	52	1.4200	18.573	4.618	4.048	2.039	4.116
UE	52	8.4000	14.200	10.53	1.038	1.081	3.311
DIR	52	13.356	25.700	18.12	3.919	.867	-.732
MS	52	10.422	34.242	18.09	5.508	.751	.364
MR	52	30.896	74.700	55.82	12.47	-.599	884
FT	52	46.694	71.212	51.856	4.875	1.697	4.083

Source: Author’s compilation

Currently Turkish real estate market is growing at the fastest there has been a great increment in the prices of residential property from the period of 2010 to 2022. This has been considered a growing period after the financial crises there are certain factors behind that particularly the macroeconomic factors are notable. The prices

have fluctuated as shown in figure 4. These blue lines motion reflected that the prices have been growing since 2010, and now are the highest. In 2022 the prices are at their peak.

That reflects that it has been now the most developing sector of the Turkish economy.

HousingPriceIndex

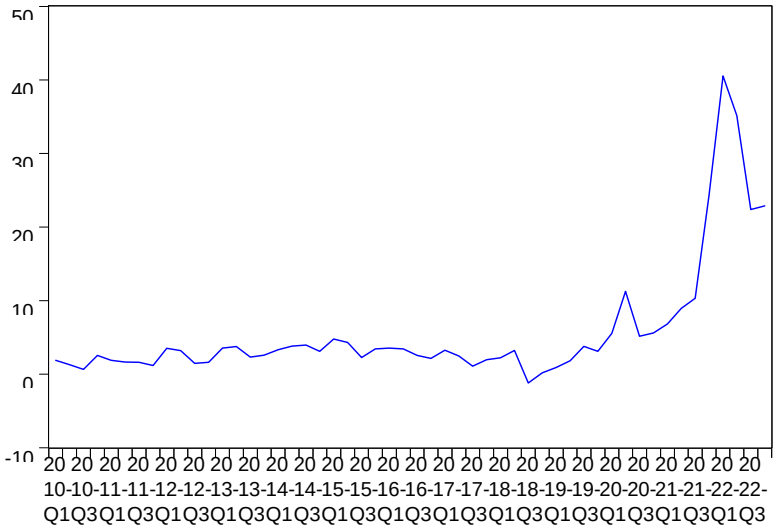

Figure 4 Housing Price Index

Source: Author's compilation

GDP is one of the most important economic indicators. Currently, the Turkish economy is developing and growing with the current market trends. Figure 4 highlights that there have been lots of fluctuations in the GDP as the lines show. HPI is also interrelated with GDP trends. From 2010 to 2022 there have been a lot of fluctuations in GDP.

GDP

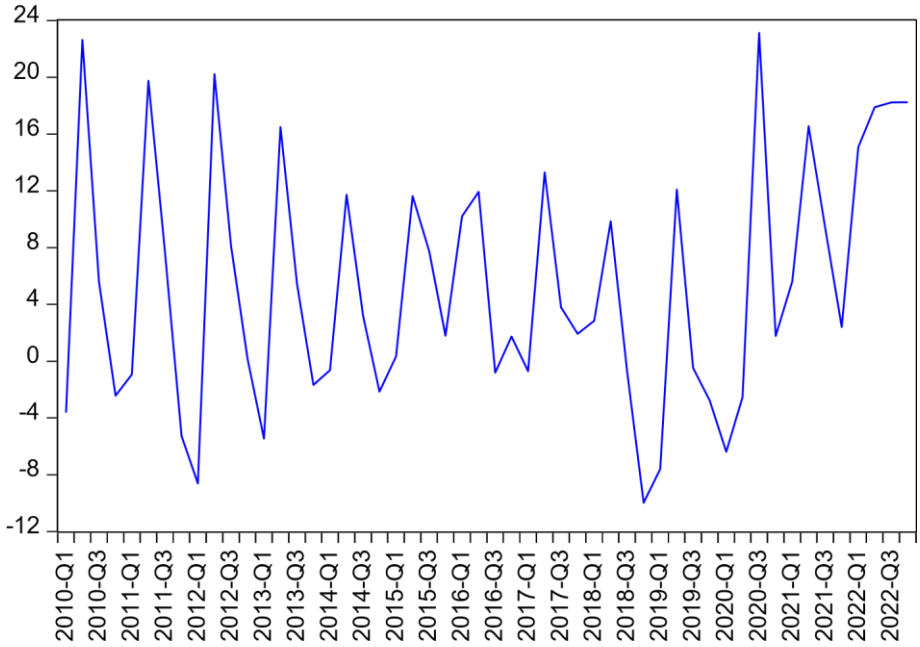

Figure 5 Gross Domestic Product

Source: Author's compilation

Inflation is the major economic factor that highlights the current conditions of the economy with the prices of commodities. Currently, it has been observed that the inflation rate of Turkey has been increasing from the previous years as the above graph reflected in the period of 2010. The rate of inflation has been increasing in 2022 it has been at its peak. After the pandemic and other arise issues, it has fluctuated (See figure 6).

Inflation

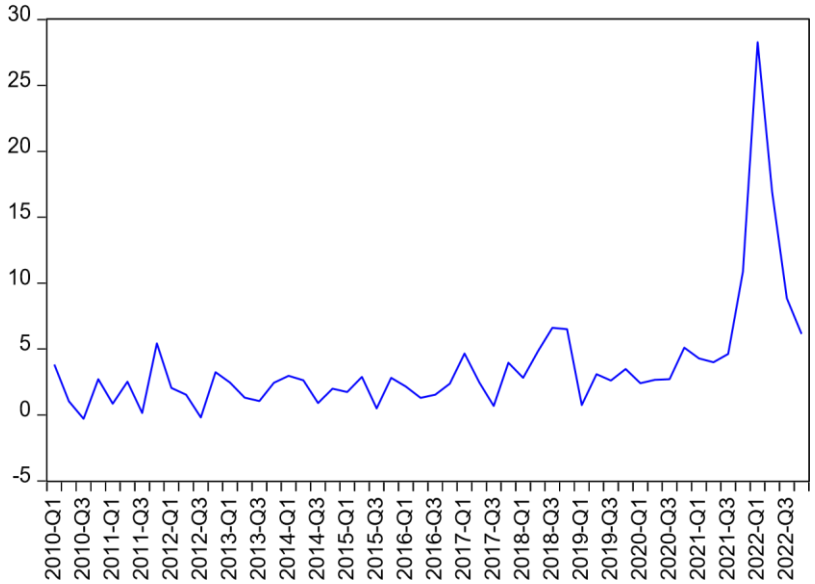

Figure 6 Inflation

Source: Author's compilation

Figure 5 presents the Exchange rate movements of Turkey from the period of 2010 to 2022. It highlights that the Turkish exchange rate has fluctuated in 2010. It was not very high trends in data representing that it has been increasing. Now it has reached a peak point. Exchange rate fluctuations are interrelated with the HPI increment and decrement (See Figure 7).

Exchangerate

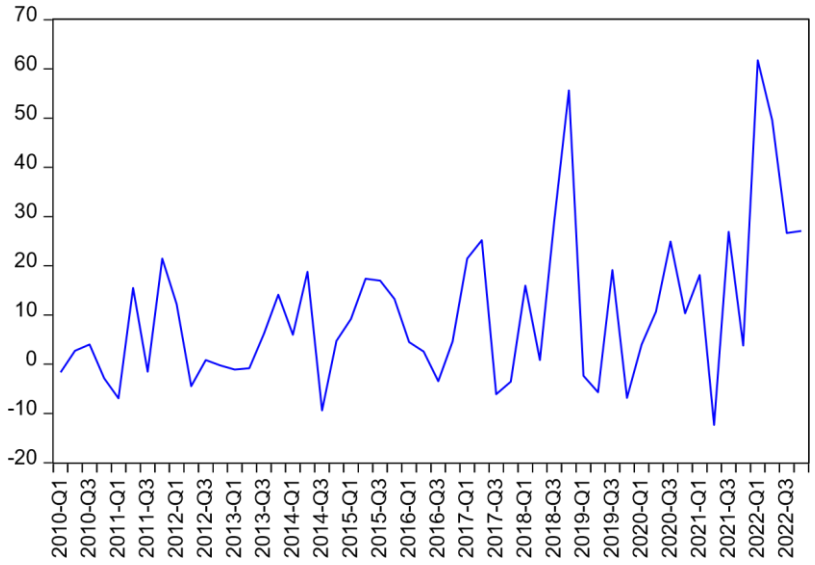

Figure 7 Exchange Rate

Source: Author’s compilation

Gold prices are highly dynamic and always fluctuate, figure 6 represents that in 2010, the prices were not so high with time there has been an increment. In 2013 the prices were at a peak and start decreasing and currently, these prices are increasing again in 2022, again it is at a peak point. Gold prices are highly influential on economic growth. (see figure 8)

GoldPrices

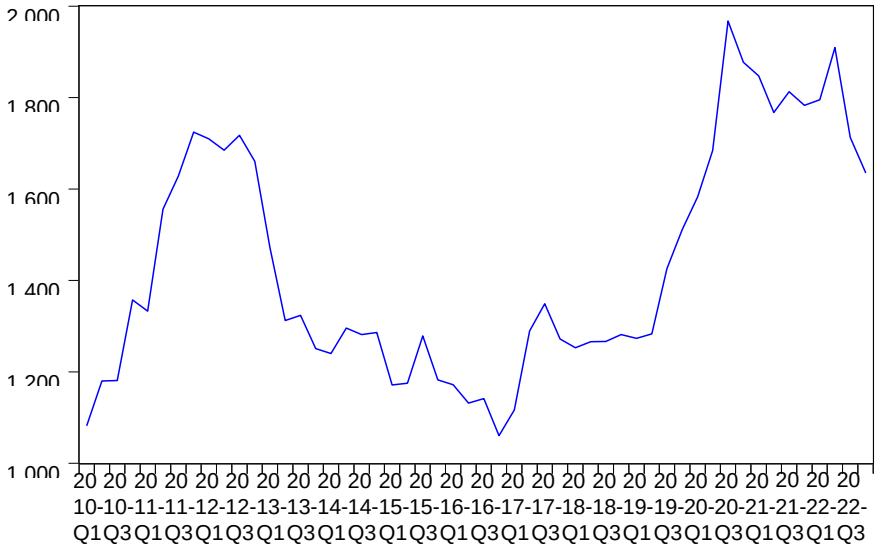

Figure 8 Gold Prices

Source: Author’s compilation

BORSA index straight line in one direction shows that these indices are constant. There has no change or fluctuations been noticed from the period of 2010 to 2022 (See Figure 9).

