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COVID-19 Pandemic Effect on House Price Index in Turkey: An Interrupted Time Series Analysis

Türkiye'de COVID-19 Pandemisinin Ev Fiyatları Endeksi Üzerine Etkisi: Kesintili Zaman Serileri Analizi

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Abstract

The COVID-19 pandemic has had a significant impact on various aspects of everyday life, and the housing market is one of these factors. The purpose of this study is to investigate the effects of the COVID-19 pandemic on the housing market. In this context, the study analyzed the House price index (HPI) data for Turkey between 2018-2022 using the interrupted time series analysis (ITS) method to examine the effects of COVID-19 on the housing market. According to the analysis, there has been a decrease in the HPI immediately after COVID-19 and this decrease is statistically significant (-105.726 and p=0.003). However, it has been found that the trend of this decrease has changed and also, it has been determined that the housing price index has increased by 14.521 points every month and year(p=0.001). As a result, this study, which shows statistically significant effects, has revealed that COVID-19 pandemic has caused significant changes in housing prices throughout Turkey.

Keywords: Time series analysis, COVID-19, Housing market.

Öz

COVID-19 salgını günlük yaşamın çeşitli yönleri üzerinde önemli bir etkiye sahip olmuştur ve konut piyasası da bu faktörlerden biridir. Bu çalışmanın amacı, COVID-19 salgınının konut piyasası üzerindeki etkilerini araştırmaktır. Bu kapsamda çalışmada, COVID-19'un konut piyasası üzerindeki etkilerini incelemek için Türkiye'nin 2018-2022 yılları arasındaki konut fiyat endeksi (KFE) verileri kesintili zaman serisi analizi (ITS) yöntemi kullanılarak analiz edilmiştir. COVID-19'un hemen ardından konut fiyat endeksinde bir düşüş yaşanmıştır ve bu düşüş istatistiksel olarak anlamlıdır (-105,726 ve p=0,003). Ancak bu düşüşün trendinin değiştiği ve konut fiyat endeksinin her ay ve yıl 14.521 puan arttığı tespit edilmiştir (p=0.001). Sonuç olarak, istatistiksel olarak anlamlı etkiler gösteren bu çalışma, COVID-19 salgınının Türkiye genelinde konut fiyatlarında önemli değişikliklere neden olduğunu ortaya koymuştur.

Anahtar Kelimeler: Zaman serisi analizi, COVID-19, Konut piyasası.

Introduction

Housing is one of the most important needs for people. Since ancient times, people have been trying to build places for themselves and their families to establish a settled lifestyle. One of the factors that can enable people to live safely, healthily, and comfortably is being a homeowner and having their housing needs met. Additionally, nowadays, many people also become homeowners for investment purposes. Homeowners contribute to their family budget by buying a house. Recently, buying a house has become an investment tool that promises a lot of return in terms of economy. The economic structure of the country also affects the home buying power and housing markets of the population. The housing market is a concept that is significantly related to the economic, social and political structure of the country (Aliefendioğlu, 2022:15; Rolfe, 2020:20; Usanmaz, 2021:11).

The housing is an enclosed space. It is used to protect against the effects of environmental factors (rain, cold, wild animals, etc.). Being a homeowner not only provides economic benefits, but also creates a sense of belonging to the area or country where the house is located. Therefore, this sense of belonging also contributes to a person's emotional well-being, fostering a sense of family and community living.

The changes in housing prices impact various markets, ranging from the construction sector to consumer expenditures and financial markets. When evaluated in terms of the role of housing prices in the economy and their effects on economic activities, homeownership is primarily considered a significant component of individuals' asset portfolios. Housing prices have implications for consumers' purchasing power and consumer spending. Additionally, an increase in housing prices stimulates the construction sector. The high demand for housing contributes to the emergence of new housing projects, thereby positively affecting the vitality of the construction sector and, consequently, the national economy. Furthermore, an increase in housing prices leads to a rise in credit demands. However, the escalation in credit demands can pose challenges for financial stability. Rising housing prices can instill confidence in consumers regarding the economy, prompting them to increase their spending. Consumers often feel more optimistic about their financial situation when housing values rise. This sentiment can trigger consumer spending and support economic growth.

High housing prices can contribute to income inequality issues. The increasing cost of housing may make it more difficult for low-income groups to acquire housing, potentially leading to social tensions and perceptions of economic injustice. Moreover, it can exacerbate the gap between low-income and high-income groups. Excessively high housing prices also pose the risk of a financial bubble. If prices rise incongruently with fundamental economic factors, it may indicate the formation of a bubble in the market. The bursting of such a bubble can lead to economic imbalances and crises. In conclusion, housing prices can significantly influence the health and balance of an economy. Therefore, changes in the housing market should be carefully monitored to assess their economic impacts, and if necessary, policy measures should be implemented.

