



Research article

The effect of COVID-19 pandemic on residential real estate prices: Turkish case¹

Selahattin Kaynak¹, Aykut Ekinci^{2,*} and Havvanur Feyza Kaya^{1,*}

¹ Department of International Business and Commerce, Samsun University, Samsun, Turkey

² Department of Economics and Finance, Samsun University, Samsun, Turkey

* **Correspondence:** Email: aykut.ekinci@samsun.edu.tr; havvanur.kaya@samsun.edu.tr.

Abstract: This study investigates the effect of the COVID-19 pandemic on the residential real estate prices in Turkey. This study indicates the effect of COVID-19, loan package, macroeconomic and behavioral control variables on abnormal returns of residential real estate prices during the event window. This study consists of three econometric steps. Firstly, the abnormal returns of the residential real estate prices are obtained by using an event study. Secondly, the effect of the COVID-19 pandemic on abnormal returns of residential real estate prices was estimated by panel data analysis for regional and city levels. According to the findings of the city level, the COVID-19 pandemic has a negative effect on abnormal returns of residential prices, as expected. However, the regional analysis shows mainly a positive COVID-19 effect.

Keywords: the residential real estate prices; event study; panel data; COVID-19

JEL Codes: C33, I18, G14, R31

1. Introduction

The COVID-19 pandemic started in China at the beginning of January 2020 and spread to all of Europe and the United States (USA) after February. It has become a global pandemic quickly. The COVID-19 pandemic has created a sudden, powerful, external and negative health shock on the global

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economic system, affecting demand and supply together. The growth rates have shrunk at record rates with the effect of the measures taken by countries against the pandemic, such as business closures and curfews. In this context², the second-quarter 2020 decline has recorded as 9%, 11.7%, 19.8%, 9.8%, 10.8% in the US, the euro area (EA-19), United Kingdom, Japan and Turkey, respectively. China was subject to the heavy impact of COVID-19 in the first half of 2020. While it shrunk by 10% in the first quarter, it grew by 11.7% by largely controlling COVID-19 in the second quarter. In the third quarter, many countries started to grow again with the more controlled course of COVID-19. With the relaxation of the bans, the growth is 7.4%, 12.5%, 15.5%, 5.3%, 15.6% for the US, EA-19, United Kingdom, Japan, and 15.6% Turkey, respectively. The sustainability of this growth depends on the course of the COVID-19 pandemic.

In such an environment, the importance of intersectoral relations and the global supply chain is increasing more and more. For example, the construction sector in Turkey is a driving force in the economy due to strong forward and backward links with other sectors. Despite the recent decline depending on the COVID-19 pandemic, the share of the construction sector in Gross Domestic Product (GDP) and employment is steady at around 7% in Turkey. Many studies in the literature examine the strong relationship between the construction industry and economic growth and the relationship between the construction industry and other sectors (Tse and Ganesan, 1997; Lean, 2001; Ruddock and Lopes, 2006; Anaman and Osei-Amponsah, 2007; Wigren and Mats, 2007; Lewis, 2009; Wibowo, 2009; Lopes, 2009; Giang and Pheng, 2011; Wilhelmsson and Wigren, 2011; Ozkan et al., 2012; Lopes, 2012; Erol and Umut, 2015; Yamak et al., 2018). In these studies, a significant part of the input-output analyses was made for the construction sector, especially in developing countries, and it was found that the backward linkage indicators of the sector are much more important and influential than the forward linkage indicators (Wu and Zhang, 2005; Kofoworola and Gheewala, 2008; İlhan and Yaman, 2010; Gul, 2017). However, few studies examine the changes in the construction industry in the face of an unexpected shock (Strobel, 2015; Redl, 2018; Fehrlé, 2019; Contat et al., 2019; Chen et al., 2020). On the other hand, many studies have been carried out on the factors affecting prices in the real estate sector, which constitute an essential part of the construction sector. Most of the studies focus on explaining the determinants of the residential prices using the macroeconomic variables rather than explaining the effect of unexpected shock variable (Glewwe, 1991; Yang, 2001; Ozturk and Fitoz, 2009; Abdulai and Owusu-Ansah, 2011; Yayar and Karaca, 2014; Afşar, et al., 2017; Bahmani-Oskooee and Ghodsi, 2018; Bahmani-Oskooee and Ghodsi, 2019; Liow and Song, 2019; Cloyne et al., 2019, Ling et al., 2020, Apergis, 2020).