BORSAIndex

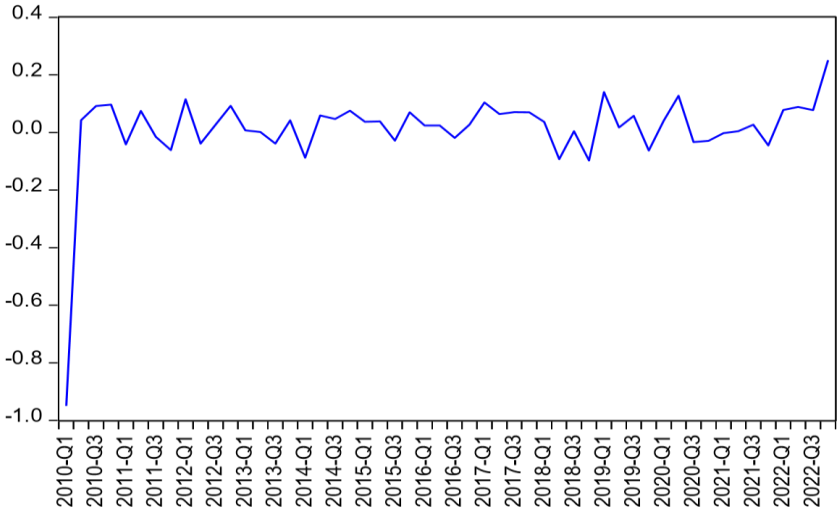

Figure 9 BORSA Index

- **Source: Author's compilation**

The trend in the USD/TL is growing at a constant rate and is now at its peak point. Figure 8 shows that it was gradually increasing rate. In 2010 started at 0.7 and now in 2022 it has been at its peak with a value of 18.75 TL against one USD. (see figure: 10)

USDTL

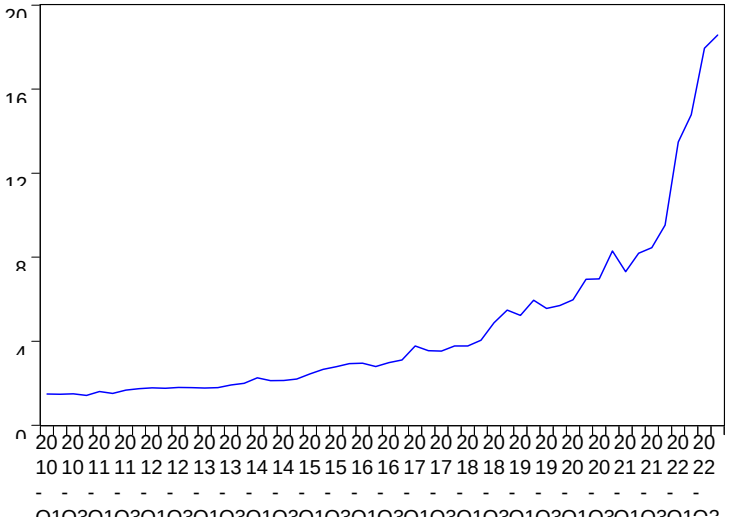

Figure 10 USD/TL

Source: Author's compilation

Unemployment is a crucial factor that has been increasing. It becomes problematic for economies as well. Figure 11 graphical representation has shown that in 2010 this was decreasing gradually. After 1st quarter of 2013 it was increasing at a constant rate, in the period 2021, it increases up to 13%, but in 2022 Turkey has created job opportunities for the people, and the unemployment ratio decreased from 13% to 9%. The rate of unemployment in the country affects every sector also the real estate sector has been influenced by that.

Unemployement

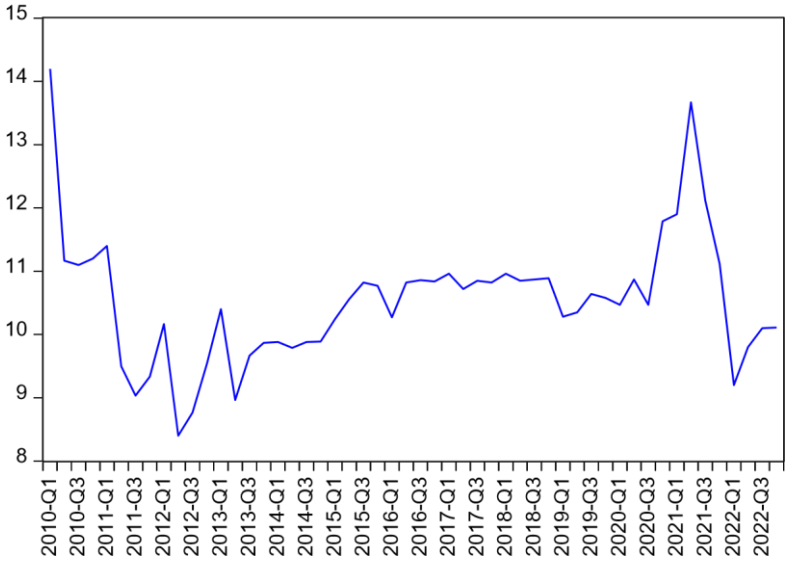

Figure 11 Unemployment

- **Source: Author's compilation**

Figure 12 represents the deposit interest rate that in 2010, the rate of deposit interest rate is high. With time, this has been increasing with the influence of certain factors and it is still rising, because of economic conditions. After the financial crisis of 2008, the housing price bubble burst interest rate was considered the most prominent tool for HPI and price determination.

DepositInterestrate

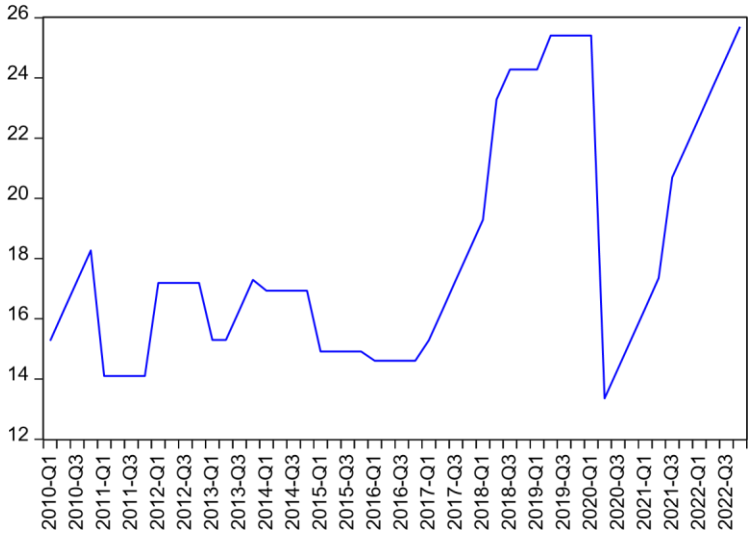

Figure 12 Deposit Interest Rate

- **Source: Author's compilation**

The money supply graph highlights there have been fluctuations from the period of 2010 to 2022. Turkish money mobilization is in fluctuations and currently, the money supply has been at its peak in previous years it is up to 34%. This is the main cause of inflation in Turkey. These changes reflect the dynamism in the economic conditions (See Figure 13).

MoneySupply

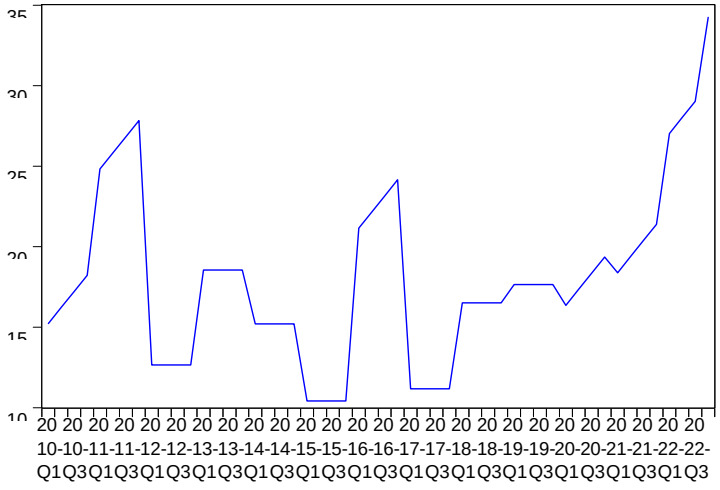

Figure 13 Money Supply

Source: Author's Compilation

Figure 14 presents that the monetary rate is moving upward, which shows that the monetary rate is increasing from the period of 2010 to 2022. The Turkish economy is a highly growing economy and has been changing dynamically.

MonetaryRates

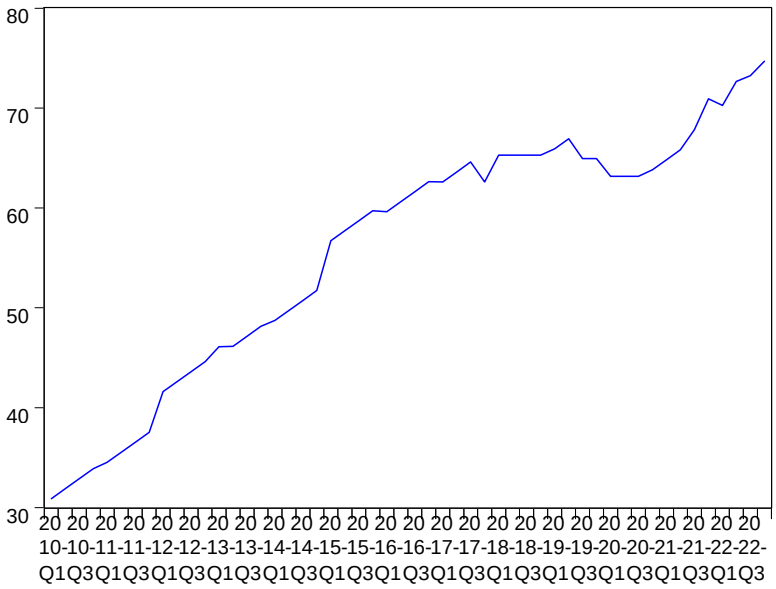

Figure 14 Monetary Rate

Source: Author's compilation

In earlier days' foreign trade rate of Turkey is not very high. The lines show that it has been increasing from 2010 to 2022 with international trading activities. It has increased and contributed to the economic growth of these activities. It is also the determinant of house prices, which reflects the affordability of the individuals (See Figure 15).

ForeignTrade

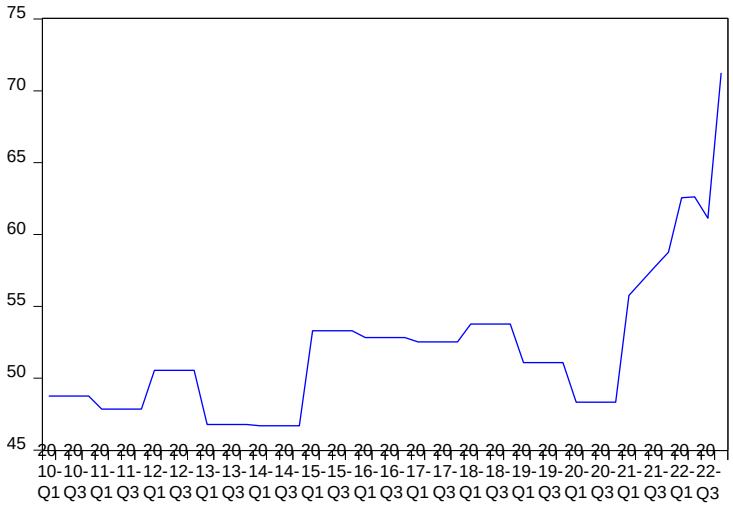

Figure 15 Foreign Trade

Source: Author's Compilation

B. Correlation Analysis

Correlation highlights the relationship among the variables table 3 represents the significant relationship between the dependent variable (HPI) and independent variables (GDP, INF, ER, GP, BI, UT, UE, DIR, MS, MR, FT). The normal range of correlation ranges from -1.00 to +1.00. The correlation between the HPI and GDP is .360 which is a medium positive relationship between the HPI and GDP. The relationship between the HPI and INF .864 shows that there is a strong positive correlation between the HPI and INF. The correlation between the INF and GDP is equal to .194 which highlights that there is a weak positive correlation between the INF and GDP. The correlation between the HPI and ER is .549 which highlights there is a moderately positive correlation between the HPI and ER. And the correlation between the GDP and ER .157 highlights that there is a weak positive correlation between the GDP and ER.