The housing market represents a significant proportion in country economies and is always an important aspect of the economy. The housing market is affected by various factors and it shows different variations depending on the economic conditions of the country. The housing stock is not fixed in every country. The home buying power of individuals living in different countries also varies. As a result, the housing market is affected by significant proportions in global extreme situations or pandemics. COVID-19 is one of such pandemics. Especially in our country, it is thought that there has been a significant increase in housing prices since the outbreak of COVID-19. People have closed themselves in their homes since the outbreak. Especially, there is a rapid increase in the prices of summer houses due to the outbreak (Aliefendioğlu, 2022:15; Rolfe, 2020:20; Usanmaz, 2021:11).

The aim of this study is to investigate whether the COVID-19 pandemic has an impact on housing prices in our country. In this investigation, the interrupted time series method, which is an advanced statistical analysis method, was used.

In this study, the interrupted time series analysis, which is one of the advanced statistical analysis methods, was used. A time series is generally a sequence of observations that are repeatedly measured at equal intervals. There are many time series models in the literature. Among these methods, the interrupted time series is a statistical analysis method that has limited use in our country. This method analyzes whether there is a change after a particular intervention, for a situation observed over a certain period of time. Therefore, in this method, the change of a situation over time is evaluated by analyzing a certain period before and after a relevant intervention. The difference in trends between before and after the intervention is analyzed using models where there is no difference in trends. In the analysis, the values of the outcome variable are required for before and after the intervention. Basically, the hypothesis is whether the observations in the pre-intervention and post-intervention periods have different levels or slopes. The distribution of data points before and after the intervention/interference, the presence of confounding factors such as variability in the data, seasonality, and no limitations on the data points. Interrupted time series is one of the strongest quasi- experimental designs. This analysis method is utilized in various sectors. For instance, in marketing research studies, it can be used to evaluate the effects of market design on purchases. In the field of economics, it can be applied to assess changes after the implementation of control measures in areas such as credit. Similarly, in political decision-making, such as evaluating the impact of laws on human behavior, this analysis can be beneficial. In the healthcare sector, changes before and after the implementation of a medical intervention on patients can be assessed using the interrupted time series analysis method (Bernal, 2017:46; Cook *et 7al.*, 2002; Pinto *et al.*, 2022:7; Wagner *et al.*, 2022:27; Wang et al., 2022:67).

In interrupted time series, three variables T, X_t ve Y_t are used. T is the elapsed time from the start of the study (year, month, etc.), X_t is a dummy variable coded as 0 before the intervention and 1 after the intervention, Y_t represents the value of the outcome variable at time t. The model is expressed by the followinf function.

$Y_t=\beta_0 + \beta_1 T + \beta_2 X_t + \beta_3 T X_t$

β_0 represents the starting level at T=0, β_1 represents the change in the outcome variable as time increases (before the intervention), β_2 represents the level change after the intervention, and β_3 represents the slope of the change after the intervention (using the interaction between time and intervention). The dependent variable for the study is the house price index (HPI), T represents the time January 2018-2022. X_t is a variable that represents the treatment effect, whether or not there is COVID-19 (Bernal et al., 2017:46; Cook et al., 2002; Pinto et al., 2022:7; Wagner et al., 2022:27; Wang et al., 2022:67).

Literature Review

In their study conducted in 2020, Aliefendioğlu et al. examined the impact of COVID-19 on the HPI in Turkey and Kazakhstan using the nonlinear autoregressive distributed lag model. As a result of the analysis, it has been determined that there are relationships and long run and short run effects between COVID-19 and the HPI. Similarly, we also found that COVID-19 has a statistically significant impact on HPI in our study. For further studies, the COVID-19 impact can be evaluated separately for each country. It can be investigated whether the effects of COVID-19 on HPI in countries change or not. Because the effects of the pandemic on each country are different. The limitation of our study is that the effects of different factors could have been analyzed by including them in the model. To the best of our knowledge, this is the first study that applies an interrupted time series model to HPI data to investigate the impact of COVID-19. The results of the COVID-19 pandemic on the housing market have been studied using different techniques in the literature. For example, Li and Zhang in their study conducted in 2021, attempted to answer the research question "Did the COVID-19 pandemic affect housing prices equally across the US?" in their research. To achieve this, the authors calculated the global Moran's I, Anselin's local Moran's I, and Getis-Ord's G_i^* statistics in order to discover spatial models and heterogeneous structures of housing price change rates across different regions in the US. The methods found that COVID-19 caused different impacts on housing prices across the US. Additionally, the models revealed that housing prices showed differences from urban to rural areas, and also among urban areas. As seen in this study, it is also seen in our study that COVID-19 caused changes in the overall housing market in Turkey. Similarly, as suggested in Li and Zhang's study, the housing market changes in different areas and regions in Turkey can also be evaluated (Aliefendioğlu et al., 2022:15; Li & Zhang, 2021:13).