On the other hand, many studies indicate that the COVID-19 pandemic brought house price and rent declines in city centres, increasing the price and rent away from the centre. Gupta et al. (2021) explained that housing markets predict that urban rent growth will exceed suburban rent growth for the foreseeable future. Rosenthal et al. (2021) showed that the rent premium associated with employment density declines sharply following the COVID-19 shock for all cities. Hu et al. (2021) highlighted a negative relationship between prior COVID-19 cases and daily housing returns using the daily hedonic housing price index for five Australian capital cities. Liu and Su (2021) tested the impact of the COVID-19 pandemic on the location demand for housing. The findings of their study show that the pandemic has led to a shift in housing demand away from neighbourhoods with high population density and a significant shift in housing demand away from large cities, though the magnitude is more minor.

²Quarterly growth rates of real GDP, change over the previous quarter, seasonally adjusted, OECD Data.

Event studies have been widely used to determine the effect of an event on a return during the event window in empirical finance. The event is a specific shock on the price or return of the asset. This shock can be a policy announcement, change or issuing a law or regulation, merger or acquisition, natural disaster or pandemic such as COVID-19. These studies are generally used for financial indicators with high frequency such as weekly, daily, intraday data in the stock, bond or foreign exchange market (Beaver, 1968; Patell, 1976; Dyckman et al., 1984; Fama, 1991; Fatum and Hutchison, 2003; Khotari and Warner, 2006; Miyajima and Yafeh, 2007; Chen et al., 2007; Liargovas and Repousis, 2011; He et al. 2020).

The number of studies examining the changes in housing prices using the event study method is quite few. Employing an event study methodology, Fuerst (2005) investigates the impact of 9/11 attacks on the New York office market using the event study. He states that studies examining the impact of 9/11 attacks have faced the problem of assessing the effects of the attack separately from the effects of economic recession and other simultaneous events. The study aims to isolate other effects on New York office rental prices by applying an event study methodology. Brau and Holmes (2006) examined the effect of stock repurchase announcements on stock returns of publicly traded real estate investment trusts (REITs) 240 open market repurchase announcements between 1982–1999 were taken as a dependent variable by using event study. In another study, Nanda and Roll (2012) examined the effect of Property Condition Disclosure Laws on house prices based on traditional parametric panel data models and a semiparametric propensity score matching model. The authors obtained the abnormal returns in housing prices after compliance with the law of the regions for 291 US Metropolitan Statistical Areas (MSAs) including 50 US States for 16 quarters before and after the law spanning 21 years from 1984 to 2004. In the study, unemployment rate, increase in per capita income, population growth rate and 30-year mortgage interest rates were used as independent variables. A legal dummy variable was created to measure the price effect after the law. The study concluded that the sales price of houses in a metropolitan area that transitioned to the Property Status Disclosure Law led to an additional increase of 3% to 4% over a four-year period. The semi-parametric analysis generates moderately larger estimated effects of the law on housing prices in comparison with the panel data model results. Jung and Lee (2017) analyze the effects of the macroprudential measures, i.e. the loan-to-value ratio (LTV) and the debt-to-income ratio (DTI), on house prices in Korea. They used the monthly house prices to get abnormal returns for 73 regions in South Korea between March 2006 and June 2015. They choose the following control variables; the number of new unsold houses, industrial production index, mortgage interest rates, Korea Combined Stock Index (KOSPI), consumer price index, M2 money supply and migration. Event month is the month of enforcement, and the event window is determined as $[t-5]$ and $[t+5]$ months. The authors calculated the abnormal returns using the constant mean return model (CMR) and the market return model (MR), tried different models with different control variables and different event windows such as $[-2,2]$ $[-3,3]$ $[-5,9]$ for robustness check. Empirical results show that macroprudential measures have a significant effect on house prices. They also found that the limits set on the debt-income ratio were more effective in lowering house prices than the loan-value ratio. The results are primarily robust when adding control variables. Hoesli, Milcheva and Moss (2020) looked at the relationship between regulation and asset bubbles in the real estate market following the Global Financial Crisis using event study. The authors calculated abnormal returns on daily returns of the 15 largest real estate companies traded on the German, French and UK stock exchanges between January 1, 2009, and April 1, 2015.