The correlation between the INF and ER a is .686 which is a strong positive correlation between the INF and ER. The table represents that the correlation between the HPI and the GP is .523 which shows that HPI and GP are positively moderately correlated with each other. The correlation between the GDP and the GP is .255 which highlights that GDP and GP are weakly positively correlated with each

other. The correlation of INF with GP is .415 which highlights that they are moderately correlated with each other. The correlation between the .281 highlights that ER and GP are weakly positively correlated with each other.

The correlation between the HPI and BI is equal to .180 which highlights that they are weakly correlated with each other. The correlation between the GDP and BI is .167 which shows that GDP and BI are weakly correlated with each other. The correlation between the INF and BI is .035 which shows that there is a very weak correlation between the INF and BI. The correlation between the ER and BI is .151 which highlights that they are weakly positively correlated with each other. The correlation between the GP and BI is .177 which highlights that there is also a positive weak correlation.

The correlation between the HPI and UT is .827 which shows that HPI and UT are strongly positively correlated with each other. The correlation between the GDP and UT is equal to .338 which shows that they are positively and moderately correlated with each other. The correlation between the INF and the UT is equal to .669 which highlights that they are strong and positively correlated with each other. The correlation between the ER and UT is equal to .527 which highlights that ER and UT are strongly positively correlated with each other. The correlation between the GP and UT is equal to .549 which highlights that ER and UT are strongly positively correlated with each other. The correlation between the BI and UT .230 highlights that there is a weak positive correlation.

The correlation between the HPI and UE is equal to 0.09 that highlight there is no relation between the HPI and the UE. The correlation between the GDP and UE -.175 highlights there is a negative weak correlation between the GDP and UE. The correlation between the INF and UE is equal -.063 and there is no correlation. The correlation between the ER and UE is -.135 which highlights there is a very weak negative correlation between the ER and UE. The correlation between the GP and UE is equal to .12 which shows there is a negative weak correlation between the GP and UE. The correlation between the BI and UE is equal to -.47 which highlights there is a mediumweak correlation between the BI and UE. The correlation between the UT and UE is equal to .077 highlighting there is no correlation between the UT and UE.

The correlation between the HPI and DIR is equal to .385 highlighting there

is a medium positive correlation between them. The correlation between the GDP and DIR is equal to -.031 which highlights that there is no correlation between them. The correlation between the INF and DIR is equal to .423 which shows they are medium positively correlated with each other. The correlation between the ER and DIR is equal to .302 which highlights that they are medium positively correlated with each other. The correlation between the GP and DIR is equal to .185 which shows that they are weak and negatively correlated with each other. The correlation between the BI and DIR is equal to .147 which highlights there is a positive weak correlation between the BI and DIR. The correlation between the UT and DIR is equal to .599 which highlights that there is a medium positive correlation between the UT and DIR. The correlation between the UE and DIR is equal to -.02 which highlights that there is no correlation between them.

The correlation between the HPI and MS is equal to .535 which highlights that there is a medium positive correlation between them. The correlation between the GDP and MS is equal to .269 which shows that they are weak positively correlated with each other. The correlation between the INF and MS .422 shows that there is a medium positive correlation between them. The correlation between the ER and MS is equal to .269 which shows that there is a positive weak correlation between them. The correlation between the GP and MS is equal to .374 highlighting there is a medium positive correlation between them. The correlation between the BI and MS is equal to the .103 that there is a positive weak correlation between them. The correlation between UT and MS is equal to .563 that highlights that there is a medium positive correlation between the UT and MS. The correlation between the UE and MS is equal to -.11 that highlights there is a negative weak correlation between the UE and MS. The correlation between the DIR and MS is equal to the .211 that highlights that there is a weak positive correlation between the DIR and MS. The correlation between the HPI and MR is equal to the .480 that classifies that there is a medium positive correlation. The correlation between the GDP and MR is equal to .107 which highlights there is a weak positive correlation between the GDP and MR. the correlation between the INF and MR is .437 which highlights that there is a medium positive correlation. The correlation between the ER and MR is equal to .394 that highlights that there is a positive medium correlation the correlation between the GP and the MR is .200 that shows that there is a positive weak

correlation between the GP and MR. the correlation between the BI and MR is equal to the .298 that highlights that there is a weak positive correlation. The correlation between the UT and MR which is equal to .711 highlights that there is a strong correlation between them. the correlation between the UE and MR is equal to .138 which highlights that there is a positive weak correlation. The correlation between the DIR and MR .544 highlights there is a positive medium correlation between the DIR and MR. The correlation between the MS and MR is equal to .123 which shows that there is a positive weak correlation between the MS and MR. the correlation between the HPI and FT is equal to .729 which highlights that there is a strong correlation between the HPI and FT.

Table 3: Correlation Results

Variable	HPI	GDP	INF	ER	GP	BI	UT	UE	DIR	MS	MR	FT
HPI	1.00											
GDP	.360	1.00										
INF	.864	.194	1.00									
ER	.549	.157	.686	1.00								
GP	.523	.255	.415	.281	1.00							
BI	.180	.167	.035	.151	.177	1.00						
UT	.827	.338	.669	.527	.549	.230	1.00					
UE	0.09	-.175	-.063	-.135	-.12	-.47	.077	1.00				
DIR	.385	-.031	.423	.302	.185	.147	.599	-.02	1.00			
MS	.535	.269	.422	.269	.374	.103	.563	-.11	.211	1.00		
MR	.480	.107	.437	.394	.200	.298	.711	.138	.544	.123	1.00	
FT	.729	.344	.614	.501	.299	.226	.827	.120	.504	.417	.672	1.00

Source: Author's compilation

C. ANN Model (Multi-Layer Perception)

The neural network techniques have been applied to a given set of data, where the time series data has been tested according to that first, second, and third lag were demonstrated as the independent variables. The values to be estimated were the values of dependent variables.

The data was segmented into 2 groups training and testing in table 4. There has been a detailed presentation of variables that are used along with their percentage contribution and detailed description. The training sections highlight the sets that are used for the forecasting of the weights in the neural networks and assumptions are made according to independent variables. After that when the errors occurred in the set the date has been organized and adjusted in the testing set so that the error can omit. Table 4 also highlights the cluster of output, that has been generated from

clustered input. It is the function of the multi-layer perceptron and there are functions of the backpropagation that uses for the training and testing model to highlight effective forecasting. Training process 71% are involved in the training and the remaining 28% have been tested and successfully generated output.

Table 4: Multi-Layer Estimations

		N	Percent
Sample	Training	37	71.2%
	Testing	15	28.8%
		52	100.0%

Source: Author's compilation

ANN model is an effective tool for forecasting the nonlinear trend in the data and has been working with different procedures. A detailed description of the neural network model is given below that highlights the three the input layer, the hidden layer, and an output layer. As this is presented in table 5 in the hidden layer there is 1 unit and the activation function used is known as the hyperbolic tangent. 8 variables from the data have been tested by using the ANN model, because of these covariates with HPI.

Table 5 Network Information Estimates

	Activity	No.	Variable
Input Layer	Covariates	1	GDP
		2	Inflation
		3	Exchange rate
		4	Unemployment
		5	Deposit Interest rate
		6	Money Supply
		7	Monetary rate
		8	Foreign trade
	Number of Units	8	
	Rescaling Method for Covariates	Standardized	
Hidden Layer (s)	Number of Hidden Layers	1	
	Number of Units in Hidden Layer 1[a]	2	
	Activation Function	Hyperbolic tangent	
Output Layer	Dependent Variables	1	Housing Price Index
	Number of Units	1	
	Rescaling Method for Scale Dependents	Standardized	
	Activation Function	Identity	
	Error Function	Sum of Squares	

Note: Excluding the bias unit

Source: Author's compilation

Figure 16 provides a complete presentation of the neural network functioning that highlights their step-by-step where the dark lines the represented by weights that are less than zero and the light colors present that the values of the weights are greater than zero.

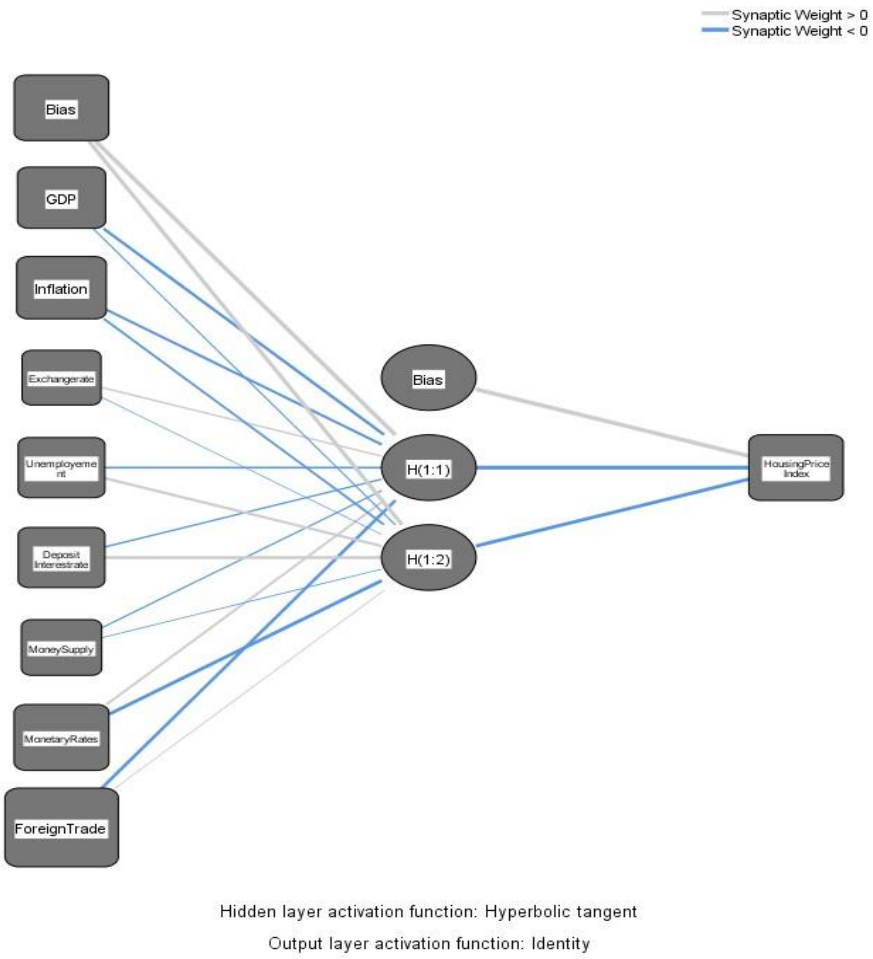

Figure 16 A network model of studied variables

Source: Author's compilation

Table 6 is the complete summary of the model. It is presenting the training and the testing summarization. The training sum of square errors is 3.03, while there are more errors in testing at 12.97. The relative error in training and testing is the same 0.169. The training time was 0.00.00.01 while using the stopping rule with 1 consecutive step that has not decreased in error. It also fits statistics for the training and the testing

Table 6 Model Summary of ANN model

Training / Testing	Model	Values
Training	Sum of Squares Error	3.038
	Relative Error	.169
	Stopping Rule Used	1 consecutive step(s) with no decrease in error
	Training Time	0:00:00.01
Testing	Sum of Squares Error	12.971
	Relative Error	.169

Note: a. Dependent Variable is Housing Price Index

1. Error computations are based on the testing sample

Source: Author's compilation

A complete description of the weights and the bias is given in table 7. The outcomes of the tables highlight that the value of the weights from the input section moves towards the hidden layer and after reaching the hidden layer they shift to the outer layer. HPI represents the outer layer in the table. H (1:2) represents the hidden layer. The weight which is linked to the neurons from the bias is 2.908, from which lag 1 is equal to -.680, from lag 2 is -.448, from lag 3 is .220, from lag 4 is -.248, from lag 5 is -.168, from lag 6 is -.154, from lag 7 is -.383, from lag 8 is -.722. Since we have tested eight variables the H (1:1) of GDP is -.680, INF -.448, ER has .220, UE has -2.48, DIR -.168, MS -.154, MR .383 and FT has -.722. While the hidden layer 1 H (1:2) presents that GDP has -.134, INF -.306, ER has -.064, UE has .476, DIR .952, MS -.091, MR -1.055 and FT has .116. Where in the Output layer, hidden 1 has Bias with 2.959 in H (1:1) it is -2.239, and H (1:2) is -1.151.