In a study by Chong and Liu in 2020, a two-way fixed effect model was used to investigate the relationship between COVID-19 related deaths and housing prices. The study found that there was a "U-shaped" relationship between the monthly death rate due to COVID-19 and the change in housing prices in Chinese cities. Similarly, Ahsan and Sadak conducted a study in 2021 investigating the impact of COVID-19 on the housing market, urban concentration and government policies in Turkey. As seen in these studies, it is possible to consider the relationship of COVID-19 with the housing market in terms of different variables such as social policies. In a study in 2020, De Toro et al. examined the trend in the housing market in the Napoli region of Italy. In this study, surveys were conducted with both the public and real estate agents operating in the region to identify the impact of COVID-19 on the housing market. As a result, it was observed that the new requirements that emerged as a result of the COVID-19 pandemic created structural changes in the demand for housing in the region. As seen in this study, our study can also be enriched by choosing different data sources and data collection methods for a specific region (Ahsan & Sadak, 2021:10; Chong & Liu, 2020, De Toro et al. ,2021:5).

In a study conducted in the United Kingdom in 2009, the England housing index series or differentiated return series was modeled using various common time series data generating processes. It was evaluated in terms of producing independent and identically distributed residuals. This was achieved by using a mean process supported by an Exponential GARCH in mean conditional variance, utilizing a random walk process with drift.

In their study conducted in 2002, Barot and Yang forecasted quarterly dynamic housing demand and investment supply models for Sweden and the United Kingdom for the period of 1970-1998 using an Error Correction Method (ECM). To facilitate the comparison of results between Sweden and the UK, they modeled both countries identically. Granger causality tests indicate that income Granger causes house prices in Sweden, while in the UK, there is feedback from house prices to income. While housing prices Granger cause financial wealth in Sweden, the opposite is observed in the UK. In Sweden, housing prices Granger cause household debt, whereas there is feedback from debt in the UK. They concluded that interest rates Granger cause house prices for both the UK and Sweden (Barot & Yang, 2022).

Brown and his colleagues employ the Time-Varying Coefficient (TVC) methodology to predict house prices in the United Kingdom. The forecast results of the TVC regression for UK housing prices are compared with the results obtained from three alternative fixed parameter regressions. The comparison of forecast performance indicates that the TVC regression outperforms Error Correction Mechanism (ECM), Vector Autoregressive (VAR), and Autoregressive Time Series regressions (Brown et al., 1997).

In 2020, Yılmaz and Kestel created two univariate time series models using general linear models and vector autoregressive models to predict house prices in Turkey. Despite the presence of seasonality in the House Index, it was neglected, and initially, ARMA models were used, followed by ARIMA models considering the seasonality effects. They determined that the results of ARIMA and Holter Winter models produced more accurate outcomes compared to classical time series models. (Yılmaz& Kestel, 2020)

In their 2019 study, Fredrik Hansson and Jako Rostami evaluated different forecasting methods for predicting house prices. They assessed monthly house prices in a wide area of Stockholm between 2005 and 2019. Initially, Long-Short Term Memory and Support Vector Machines were compared. Subsequently, comparisons were made with the results of the classical seasonal ARIMA model. As a result, although not performing as well as the ARIMA model in predictions, the Long-Short Term Memory method was found to be more successful compared to Support Vector Machines (Rostami & Hansson, 2019).We used different model for the analysis.

Data

The data used in the study has open access. The data were taken from the section created in the data section of The Organization for Economic Co-operation and Development (OECD) website. Ethics committee approval was not obtained because the data were public and there was no human or animal-oriented intervention. Relevant data were obtained for Turkey (Main Economic Indicators, 2023).

Since the first case of COVID-19 in our country was seen in March 2020, the months and years after this point were determined as the part where the relevant event was seen. In order to evaluate the effect of the housing market, the house price index value, which is also used internationally by the OECD, was used. House price index is an index calculated monthly to follow the price changes in the housing market and includes the price data of the houses subject to sale to represent the price changes throughout the country. This index value adjusts the quality differences among the houses sold in the current period according to the reference period. House price index value is calculated by international statistical organizations in accordance with the standard. R-4.2.2 program was used for data analysis. Scales, stargazer, dplyr, pander, Wats, its.analysis packages included in the R program were used. The statistical significance level was taken as 0.05 (English, 2023; Li & Zhang, 2021:13).