As can be seen, inquiring about the effect of COVID-19 shock on residential prices using the event study approach is an essential contribution to the relevant literature. On the other hand, Turkey

announced a mortgage loan package to support the housing sector, including lower mortgage rates and easing the credit conditions. To the best of our knowledge, Turkey is the only country that designed a loan package to support the housing sector using the public banks against the recession of the COVID-19 pandemic. Revealing how prices are affected by the COVID-19 pandemic in the residential sector in Turkey will provide significant benefits for both private and public authorities/institutions to understand and manage the situation in case of a possible future pandemic or similar shock. Lastly, the study uses the official residential price data obtained by the Electronic Data Delivery System of the Central Bank of the Republic of Turkey (CBRT-EDDS) and one of the most extensive online home sales website data (Sahibinden.com) in Turkey. Sahibinden.com residential index has two main advantages: (i) it announced the residential price index one and half month earlier than official CBRT-EDDS data since it depends on the online home sales advertisements; (ii) CBRT-EDDS data covers 27 provinces, which aggregates some cities in one province. On the other hand, Sahibinden.com residential price index is calculated for 75 cities in Turkey.

The first COVID-19 case was announced on March 11, 2020, in Turkey. In the first COVID-19 wave, daily cases reached about 14.000 in April and decreased under 3.000 at the end of May. In response to these cases, the Turkish government announced a high degree of stay-at-home orders and lockdowns in April and May. As a result of the outbreak in question, residential sales have been adversely affected due to the COVID-19 pandemic and measures against it, especially in these two months. The adverse effects are evident as the mobility of individuals is minimal, the uncertainty on future income flows reaches the highest level, and the real estate agents who are mediators in the sector work limited due to their health protection procedures. As the construction sector is substantial for the Turkish economy, the government took action against the recessionary effect of COVID-19 on the construction sector. The loan package was announced on June 1 under the leadership of public banks. Sales and prices in the residential sector have seen their historical peaks thanks to the Loan Incentive Package by declining mortgage rates, 1-year deferred payment and up to 15-year maturity options (maturity is typically ten years for mortgage loans in Turkey). This stimulus package came simultaneously by lifting most of the COVID-19 measures due to ending the first wave. The second wave of COVID-19 in Turkey came in November 2020, and the Loan Incentive Package ended in the first week of August 2020.

In the study, house prices were obtained for 26 sub-regions with the CBRT housing prices index and 75 provinces through Sahibinden.com real estate index. COVID-19 was first seen in March was chosen as the event month, while the previous five months were selected as the control period and the next six months for which the data was obtained as the post-event period. The effect of the COVID-19 pandemic, the loan package, and macroeconomic control variables on residential real estate prices has been estimated by using panel data models after obtaining the abnormal returns at residential prices via event study methodology.

The rest of the paper is organized as follows. Section 2 gives background information on the residential real estate market in Turkey during the COVID-19 Pandemic. Section 3 introduces the data, econometric methodology and models. In section 4, the empirical results of the models based on regional level data and city-level data are presented. Section 5 draws conclusions from the findings.