Table 7 Parameter Estimates of the ANN model

Hidden Layer 1	Output Layer Predictor	H (1:1)	H (1:2)	(HPI)
Input Layer	(Bias)	2.908	1.573	
	GDP	-.680	-.134	
	Inflation	-.448	-.306	
	Exchange rate	.220	-.064	
	Unemployment	-.248	.476	
	Deposit Interest rate	-.168	.952	
	Money Supply	-.154	-.091	
	Monetary Rates	.383	-1.055	
	Foreign Trade	-.722	.116	
Hidden Layer (1)	(Bias)			2.959
	H(1:1)			-2.239
	H(1:2)			-1.151

Source: Author's compilation

The graphical representation of the housing prices highlights the predicted and observed values of the HPI. It can be observed that their outliers are moving in an upward direction. Figure 17 presents the observed and estimated values.

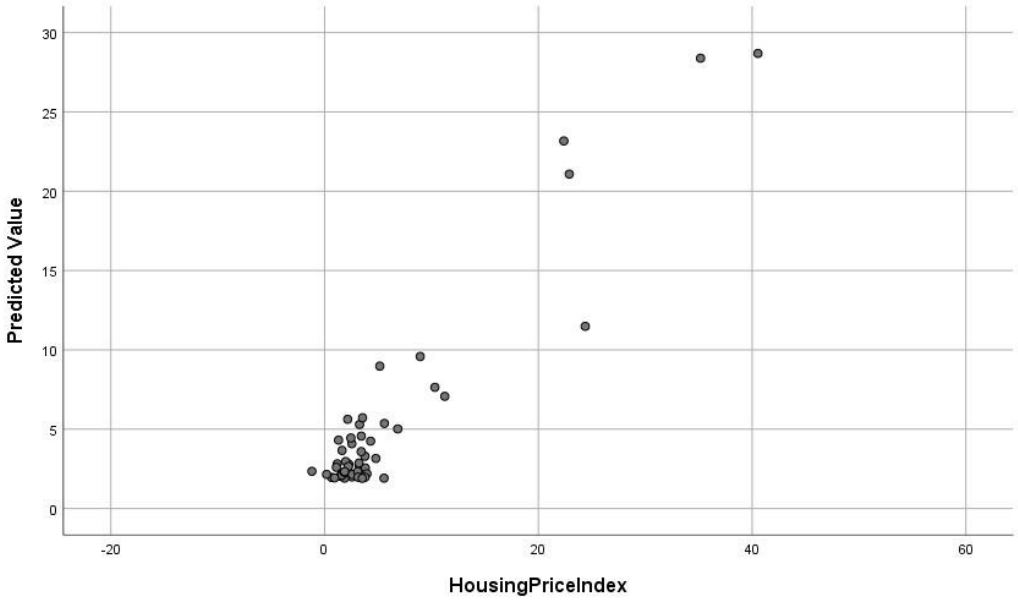

Figure 17 Predicted Value of Housing Price Index

Source: Author's compilation

Figure 18 highlights the residual and the predicted values of the housing price index (HPI). After getting the outcomes from the residual and predicted value, it can be observed the application of the ANN model is suitable and appropriate for forecasting.

Figure 16 highlighted that the residual values do have not a definite way that shows that they are not associated and interlinked with each other. If they are not connected, this would be considered as the independency of the variable and that confirms the accuracy of the ANN model.

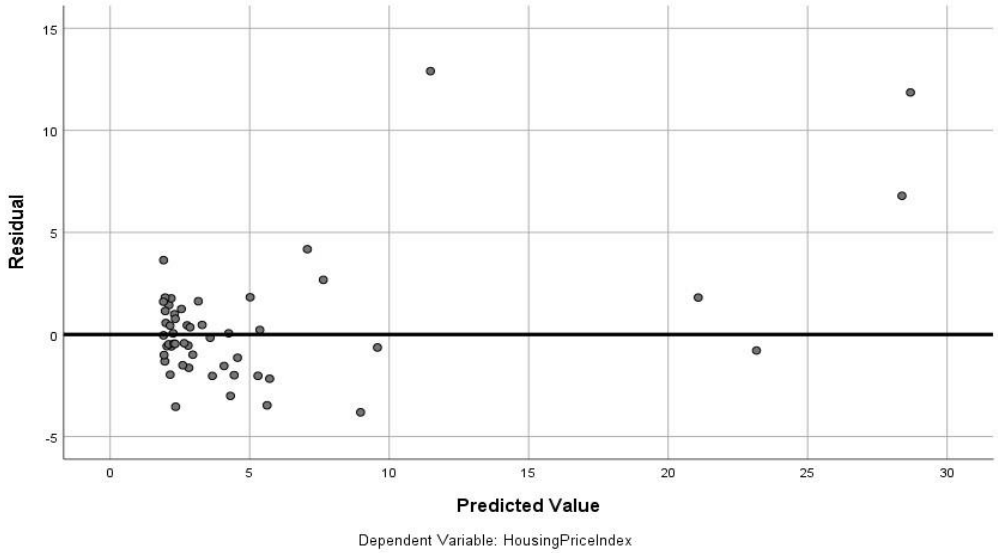

Figure 18 Residual values of the Housing Price Index

Source: Author's compilation

Independent variables are essential for representing the accurate and effective and exact relationship with the other variables. Table:8 highlights the normalized importance of the independent variables these variables have been normalized by dividing with standard deviations and the percentage are given as GDP is equal to 33.2% inflation is equal to 37.0%, the exchange rate is equal to 8.7%, unemployment is equal to the 29.2%, deposit interest rate is equal to the 29.3%, the money supply is equal to the 12.4%, money rate is equal to the 51.0% and foreign trade is equal to the 100.0%.

Table 8 Independent Variables Importance under the ANN model

Variable	Importance	Normalized Importance
GDP	.110	33.2%
Inflation	.123	37.0%
Exchange rate	.029	8.7%
Unemployment	.097	29.2%
Deposit Interest rate	.097	29.3%
Money Supply	.041	12.4%
Monetary Rate	.169	51.0%
Foreign Trade	.332	100.0%

Source: Author's compilation

Figure 19 is the graphical representation of the normalized independent variables with their percentage. The figure has four parts the 0% to 100%. According to the figure foreign trade has the highest percentage among the other variables and is equal to 100.0%, it falls in all four parts, which means foreign trade is 100% important for HPI. Second, the highest percentage is the monetary rate which is 51%, which simply means that the monetary rate is 51% important for HPI. Inflation is nearly 37% important for HPI. GDP is 22% important for HPI. Deposit interest rate, unemployment, money supply, and exchange rate fall in 1st part below 20%. Since like deposit interest rate and the unemployment rate is 19% important for HPI. The money supply is 10% important for HPI. The exchange rate has very low importance for HPI, around 7%.

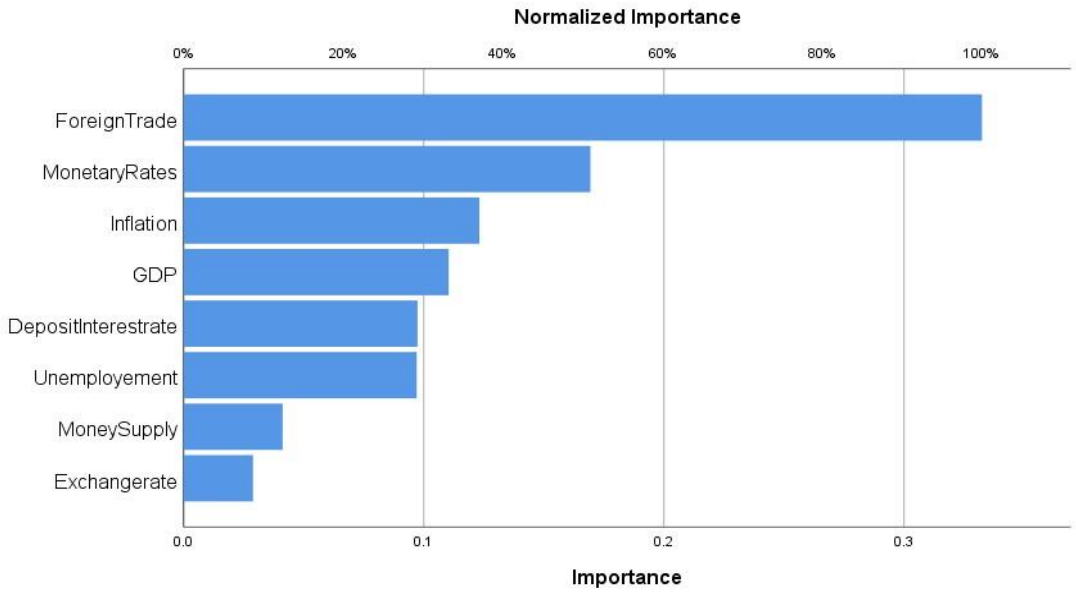

Figure 19 Normalized Importance of independent variables

Source: Author's compilation

D. ARIMA Model

ARIMA model has been applied due to the data differentials that are important for making the estimations. There have been three stages of modeling have been applied identification, estimation, and diagnostic which are suggested by Box and Jenkins. Table 9 is representing the diagnostic approach that highlights that the model is satisfactory and running properly. Where the R-squared value is equal to .914, RMSE is equal to 2.646, MAPE is equal to 82.652, Max MAPE is equal to 806.652, MAE is equal to 1.878, Max MAE is equal to 6.122 and the normalized value is equal to 2.200.

Table 9 Model Fit Estimations of the ARIMA model

Fit Statistic	Mean		SE Min	Max.	Percentile	Percentile	Percentile
Stationary	.625		.625	.625	.625	.625	.625
R-squared	.914	.	.914	.914	.914	.914	.914
RMSE	2.646	.	2.646	2.646	2.646	2.646	2.646
MAPE	82.652	.	82.652	82.652	82.652	82.652	82.652
Max APE	806.396	.	806.396	806.396	806.396	806.396	806.396
MAE	1.878	.	1.878	1.878	1.878	1.878	1.878
Max AE	6.122	.	6.122	6.122	6.122	6.122	6.122
Normalized	2.200	.	2.200	2.200	2.200	2.200	2.200
BIC							

Source: Author's compilation

Table 10 indicates the model statistics estimation results of the ARIMA model. There are 2 predictions in the model. The stationary R-Squared is .624, which suggests the stationary part of the model. In inflation, the Deposit interest rate has a seasonal trend of up to 62% with the housing price index. R-Squared is .914. Deposit interest rate, gold prices, USD/TL and BORSA index have 91% variations in the prediction of a housing price index. RMSE presents the actual and estimated model prediction. High RMSE is bad while our RMSE is 2.646, which indicates the model is the best fit. MAPE is the best value for predicting and forecasting the model. If MAPE is below 5% that means the model is good and accurate for forecasting. Here MAPE is 2.65 model is correct for predicting.