Results

In the study, HPI values from the OECD site were used according to the months of Turkey. As a result of the analysis, the average value of the HPI value for all years was obtained as 229.60±149.290. In addition, the 1st and 3rd quartile values, which give information about the median value of the index and its median distribution, were also given in the Table 1 (Table 1).

Table 1. Descriptive Statistics of House Price Index.

		Percentiles		
Mean	**Std. Deviation**	25	50 (Median)	75
229,6018	149,29036	137,0000	170,4000	237,0500

The effect of the COVID-19 pandemic was examined for the HPI value obtained in the specified range. When the interrupted time point is taken as March 2020, and the COVID-19 onset time is considered as the interval time, the estimations, standard errors and p values obtained as a result of the interrupted time series analysis of the data are given in Table 2. The time coefficient in Table 2 shows the pre-intervention trend of the HPI. When the coefficient value of this trend was examined, it was observed that it was positive but not statistically significant (p=0.750). For each month that passes, the house price index increases 0.602 points on the index. The Intervention coefficient indicates the decrease in the HPI immediately after the COVID-19. The immediate effect was negative and statistically significant. The Time Since Treatment coefficient indicates that the trend has changed after the intervention. The sustained effect is positive and statistically significant. The coefficient indicates that for each month and year that passes after the intervention, HPI increases of 14.521 points on the index (p<0.001). So it can say that, the intervention was very effect the HPI. As a result of the analysis, the coefficient of determination showing the amount of explanatory power of the model was obtained as R squared 0.82. This coefficient value is also quite high. In addition, the established model was found to be statistically significant (p<0.001) (Table 2, Figure 1).

Table 2. Model Results of Interrupted Time Series for House Price Index.

Coefficients	Estimate	Standard Error	t value	p value
Intercept	130.438	26.854	4.857	<0.001
Time	0.602	1.879	0.320	0.750
Intervention	-105.726	33.939	-3.115	0.003
Time Since Intervention	14.521	2.211	6.567	<0.001

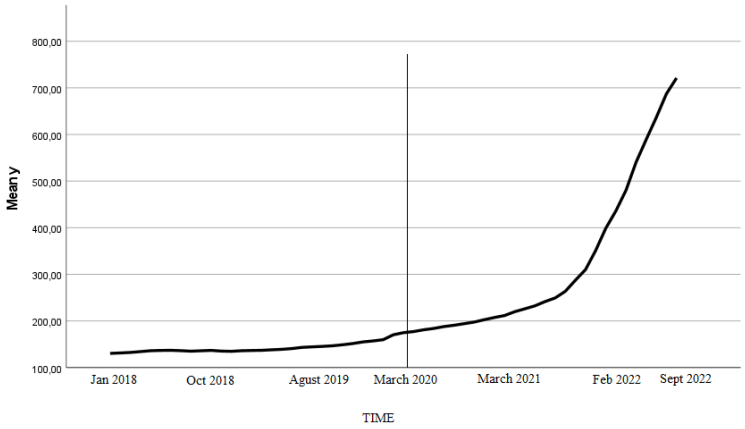

Figure 1. Line graph of house price index.

Discussion

The housing market plays a significant role in the economy. The housing market is affected by various factors such as political, economic, etc. The COVID-19 pandemic, which emerged in the Wuhan district of China in December 2019 and spread globally, is one of those factors. The pandemic is greatly impacting the economic structures of countries. In order to improve predictions in the fields of economics and finance, univariate time series analyses are frequently employed in many instances. However, they are not commonly utilized in forecasting house prices. Specifically, it has been observed that the interrupted time series method, which we employed in the study, is not commonly used in such research.

In this study, the evaluation of HPI values in Turkey between 2018 and 2022 is carried out and the impact of the COVID-19 process is analyzed using the interrupted time series method. The aim of this study is to determine the impact of the COVID-19 pandemic on Turkey's HPI index using the interrupted time series method, a specific type of analysis. When the literature is reviewed, no study using the interrupted time series analysis method for this purpose has been found. This also constitutes an advantage of our study.