2. Residential real estate market in Turkey during the COVID-19 pandemic

The Central Bank of Turkey has reported total residential sales in Turkey as monthly since January 2013. The average of the residential sales in Turkey during the pre-COVID-19 period³ was 108,362 and showed the long-term normal for the sector (see Figure 1). The residential sales fluctuated around the long-term trend depending on economic fluctuations, but there have been two distinctive boom and bust periods in the recent years. The residential sales dropped to long-term average in January 2019 and reached the lowest point (historic low before COVID-19) with 61,555 in June 2019 since the harmful effect of increasing mortgage rates⁴ after the economic slowdown and foreign exchange crisis that began in August 2008 in Turkey.

The residential sales increased over the long-term average in August 2019 with 110,538 sales and reached the highest level for the pre-COVID-19 period with 202,074 sales in December 2019. As understood from Figure 1, the residential sector was in an expansion period before the COVID-19, triggering the decreasing inflation and mortgage rates, increasing economic activity and improving expectations. The first recorded COVID-19 case was announced on March 11, 2020, by the Republic of Turkey, Ministry of Health and had a devastating effect on the Turkish residential real estate market. The residential sales were 118,753 in February and 108,670 in March and hit a record low in April with 42,783 and May with 50,936 because of negative effects of health concerns, stay-at-home orders and economic uncertainty. We, therefore, named these two months as COVID-19 recession period.

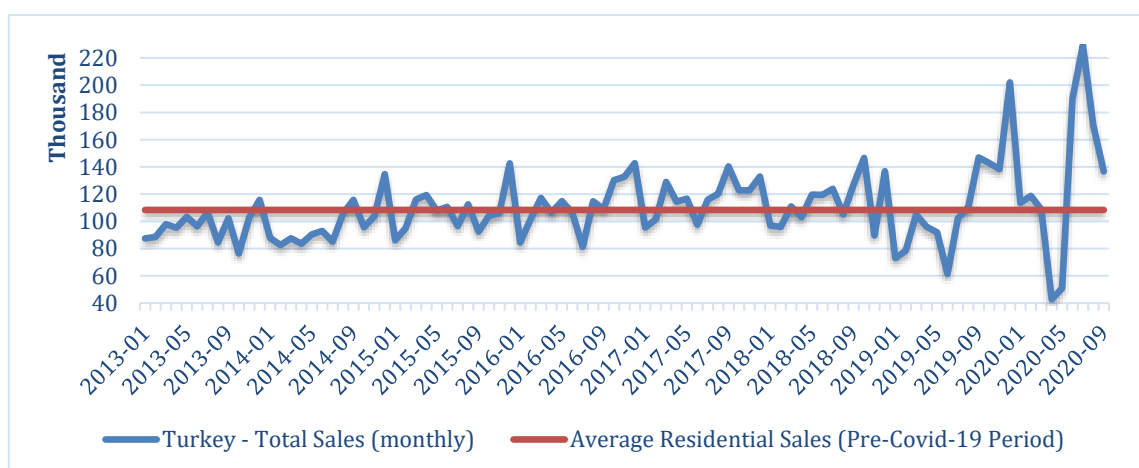


Figure 1. Total monthly residential sales in Turkey.

Source: CBRT, EDDS.

The Turkish government had announced a loan package to support the economy through Turkey's three largest state lenders Ziraat Bank, Vakıf Bank and Halk Bank and two of their participation banks Ziraat Katılım and Vakıf Katılım. These banks offer mortgage, car, holiday and social-life support loans with a longer maturity, loan rates under inflation and postponed payment. The mortgage loan

³From January 2013 to March 2020.

⁴The weighted average mortgage rate was 13.1% in June 2018 and increased to 28.94 % in October 2018. See for more information Figure 4.

package offers lower mortgages rates 0.64% for new residential and 0.74% for second-hand residential⁵, longer maturity up to 15 years⁶ and postponed payment option up to 12 months. The residential sales in Turkey had a historical record in June by 190.012 and in July by 229.357 thanks to supporting mortgage loan packages (see Figure 1). Therefore, we named these two months as the expansion period of the mortgage loan package.