Table 10 Model Statistics Estimations of the ARIMA model

Model	Number of Prediction	Stationary R-Squared	R-Squared	RMSE	MAPE
Housing Price Index	2	.625	.914	2.646	2.652

Source: Author's compilation

Table 11 presents the parameters of ARIMA modeling. Two parameters; inflation and the deposit interest rate have no transformation in the data. The difference in numerator lag 0 by estimate 1 is .746 having 1 difference and

denominator lag 1 has .285 with estimates

1. While the deposit interest rate is 6 times delaying in estimates 1 by differencing 1 at numerator lag 0, with -.535 estimates 1.

Table 11 ARIMA Model Parameters

Housing Price Index	No Transformation	Difference	Estimate 1
Inflation	No Transformation	Numerator Lag 0	.746
		Difference	1
		Denominator Lag 1	.285
Deposit Interest rate	No Transformation	Delay	6
		Numerator Lag 0	-.535
		Difference	1

Source: Author's compilation

Figure 20 is highly effective in representing the diagnostic checking approach that highlights the ACF and PACF of the model residuals showing that the values of all ACF and PACF of the residual sequence were stable.

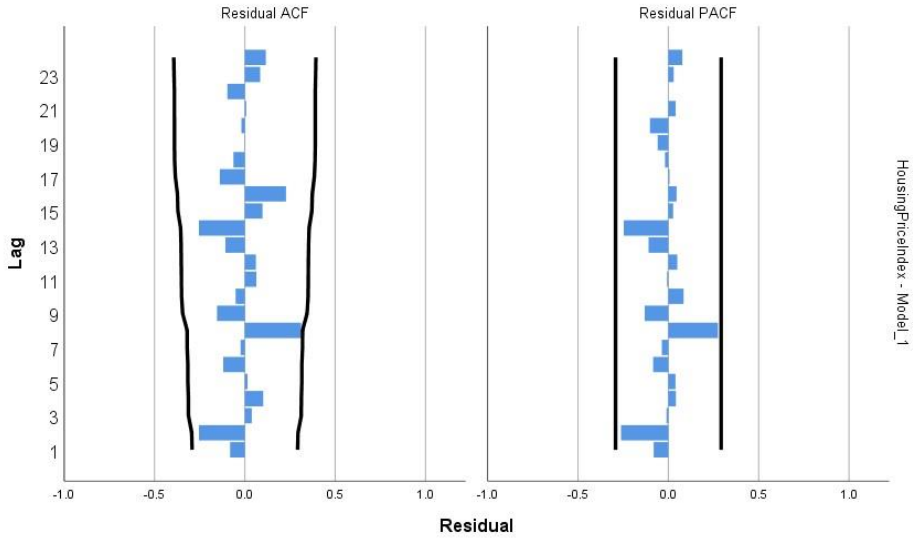

Figure 20 Residual ACF and Residual PACF of ARIMA Model

Source: Author's compilation

Figure 21 highlights the emerging trends in the housing prices index and currently, there has been an increment. ARIMA forecasting technique is highly effective. In this figure, differences series are plotted it has shown that the series has the mean stationery. In the end, the values seem to be high which highlighted that the data is not variance stationary.

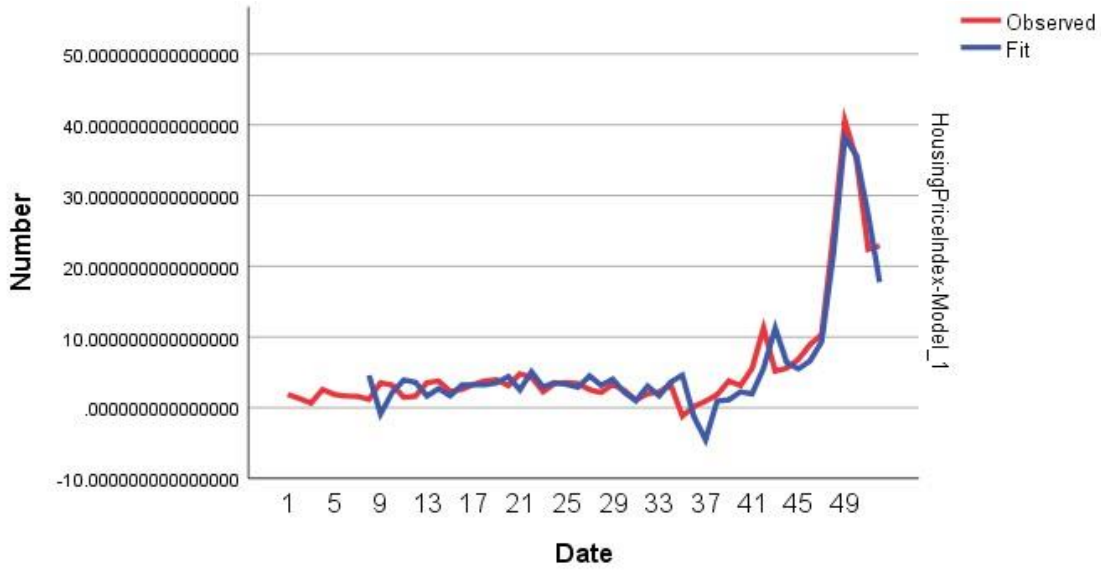

Figure 21 Forecasted Housing Price Index

Source: Author's compilation

Table 12 the comparison of the accuracy of the models. It is the most important part of the whole research, it is representing the comparison table that highlights that ARIMA and ANN both techniques are highly effective for the results. The mean square error (MSE), root mean square error (RMSE), and mean absolute percent error (MAPE) were lower values of the ARIMA model and ANN Model have higher values. It has been observed that the ANN model is highly effective for forecasting. In the first model using the ARIMA model with INF, GP, BI, UT, DIR with HPI, where ME reflects the -0.0341 is a small number and negative value suggest that the model is a better fit. MSE is 3.82 which is above the average, but it is more than 0, the model is more accurate in standard error. RMSE is 1.95 reflects that in the model there is the accuracy of forecasting based on the 12 years' quarterly data. MAE is 1.37 reflecting that magnitude of deposit interest rate, gold prices, BORSA index, USD/TL, and inflation have a good direction with the housing price index. MPE is 0.21 suggests that 21% errors of the forecasted model happen by deposit interest rate, inflation, gold prices, BORSA index, and USD/TL in HPI. Around 0.21% MAPE implies the model is about 99.79% accurate in predicting the next 52 observations. SMAPE has both a lower bound and upper bound, it is known as symmetric. A value is 0.49 indicates that the predicted model is significant and symmetric. U1 is 0.09 and U2 is 1.505 these are error terms that are residuals in the ARIMA model. In the second model using the ANN model with GDP, INF, ER, UE,

DIR, MS, MR, and FT with HPI, where ME reflects the 1.13 is a small number and positive value suggest that the model is a better fit. MSE is 37.76 which is above the average, but it is more than 0, the model is more accurate in standard error. RMSE is 6.14 reflecting that in the model there is the accuracy of forecasting based on the 12 years' quarterly data. MAE is 3.15 reflecting the magnitude of GDP, inflation, exchange rate, unemployment, deposit interest rate, money supply, monetary rate, and foreign trade having a good direction with the housing price index. MPE is -0.78 suggesting that 78% of errors of the forecasted model happen by GDP, INF, ER, UE, DIR, MS, MR, and FT in the housing price index. Around 1.38 MAPE implies the model is about 98.62 accurate in predicting the next 52 observations. SMAPE has both a lower bound and upper bound, it is known as symmetric. A value is 0.53 indicates that the predicted model is significant and symmetric. U1 is 0.39 and U2 is 3.24 these are error terms are residuals in the ANN model.

Table 12 Error Statistics of ANN And ARIMA Results

	ME	MSE	RMSE	MAE	MPE	MAPE	SMAPE	U1	U2
ARIMA	-0.0341	3.823005	1.955251	1.373666	0.218586	0.550563	0.494614	0.094873	1.052571
ANN	1.134375	37.76629	6.145429	3.157049	-0.78108	1.389151	0.538834	0.393737	3.245136

Source: Author's compilation

E. OLS Regression:

R square is 0.921863 which shows that GDP, INF, ER, GP, BI, UT, UE, DIR, MS, and MR have 92% variations on the HPI and the overall model is statistically significant. The adjusted R-value is quite similar which is 0.900375 and is considered more reliable due to similarity. The beta coefficient 1 is equal to 0.00 which highlights that if a 1% increase in GDP. There will be no effect housing price index in Turkey. The beta coefficient 2 is INF 1.201 which indicates that a 1% increase in inflation causes a 12% increase in the housing price index in Turkey. The beta coefficient 3 is equal to -0.09 that highlights a 1% increase in the exchange rate causes a 9% decrease in the housing price index in Turkey. The beta value coefficient 4 is equal to -0.00 which indicates that a 1% increase in gold prices causes no impact on the housing price index in Turkey. The beta value coefficient 5 is 2.08 that highlights the 1% increase in the BORSA Index causes a 208% increase

in the housing price index. The BORSA index is considered is most affected variable on HPI. The beta value coefficient 6 is 1.43 which highlights that the 1 % increase in the UT causes a 143% increase in the housing price index in Turkey. USD/TL is the second highest variable that affects HPI. The beta value coefficient 7 is -0.946 which highlights that a 1% increase in unemployment causes a 94% decrease in the housing price index. The beta value coefficient 8 is -0.4277 which highlights that a 1% increase in the DIR causes a 42% decrease in the housing price index in Turkey. The beta value coefficient 9 is -0.111 which highlights that the 1% increase in the MS causes an 11% decrease in the housing price index in Turkey. The beta value of the coefficient 10 is equal to -0.105 which indicates that a 1% increase in the MR causes a 10% decrease in the housing price index in Turkey. The beta value coefficient 11 is equal to 0.171 which highlights that a 1% increase in foreign trade causes a 17% increase in the housing price index in Turkey.

Table 13 OLS Estimation Result

Variable	Beta Std. Error	T-Stat	Prob.	
Constant	13.70874	1.308251	1.308251	0.1983
GDP	0.001762	0.050960	0.034584	0.9726
INF	1.201925	0.138993	8.647395	0.0000
ER	-0.097875	0.033540	-2.918178	0.0058
GP	-0.000798	0.001996	-0.399578	0.6916
BI	2.083370	3.246762	0.641676	0.5247
UT	1.437398	0.291558	4.930054	0.0000
UE	-0.946710	0.485912	-1.948315	0.0584
DIR	-0.427708	0.133449	-3.205042	0.0027
MS	-0.111992	0.053499	-2.093345	0.0427
MR	-0.105715	0.095596	-1.105853	0.2754
FT	0.171778	0.152070	1.129596	0.2654
R-SQ.	0.921863	Adjusted R-Sq.	0.900375	

Dependent Variable: Housing Price Index.