The studies discussed in the literature review section, like our study, aim to help understand and explain the relationship between COVID-19 and the housing market in various ways. However, it is apparent that the effects of the COVID-19 pandemic on the housing market remain uncertain, and there does not seem to be a study in the literature that attempts to evaluate the impact of the COVID-19 outbreak on housing markets using our method. Therefore, we believe that our study will fill the gap in the literature by discovering the trend in housing prices in Turkey during the COVID-19 outbreak.

Declaration of Interest: The authors report there are no competing interests to declare.

References

Ahsan, M.M. ,Sadak, C (2021). Exploring housing market and urban densification during COVID-19 in Turkey. *J. Urban Manag*, 10, 218–229.

Aliefendioğlu, Y., Tanrivermis, H., Salami, M. A. (2022). House price index (HPI) and Covid-19 pandemic shocks: evidence from Turkey and Kazakhstan. *International Journal of Housing Markets and Analysis*, 15(1), 108-125.

Barot, B., & Yang, Z. (2002). House prices and housing investment in Sweden and the UK: Econometric analysis for the period 1970–1998. Review of Urban & Regional Development Studies, 14(2), 189-216.

Bernal, J.L., Cummins, S., Gasparrini, A.(2017). Interrupted time series regression for the evaluation of public health interventions: a tutorial. *International Journal of Epidemiology*, 46(1), 348-355.

Brown, J. P., Song, H., & McGillivray, A. (1997). Forecasting UK house prices: A time varying coefficient approach. Economic Modelling, 14(4), 529-548.

Chong, T.T.L., Liu, H. (2020). How Does the COVID-19 Pandemic Affect Housing Prices in China?

Cook, T.D., Campbell, D.T., Shadish, W. (2002). Experimental and quasi-experimental designs for generalized causal inference, Boston,Houghton Mifflin.

De Toro, P.; Nocca, F., Buglione, F.(2021). Real estate market responses to the COVID-19 crisis: Which prospects for the metropolitan area of Naples (Italy)? *Urban Sci*, *5*(23), 348-355.

English, P.(2023). The its. analysis R Package–Modelling Short Time Series Data. R Package (Version 1.6.0).

Interrupted Time Series. (https://ds4ps.org/pe4ps-textbook/docs/p-020-time- series.html , 2023).

Li, X., Zhang, C.(2021). Did The COVID-19 Pandemic Crisis Affect Housing Prices Evenly in the U.S.? *Sustainability*, 13(21),12277.

Main Economic Indicators. https://www.oecd-ilibrary.org/economics/data/prices/national-and-regional-house-price-indices_2dc6f1df-en, 2023).

Pinto, R., Valentim, R., Silva, L.F., Souza, G.F., Santos Lima, T.G.F.M., Oliveria, C.A.P., Santos, M.M., Miranda, A.E., Oliveria, A.C., Kumar, V., Atun, R. (2022). Use of interrupted time series analysis in understanding the course of the congenital syphilis epidemic in Brazil. *The Lancet Regional Health-Americas*, 7, 100163.

Rolfe, S., Garnham, L., Godwin, J., Anderson, I., Seaman, P., Donaldson, C. (2020). Housing as a social determinant of health and wellbeing: Developing an empirically-informed realist theoretical framework. *BMC Public Health*, 20(1), 1-19.

Rostami, J., & Hansson, F. (2019). Time Series Forecasting of House Prices: An evaluation of a Support Vector Machine and a Recurrent Neural Network with LSTM cells.

UK housing market: time series processes with independent and identically distributed residuals .(https://eprints.bournemouth.ac.uk/9484/1/JREFE_article_Feb_08.pdf, 2009).

Usanmaz, D. (2021). Covid-19 Pandemi Sürecinin Türkiye'de Konut Sektörü Üzerine Etkileri." *Nevşehir Hacı Bektaş Veli Üniversitesi SBE Dergisi*, 11(3),1352-1365.

Wagner, A.K., Soumerai, S.B., Zhang, F. , Ross-Degnan, D. (2022). Segmented regression analysis of interrupted time series studies in medication use research." *Journal of Clinical Pharmacy and Therapeutics*, 27(4),299–309.

Wang, SY., Seghieri, C., Vainieri, M. , Groene, O. (2022). Changes in Acute Myocardial Infarction, Stroke, and Heart Failure Hospitalizations During COVID-19 Pandemic in Tuscany-An Interrupted Time Series Study." *Int J Public Health*, 67, 1604319.

UK housing market: time series processes with independent and identically distributed residuals .(https://eprints.bournemouth.ac.uk/9484/1/JREFE_article_Feb_08.pdf, 2009)

Yilmaz, B. (2020). Forecasting house prices in Turkey: GLM, VaR and time series approaches. Journal of Business Economics and Finance, 9(4), 274-291.