Source: Author’s compilation

F. Hypothesis Testing

Table 14 Hypotheses Testing H

	Hypothesis	Pvalue	Supported / Not
H2	GDP has a significant effect on the housing prices index in Turkey	0.9726	
H2	Inflation has a significant effect on the housing prices index in Turkey.	0.0000	Supported
H3	The exchange rate has a significant effect on the housing prices index in Turkey.	0.0058	Supported
H4	Gold Prices have a significant effect on the housing prices index in Turkey.	0.6916	Not Supported
H5	The BORSA index has a significant effect on the housing prices index in Turkey.	0.5247	Not Supported
H6	USD/TL has a significant effect on the housing prices index in Turkey.	0.0000	Supported
H7	Unemployment has a significant effect on the housing prices index in Turkey.	0.0584	Supported
H8	The deposit interest rate has a significant effect on the housing prices index in Turkey.	0.0027	Supported
H9	Money Supply has a significant effect on the housing Supported prices index in Turkey.	0.0427	
H10	The monetary rate has a significant effect on the Not Supported housing prices index in Turkey	0.2754	
H11	Foreign trade has a significant effect on the housing Not Supported prices index in Turkey.	0.2654	

The OLS table highlights the significant relationship among the variables if the p-value is below 0.05 and highlights there is a significant relationship if the value is greater than 0.05 it highlights that there is no significant relationship. The p-value of GDP is 0.9726 which is greater than 0.05 at a 5% significance level which means H1 is rejected and there is no significant relationship between GDP and HPI in

Turkey. GDP does not affect the housing price index in Turkey. INF P-value of 0.000 is below 0,05 supports the H2 and highlights that there is a relation between inflation and the HPI and inflation has a significant impact on HPI in Turkey. ER, the p-value is equal to 0.0058 which supports the H3 that highlights that ER has a significant impact on the HPI in turkey. GP has a pvalue of 0.6916 which is greater than the significant value of 0.05 and highlights that H4 is rejected and GP has no significant effect on the HPI. The BI p-value is equal to 0.5247 which is also greater than the significant value and H5 is rejected and BI has no significant effect on the HPI in Turkey. The p-value of UT is 0.0000 which is below the significant value, H6 is accepted which highlights that USD/TL has a significant effect on the housing prices index in Turkey. The p-value of 0.0584 is equal to the significant value that highlights that H7 is accepted and UE has a significant effect on the HPI. The p-value of DIR is 0.0027 and H8 is accepted and highlights that DIR has a significant effect on the HPI. The p-value of MS is equal to 0.0247 which is below the significant level and for that H9 is accepted and highlights that MS has a significant effect on the HPI. The p-value of MR is equal to 0.2754 and rejected the H10 and showing that MR has no significant effect on the HPI (See Table 13).

G. Discussions

Our study is concerned with the implementation of the ARIMA and ANN the interpretation of the tables highlighted the efficiency of the table, and the findings have revealed that the ANN model is more efficient for forecasting. The difference between the RMSE, MAPE, and SMAPE highlighted that the ARIMA model has the lowest value than the ANN models.

ANN model is the most accurate tool for forecasting that highlights the future trends of the housing markets. The three approaches are highly concerned with the estimation process. Starting from table 4 that there is a complete description of the training and the testing. ANN model that is used in our study is the functions of the backpropagation of the algorithm. Which is the special function that is concerned with the reduction of the RMSE value across the training patterns. The value of the RMSE is the indicator of performance and highlighted measurement of performance. This is the most important factor that enables us to differentiate between the two models ARIMA and ANN.

Later on, the working function of the neural network is highlighted as the better version of the network design. All the parameters are highly known and discussed. We have used the symmetric parameter designs. For a better understanding and the accuracy of the model. For experimentation, the housing price index has been going through several layers where the different neurons units in the hidden layer and applied the three different learning rates and considering the lag values of the maximum two parameters (Wang et al., 2019; Lim et al., 2016).

ANN models are can be learned from the experiences after that the input has been given for testing the output. And there is one necessary thing is that the time series data must be stationary.

Table 4 of the research is highlighted the multi-layer perceptron (MLP), that is highlighting the multi-functioning of neural network that is comprised of the three different types of layers in table 4 the group of the output has been generated from the group of input that is the function of the multi-layer perceptron and there are functions of the backpropagation that uses for the training and testing model highlight effective for the forecasting and table 04 highlights that training process 71% are involved in the training and remaining 28% have been tested and successfully generated output similar to study (Lee & Ryu, 2021).

The multi-layer perceptron is working on the signals once the signals are received then it starts processing the data. All these functions are performed in the three layers.

As was previously noted (Kiptaci et al., 2017), an artificial neuron's fundamental operating system entails adding together weighted inputs and producing output by using an activation function. The transfer function is another name for it. All layers of a neural network often use activation functions. There are two categories of activation functions: linear activation functions and non-linear activation functions. Table 7 displays the commonly used activation functions (Ge et al., 2003).

Table 8 is representing the individual approach that highlights that the model is satisfactory and running duly. Where R- squared value is equal to the.914, RMSE is equal to 2.646, MAPE is equal to 82.652, Max MAPE is equal to 806.652, MAE is equal to 1.878, Max MAE is equal to 6.122 and the regularized value is equal to

2.200 results are similar to (Daradi et al., 2018; Li et al., 2018; Ghodsi et al., 2018; Munusamy et al., 2015).

Earlier research (Aminuddin & Maimun, 2022) used a back propagated ANN model to predict the Malaysia house price index. To verify the model's capacity for prediction, they attained a MAPE value of 8%. (Pradhan & Lee, 2010; Wu et al., 2009) gave an overview for predicting two separate house price indices, and back propagated ANN models were used in Taiwan. These two models' respective prediction accuracies were assessed using the data they MAPE values were 1.71 and 2.06, as well as 2.05 and 2.58 for RMSE. Once these values are contrasted with the back propagated ANN model created in this study. It can be shown that the model performs better than the earlier ANN models & forecast the housing price index. Additionally, the outcomes of the three accuracy tests show the predictive effectiveness of the design.

Further the results and the interpretations sections have also presented the graphical representation of the ANN model, Figure 13 shows the neural network functioning in its entirety and demonstrates it step-by-step. The black lines represent weights that are less than zero, while the light hues show weights with values larger than zero. Figure 14 The graphical representation of home prices that contrasts the HPI's expected and actual values. Additionally, it can be seen that their outliers are shifting upward. Figure 15 displays the estimated and observed values. After obtaining the results from the residual and the anticipated values. It can be shown that the application of the ANN model is a reasonable and adequate technique for forecasting (Wu et al., 2009), which shows the residual and the expected value of the housing price index (HPI). Furthermore, the figure made it abundantly evident that there is no solid evidence of an association or connection between the residual values and one another. If they are not connected, this would be regarded as the variable's independence and would support the validity of the ANN model (Ghodsi et al., 2010; Lee et al., 2018).

The other most important model we have used is the ARIMA One of the most often used methods for forecasting is the ARIMA model. The future value of a variable in an ARIMA model is intended to be a linear mixture of past values and previous mistakes (Abidoye et al., 2019). The ARIMA model is essentially a data-oriented strategy that is developed from the data's structure. The ARIMA is,

however, constrained by any sizable nonlinear data set. SVMs were thus incorporated into the proposed hybrid model to handle the nonlinear data pattern. Due to the data differences that are crucial for establishing estimates, the ARIMA model has been used. Identification, estimation, and diagnosis are the three steps of modeling that Box and Jenkins suggest having all been used (Abidoye et al., 2019; Pradhan & Lee, 2010).

The diagnostic technique is shown in table 17, which emphasizes that the model is satisfactory and operating as intended. When the R-squared value is equal to.914, the RMSE is equal to 2.646, the MAPE is equal to 82.652, the Max MAPE is equal to 806.652, the MAE is equal to 1.878, the Max MAE is equal to 6.122, and the normalized value is equal to 2.20. These results are supporting to (Zhao et al., 2019; Shindw & Gawande, 2018).

To forecast the New Zealand house price index (Zhao et al., 2019) developed autoregressive integrated moving average (ARIMA) models utilizing three separate datasets. The MAPE values obtained for these models' validation ranged from 2.09 to 5.77. This study's OLS regression model beats or offers comparable predicted performance values to earlier predictive models of the house price index introduced in various nations when these values are compared with the model.

The figures of the ARIMA model represent the model specification and the motions of the data according to Figure 17 effectively convey the diagnostic screening strategy that emphasizes the values of each ACF and PACF in the residual sequence were steady. The abbreviations ACF and PACF stand for autocorrelation function and partial autocorrelation function, respectively. We can obtain a sense of what models to fit by combining these two plots. A time series' autocorrelations are calculated and plotted using autocorrelation. The correlation between time series observations spaced k time units apart is known as autocorrelation (Deb et al., 2022; Kayakuş et al., 2022).

Figure: 18 illustrates the new patterns in the index of home prices, which have recently increased. The ARIMA forecasting method is quite powerful. The disparities between the series are displayed in this figure, and it has been demonstrated that while the series' means are stationary at the end, the values appear to be large, highlighting the fact that the data is not variance stationary (Kayakuş et al., 2022).

The findings of our developed models ARIMA and ANN highlight that the housing price index is the most significant element and is interconnected with other variables it has been significantly affected by some of the variables and some are not associated with it and also previous studies also support that fact. The literature has been flooded with studies that support the relationship between housing price indices and macroeconomic factors (Abidoye et al., 2019; Deb et al., 2022). Ordinary least square is the method that highlights the association between the variables. The main motive is to analyze the linkage among the variables of the linear regression of the study, to provide an accurate estimate. A rule or criterion that is grounded in reality is required for this estimation process. The Ordinary Least Squares (OLS) method of estimation is the most used (Lee et al., 2022). Minimizing the sum of the squares of residuals across all observations in the data frame is what is meant by the "Least Squares" component. Table 12 OLS table is one of the most important for our discussion is highlights that for variables whose p-value is below 0.05, the null hypothesis is accepted if the value is greater than the significance value then the null hypothesis is rejected. According to (Acolin et al., 2022) a price increase affects economic output. According to our research, there is no connection between the GDP and the house price index. Even though the majority of earlier studies did not support it (Tham et al., 2022), they did show a significant relationship between them. HPI and GDP doesn't have any relationship (San Ong, 2013).

The findings of the study have verified that monetary rate has no impact on the housing price index which opposes previous studies that have been carried out (Aoki, 2004) that highlighted that monetary shocks have a direct impact on house prices via the mortgage rate channel. The results of this study are from an economy that is a relatively extreme case of housing price boom compared to the US, the euro area, Canada, the UK, and most other industrialized countries. The findings of our study have mentioned that inflation and HPI are influencing each other and the supported evidence from (Rehman et al., 2022). Also supported that inflation and the housing prices index are linked (Sutton, 2002). The BORSA Index is having no impact on the housing price the hypothesis is not supported by that. Hence, if there is a certain change that occurs in it has no sort of link with the housing price because the value is greater (Gebeşoğlu, 2019).

(Lean & Smyth, 2014) mentioned in his studies that the Malaysia stock index influences the house price index. The previous study is not matched with our hypothesis results. The deposit interest rate (DIR) has a significant relationship with the housing price index that is highlighted by the findings of the results and Turkey housing markets have also been affected by that investment in the real estate market (Wang & Wen, 2012; Kartal et al., 2021).

(Colak, 2021) found that there is no relationship between the interest rate and the housing price index. (ÇOLAK, 2021) explained that interest rate is less likely to influence purchases of those who have already their own but affected those who don't have their own house. So all in all, it is a crucial factor in the determination of the housing price index. Several studies have mentioned that there was a negative relationship between interest rates and housing prices, for example, see (Hamdar et al., 2022; Abelson et al., 2005; Barbu et al., 2017; Kartal et al., 2021). Most of the studies suggested that a decrease in interest rate might lead to a cheaper mortgage or cheaper housing loans. This leads to higher demand for housing and drives up housing prices.

Exchange rate fluctuation has a significant impact on the housing price index. As the value is below 0.05 that highlights the null hypothesis is accepted. Our findings of results are similar to other past studies that have been carried out by various scholars and some of the studies do not have similarities with us. According to (Sumer & ÖZorhon, 2020) there is a positive relationship between the exchange rate and the housing price index. (Kim & Park, 2005) highlighted that there is also a positive relationship between the HPI and the exchange rate.

The findings of our study highlighted that inflation has an impact on the housing price index and according to (Parrikar, 2019) there is also a positive relationship between inflation and the housing price index. The money supply is associated with the housing price index this is verified by our studies. (Yang et al., 2022) suggests that money supply has a positive relationship with each other. The most secure and safest investments for people are gold prices, a key economic indicator. Additionally, the price of gold is typically rising and occasionally falling, but generally speaking, it is rising. Our research has demonstrated that there is no correlation between gold prices and the index of home prices and that this has no bearing on consumer affordability (Bhunia, 2013; Chaudhry et al., 2013).

V. CONCLUSION

A. Conclusions

Housing markets are the most important assets of the economies that are the booster for economic growth. Nowadays these markets are considered safe haven investment markets. For individuals, it is not just the source of shelter but also the source of earning. That highlights that house prices have a great influence on the economy. The dynamism in the markets or economic conditions leads to the brought financial stability in the market. This is a highly emerging business in Turkey as well. The research aims to determine the impacts of the different macroeconomic variables on the housing price index of the Turkish markets because Turkey's economy is a rapidly growing and highly developing economy across the world. The demand for houses is very high in the Turkish economy. Real estate development and price fluctuations not only influence the particular sector but also enhance the stability of the economic conditions. It has been considered as the like the development of other sectors Turkish real estate market is also contributing to economic growth at a double rate and there is a highly demanded market of the residential sectors (Kirikkaleli et al., 2021; Sumer & Ozorhon, 2021).

After the housing bubble burst the market is considering taking more attention. That financial crisis brought a change in economic activities and influence the lives of individuals that are the reason certain factors are highly crucial factors for determining the affordability of prices. In our studies, we have selected the different macroeconomic variable that was determined to be the most important ones. As for that concern, investors are highly focused on the estimation and forecasting of the housing price index which is the reason for our study. we have selected the two most important forecasting techniques that are highly beneficial for investors and other individuals who are interested in investing in the real estate sector (Kartal et al., 2021; Yilmaz, 2020).

As the study has predominantly proved the effectiveness of the models and the impacts of the variables. The investigation has been carried out to highlight the individuality of each variable. Certainly, demand and the supply of housing prices are impacted real economic activities. All in all, we have determined that these factors have the potential to paralyze overall economic activities. Our finding of the results for the ANN model highlights that ANN Model is more accurate for making estimations and highlighted the future trends in the housing price index (Han et al., 2018; Lim et al., 2016).

As real estate investment is highly prioritized by every individual and every firm because the rate of return from investments in residential property is one of the demanding and most trending business activities. In the recent year, it has been noticed that middle-class families who are not able to afford the highest rate property purchase save a portion of their income and intended to invest these savings in residential property, not for the need of a house for the shelter but for selling this property at the higher rate in future. But certain factors highly affected the affordability of the individual but in past studies, there has been no evidence found that reflects the role of such factors (Abidoye et al., 2019; Mangaleswaran & Vigneshwari, 2019).

This research contributed to the highlights of the impact of the gross domestic product, inflation, BORSA index, unemployment, exchange rate, money supply, monetary rate, foreign trade, and others on the housing price index. For the accomplishment of our study, we have selected the ARIMA and ANN modeling techniques. An ARIMA model was used to analyze the linear part of the problem and then the residuals from the ARIMA model were modeled by using a neural network model. The results from the hybrid model indicated that the modeling approach gave more reliable predictions of the housing prices index. Both models measure the old-time series approach. And the results that over time fluctuations have been observed and the difference in the residual housing price index and the actual prices (Altan & Karasu, 2019).

Currently, Turkey's economy has been going through many challenges that have several impacts on real estate and other sectors. According to the reports CBRT 2022, the current inflation rate is the highest in Turkey. The current dynamics have created a bundle of challenges and uncertainties for real estate investors one of the

biggest challenges to forecasting the prices of houses. And other most important things are to create revenue generation in such an uncertain environment. The most important motive of the research is to explore the impacts of the macroeconomic factors on the housing price index in turkey and how the Turkish real estate market is responding to such factors. For that purpose, data has been taken from the period of 2010 to 2022 (GAUTAM & KANOUJIYA, 2022; Lim et al., 2016).

For accurate forecasting, there is the implementation of the accurate model one of the specific and more accurate models that are used to handle the non-linear data ANN model. ANN Model is working with the functions of the layer that are functioning with the neural networks. Where the input that is given to the model is gross domestic product (Kitapci et al., 2017), inflation (Lim et al., 2016), an exchange rate (Zahedi & Rounaghi, 2015), unemployment (Li et al., 2018), deposit interest rate (Ho et al., 2012), money supply (Coen et al., 2018), monetary rate (Darity et al., 2018), and foreign trade (Imm et al., 2007).

The finding of the study highlights that our first independent variable that is GDP which is considered the major economic indicator findings proved that there is no impact of GDP on the housing price index in turkey. As the increment in the GDP or decrement the HPI has no influence. Turkish economy is highly dynamic and there has been dynamism in the level of imports and exports. Their production level does not have any influence on the affordability of the consumers. The other most important findings of the study have determined that inflation and the HPI are linked with each other, which shows that inflation causes changes in the affordability of the consumers (Kitapci et al., 2017). Inflation affects the consumption of individuals and also when inflation is high it reduced purchasing power. The prices have been changed according to that. The Turkish inflation rate has fluctuated recently it has been at its peak and that influence the performance and the growth of the real estate sector (Daradi et al., 2018).

Exchange rate fluctuation has a significant impact on the housing price index. It reflects that foreign investment opportunities are also influenced and most importantly if there are certain changes in the exchange rate. There must be fluctuation in the prices of the property that these economic variables are closely linked with each other. Currently, Turkey has decrement in the exchange rate that attracts foreign investors and also creates opportunities for the growth of the Turkish

real estate market (Ge et al., 2003; Li et al., 2018).

Exchange rates have also influenced the construction cost of business and also another cost of capital has been influenced by them. In this research, the effects of the USD/TL exchange rate on returns were investigated. And our results interpreted that USD/TL has a significant connection with the housing price index. As the dollar rate decrease in the Turkish currency, more foreign investor will like to invest they get the benefits of the low prices as this is one of the crucial factors for the investors that help them taking investment decisions (Sarangi et al., 2022).

Gold prices are a major economic indicator and the safest and most secure investments for individuals. And mostly gold prices are always increasing and sometimes they depreciate otherwise they are appreciated most of the time. Our study has verified that gold prices are not connected with the housing price index it does not have any influence on the affordability of the consumers (Wu et al., 2018). The BORSA Index is having no impact on the housing price the hypothesis is not supported by that. Hence if there is a certain change that occurs in. It has no sort of link with the housing price. The real estate market is the most dynamic market and most of the real estate investment trusts are considered highly investing firms. And real estate investment trusts are highly listed on the BORSA stock exchange (Ozdemir & Tokmakcioglu, 2022).

There is no previous research that highlights the effects of the unemployment rate on the real estate sector. Our studies focus on the relationship between the housing price index and unemployment which is also the major key factor. As our results interpreted that there is a link between them. they are significantly associated with each other. If the individuals that have earning sources can't afford their personal and basic expenses to meet and then how they afford the rate of the prices of the houses? In Turkey, it is also the key factor that affected the purchasing power of individuals (Kitapci et al., 2016; Lim et al., 2017).

Currently, the rate of unemployment in Turkey is the highest of all time taking from the period of 2010 to 2022 it has been continuously increasing, and the above ratio is 59% of people having no job. Since this will need the current and accurate methods of forecasting for the investors to invest in the market. The unemployment rate increase will definitely decrease the demand for the real estate markets. It is also obvious that if individuals have their earning they can not only

contribute to economic growth but also increases the rate of investments in the real estate markets. This unemployment rate decides the current trends in prices. And prices are fixed according to the current status of the unemployment rate in the economy (Zainun, 2011).

The deposit interest rate (DIR) has a significance relationship with the housing price index that is highlighted by the findings of the results and turkey housing markets have also been affected by that investment in the real estate market. Recently due to high inflation and other economic problems, there has been a change in the interest policies that have been changed to lower the rate of interest rate. When the banks offered a higher rate of interest in depositing the money in the banks that will enable the customers to deposit their money in the bank rather than making investments in the real estate market are other investments. It can be predicted that there has been an indirect positive relationship between them. There have been certain factors that cause the increment in the interest rate and enable the investors to set the prices according to that. As it is also one of the most important economic factors that will enable the stakeholders of the real estate sector that have to formalize their strategies according to that. Turkey is a developing country there has always been a fluctuation in the policies and rates of interest (Khalafallah, 2008; Dougherty & Van Order, 1982).

Like other macroeconomic indicators monetary rates have a very important role in economic development, our study suggests that there is no interconnectedness between the monetary supply and the housing price index. It clearly identified that there is no effect on the price simply highlights that there if there has been any modification in the policies and the other strategies the price remained constant (Abidoye et al., 2019). Another important thing that our study assures us is that there is an interconnectivity between the money supply and the housing price (Ćetković et al., 2018). The empirical results verified that when the money supply in the economy has been changed there must be price fluctuations occur. And last our studies also highlighted the role of foreign trade on the housing price index (Imm et al., 2007). There has been no inter-relatedness between the housing price index and foreign trade. The findings suggest that in Turkey the effects of monetary policy and the money supply shocks on the housing market are important. The evidence of our study highlights the relationship between money supply and house prices in Turkey

is consistent with the above discussion and conventional wisdom. A theoretical explanation for this finding is that an increase in money supply is expected to reduce all interest rates, including the mortgage rate. These results are supported by the impulse response and variance decomposition analyses (Coen et al., 2018).

Summing up, it has been considered that the real estate sector of Turkey is growing and developing and its growth and proper functioning are highly influenced by certain factors majorly the macroeconomic variables. And its forecasting is trending in the current economic conditions. Accurate tools and techniques are required and these variables are contributing to enhancing the financial stability is Turkish markets. After that in our study, we clearly demonstrated the accuracy of the models in our study.

B. Recommendations

Our study is highly beneficial for investors in the real estate sector. This study highly providing a better understanding of the trends in the real estate markets of Turkey. It is purely carried in the real estate sector of Turkey for the demonstration of the housing price. It has been suggested to future researchers they must take the other developing economies for the research to enrich the literature and provide a better understanding of the other economies. There has been no clear and updated data available about forecasting the housing price index of the NORDIC economies. The data we have taken from 2010 to 2022 is quarterly for analysis it is a recommendation to future researchers must take data sets annually, monthly, or weekly.

Another important thing is that the study has been taken into account to highlight the role of the macroeconomic variables. We have used certain variables in our research and highlighted their impact on the housing price index we have taken the housing price index as the dependent variables and GDP, INF, GP, ER, UE, UT, DIR, FT, MS, and MR as the independent variables. Another suggestion for future work is to test these variables with other techniques such as ARDL and NARDL to see the long-run and short-run effects on HPI in Turkey. Other than making variations and selecting another industry rather than real estate focusing on the education sector or oil and gas sector for future work and enriching the literature.

We have applied the best forecasting techniques and models but this study is only limited to forecasting the housing price index taking another dependent variable together highlight the impact and present other new findings.

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APPENDIX

Data Sheet I

Y	Q	HPI	GDP	INF	ER	GP	BI	UT	UE	DIR	MS	MR	FT
2010	Q1	1.87	-3.63	3.83	2.73	1083.0 0	-0.95	1.49	14.20	15.27	15.23	30.90	48.76
2010	Q2	1.30	22.64	1.04	4.01	1180.0 0	0.04	1.48	11.17	16.27	16.23	31.90	48.76
2010	Q3	0.64	5.61	-0.30	-2.85	1181.0 0	0.09	1.50	11.10	17.27	17.23	32.90	48.76
2010	Q4	2.56	-2.43	2.71	-6.93	1357.0 0	0.10	1.42	11.20	18.27	18.23	33.90	48.76
2011	Q1	1.87	-0.93	0.85	15.50	1333.0 0	-0.04	1.61	11.40	14.11	24.82	34.53	47.85
2011	Q2	1.63	19.76	2.53	-1.51	1556.0 0	0.07	1.52	9.50	14.11	25.82	35.53	47.85
2011	Q3	1.61	7.66	0.16	21.47	1628.3 0	-0.02	1.67	9.03	14.11	26.82	36.53	47.85
2011	Q4	1.19	-5.28	5.44	12.21	1724.2 0	-0.06	1.74	9.33	14.11	27.82	37.53	47.85
2012	Q1	3.52	-8.62	2.04	-4.46	1709.9 0	0.12	1.79	10.17	17.19	12.66	41.60	50.55
2012	Q2	3.21	20.22	1.54	0.84	1684.6 0	-0.04	1.76	8.40	17.19	12.66	42.60	50.55
2012	Q3	1.46	8.14	-0.19	-0.24	1717.5 0	0.03	1.80	8.77	17.19	12.66	43.60	50.55
2012	Q4	1.62	0.14	3.24	-1.08	1660.6 0	0.09	1.80	9.53	17.19	12.66	44.60	50.55
2013	Q1	3.55	-5.45	2.46	-0.80	1472.2 0	0.01	1.77	10.40	15.30	18.55	46.10	46.79
2013	Q2	3.77	16.50	1.32	6.19	1312.4 0	0.00	1.79	8.97	15.30	18.55	46.16	46.79
2013	Q3	2.31	5.43	1.06	14.14	1323.6 0	-0.04	1.92	9.67	16.30	18.55	47.16	46.79
2013	Q4	2.58	-1.67	2.45	5.98	1250.6 0	0.04	1.99	9.87	17.30	18.55	48.16	46.79
2014	Q1	3.30	-0.63	2.97	18.80	1240.1 0	-0.09	2.26	9.88	16.94	15.20	48.73	46.69
2014	Q2	3.81	11.73	2.62	-9.41	1295.6 0	0.06	2.12	9.79	16.94	15.20	49.73	46.69
2014	Q3	3.96	3.16	0.90	4.72	1281.3 0	0.05	2.13	9.88	16.94	15.20	50.73	46.69
2014	Q4	3.10	-2.15	2.00	9.22	1285.8 0	0.08	2.20	9.89	16.94	15.20	51.73	46.69
2015	Q1	4.79	0.33	1.75	17.40	1171.1 0	0.04	2.44	10.24	14.92	10.42	56.72	53.30
2015	Q2	4.31	11.63	2.88	16.97	1175.2 0	0.04	2.66	10.56	14.92	10.42	57.72	53.30
2015	Q3	2.25	7.75	0.50	13.23	1278.5 0	-0.03	2.79	10.82	14.92	10.42	58.72	53.30
2015	Q4	3.43	1.80	2.82	4.48	1182.4 0	0.07	2.93	10.77	14.92	10.42	59.72	53.30
2016	Q1	3.55	10.22	2.16	2.57	1171.5 0	0.02	2.95	10.27	14.61	21.15	59.64	52.83
2016	Q2	3.43	11.94	1.30	-3.44	1131.6 0	0.02	2.79	10.82	14.61	22.15	60.64	52.83
2016	Q3	2.54	-0.81	1.54	4.65	1141.5 0	-0.02	2.99	10.86	14.61	23.15	61.64	52.83
2016	Q4	2.16	1.73	2.37	21.46	1060.3 0	0.03	3.11	10.84	14.61	24.15	62.64	52.83
2017	Q1	3.27	-0.71	4.67	25.22	1116.4 0	0.10	3.78	10.96	15.29	11.18	62.60	52.53
2017	Q2	2.45	13.30	2.48	-6.10	1289.2 0	0.06	3.55	10.72	16.29	11.18	63.60	52.53
2017	Q3	1.10	3.79	0.68	-3.56	1349.0 0	0.07	3.53	10.85	17.29	11.18	64.60	52.53
2017	Q4	1.97	1.93	3.96	15.97	1271.5 0	0.07	3.78	10.82	18.29	11.18	62.60	52.53
2018	Q1	2.22	2.85	2.82	0.84	1252.6 0	0.04	3.78	10.96	19.29	16.51	65.28	53.77
2018	Q2	3.22	9.86	4.81	29.16	1266.1 0	-0.09	4.05	10.85	23.28	16.51	65.28	53.77
2018	Q3	-1.19	-0.70	6.61	55.66	1266.6 0	0.00	4.88	10.87	24.28	16.51	65.28	53.77
2018	Q4	0.19	-9.96	6.50	-2.37	1281.5 0	-0.10	5.48	10.89	24.28	16.51	65.28	53.77
2019	Q1	0.93	-7.60	0.75	-5.68	1273.2 0	0.14	5.23	10.28	24.28	17.65	65.94	51.09
2019	Q2	1.83	12.10	3.10	19.14	1282.8 0	0.02	5.95	10.35	25.41	17.65	66.94	51.09
2019	Q3	3.78	-0.48	2.61	-6.82	1426.1 0	0.06	5.56	10.64	25.41	17.65	64.94	51.09
2019	Q4	3.13	-2.76	3.48	3.99	1511.4 0	-0.06	5.70	10.58	25.41	17.65	64.94	51.09
2020	Q1	5.56	-6.39	2.41	10.67	1582.9 0	0.04	5.97	10.47	25.41	16.35	63.17	48.33
2020	Q2	11.24	-2.53	2.66	24.91	1684.2 0	0.13	6.95	10.87	13.36	17.35	63.17	48.33
2020	Q3	5.16	23.12	2.71	10.36	1967.6 0	-0.03	6.97	10.47	14.36	18.35	63.17	48.33
2020	Q4	5.59	1.77	5.10	18.14	1877.4 0	-0.03	8.30	11.79	15.36	19.35	63.83	48.33
2021	Q1	6.84	5.62	4.29	-12.32	1847.3 0	0.00	7.31	11.90	16.36	18.38	64.83	55.76
2021	Q2	8.94	16.56	3.99	26.90	1767.3 0	0.00	8.18	13.67	17.36	19.38	65.83	56.76
2021	Q3	10.32	9.38	4.62	3.78	1812.6 0	0.03	8.45	12.12	20.70	20.38	67.83	57.76
2021	Q4	24.38	2.41	10.91	61.75	1783.0 0	-0.04	9.53	11.12	21.70	21.38	70.92	58.76
2022	Q1	40.54	15.07	28.29	49.57	1795.0 0	0.08	13.4 8	9.20	22.70	27.02	70.28	62.55
2022	Q2	35.17	17.89	16.94	26.66	1909.3 0	0.09	14.7 8	9.80	23.70	28.02	72.67	62.61
2022	Q3	22.38	18.22	8.85	27.07	1712.8 0	0.08	17.9 4	10.10	24.70	29.02	73.25	61.14
2022	Q4	22.89	18.24	6.15	7.31	1635.9 0	0.25	18.5 7	10.11	25.70	34.24	74.70	71.21

Data Sheet II

Y	Q	ARIMA	ANN
2010	Q1	#NULL!	1.918325378166250
2010	Q2	#NULL!	1.313446317837230
2010	Q3	#NULL!	1.086964778211500
2010	Q4	0.412032752249797	1.708125107715240
2011	Q1	3.043737112913370	1.189572764449930
2011	Q2	0.550495858758121	1.534729102432910
2011	Q3	2.286045744057760	1.140821447000340
2011	Q4	2.088047340797830	2.379555308122540
2012	Q1	1.120393695159260	2.396381679182540
2012	Q2	3.579687094031490	2.302929837945450
2012	Q3	1.360146970314540	1.993139474476630
2012	Q4	1.749103610460990	2.773257298637150
2013	Q1	2.889533553594490	1.679527822971370
2013	Q2	3.496792375551270	1.460488811772010
2013	Q3	2.805278515034440	1.494703898952340
2013	Q4	2.576946915626020	1.836677859985160
2014	Q1	4.552464167736620	2.062225006718410
2014	Q2	2.483808133050700	1.956008433368520
2014	Q3	2.090282719214580	1.644444631906650
2014	Q4	3.747997920583790	1.922007058141820
2015	Q1	4.716964692462700	3.829738159863570
2015	Q2	7.117367564686670	4.233351820988410
2015	Q3	2.668821509768390	3.757485756054890
2015	Q4	1.340543707214600	4.410569540459260
2016	Q1	4.515924908467650	4.126767095073280
2016	Q2	2.830371895694690	3.886391385026120
2016	Q3	4.388754958164790	4.061282779934960
2016	Q4	3.037548160045670	4.348384468887470
2017	Q1	4.619736140333560	5.154629745500930
2017	Q2	3.410917995803470	4.524036303516430
2017	Q3	-0.285350453865264	4.117697428506370
2017	Q4	1.659404500488040	4.968028615445500
2018	Q1	3.666880364912840	5.098424980649280
2018	Q2	3.513842054441100	5.745835262813980
2018	Q3	6.448434885311810	6.596187506587080
2018	Q4	-0.367191507296708	6.830839508121830
2019	Q1	0.240115145778885	4.529443367107340
2019	Q2	-0.414205723990306	5.473936117769640
2019	Q3	1.271109187169880	5.108556800260960
2019	Q4	3.316870129417360	5.399681192978130
2020	Q1	3.047730176709480	4.452138821434180
2020	Q2	9.032824652028520	4.949479222702880
2020	Q3	10.229286478239800	4.970755146608210
2020	Q4	3.721051561772690	6.215561108833230
2021	Q1	6.242426825477740	7.543638191769710
2021	Q2	12.086805233368100	8.110328199037460
2021	Q3	11.470517390093100	8.681193687863180
2021	Q4	20.338839729254800	10.537843938277500
2022	Q1	39.669974918842900	12.036173330010600
2022	Q2	35.212286369626900	12.489518559902400
2022	Q3	23.037197311252800	12.541139864002600
2022	Q4	22.488939649364200	13.716109902232900

RESUME

Name Surname: Mahdi AbuAnzeh

Education:

Master of Business Administration Istanbul Aydin University Istanbul – Turkey- GPA:

3.45/4.

Bachelor Degree in Surveying and Geomatics Engineering AL Balqa Applied University Jordon- GPA: 2.9/4.

High school King Saud Educational Complex Riyadh - Saudi Arabia GPA: 99.5/100.

Work Experience:

Real Estates Investment Consultant Investo Global – Istanbul Feb 2021 – Apr 2022

Branding and Social Media Specialist Seven Creatives Agency – Amman Feb 2020 – Now

Project Engineer / Finishing and Interior Work Urbacon Trading and Contracting (UCC) – Qatar April 2015 – May 2018 **Projects:**

Hotel and Complex of Al Najada Souq – Doha Down Town (411 million USD).

Panorama Residential Tower – The Pearl (219 million USD).

The Traffic Control Center - Ministry of Interior (274 million USD).

Geomatics Engineer and GIS Certified Trainer Infograph / ESRI official distributor - Amman June 2013 – January 2015

Trainee at Department of Lands and Survey Amman - Jordan August 2012 – February 2013

Cashier and Amusement Attendant Shenck’s Amusement Pennsylvania - United States 2011.

Languages:

-Arabic: Native Language

-English: Advanced -Turkish: Intermediate

Skills:

-Communication, Team management, Solution oriented, Flexibility, Creativity, leadership skills, systematic thinking

- Computer skills (Microsoft Office) and others