The positive and negative shock on the residential sector in Turkey was valid for all sub-regions (see Figure 2). The growth rate of residential sales in Turkey⁷ by 26 sub-regions over the event-study window, which covers the months between October 2019 and September 2020, indicates that the negative shock, which is COVID-19 shock on residential sales in April 2020, and positive shock, which is mortgage loan package shock on residential sales in June 2020, spread over almost all regions.

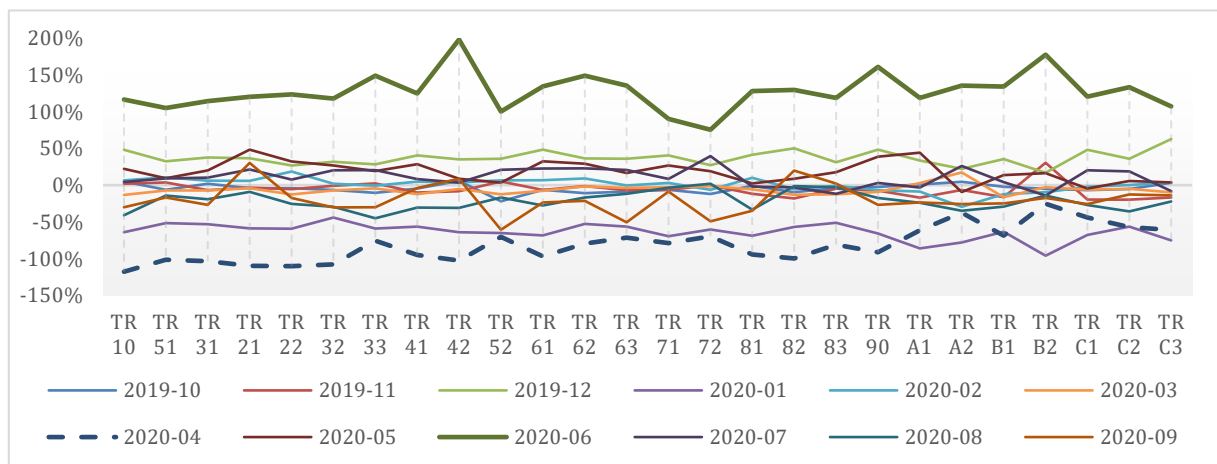


Figure 2. Growth rate of total residential sales in Turkey, by regions.

Source: CBRT, EDDS.

Figure 3 shows the relationship between the monthly change in mortgage loans (in million Turkish Lira-TL) and mortgage loan rates (%). The negative relationship between the mortgage loans and volume of loans was strong before the COVID-19 pandemic. The weighted average of mortgage loans in the Turkish banking sector was 13.1% in June 2018 and jumped to 28.94% in October 2018, and changes in mortgage loans turned negative. Mortgage loans have started to increase along with the negative trend in mortgage rates, especially in the last quarter of 2019 and the first quarter of 2020. The COVID-19 creates high uncertainty in the incomes of households. Hence the new demand for mortgage loans has stopped for April and May, i.e. COVID-19 recession period. The mortgage loan package announced on June 1st and the weighted average of mortgage loans decreased from April to May, from 11.2% to 9.3%. Mortgage loans increased 17.1 billion TL in June and 27 billion TL in July and created outlier for these two months regarding mortgage loans. The mortgage loan package ended on 10th August 2020, so the change in mortgage loans was still significant in August. The data on mortgage loans and rates indicates that easing in credit conditions, i.e., longer maturity up to 15 years

⁵The monthly mortgage rates were between 0.96%–1.16% before the mortgage loan package in the Turkish banking sector.

⁶Typically, the maturity rate for mortgage rates in the Turkish banking sector is ten years.

⁷The first difference in natural log of residential sales.

and postponed payment option up to 12 months, was more effective on mortgage loans than a decrease in mortgage rates over the expansion period of the mortgage loan package.

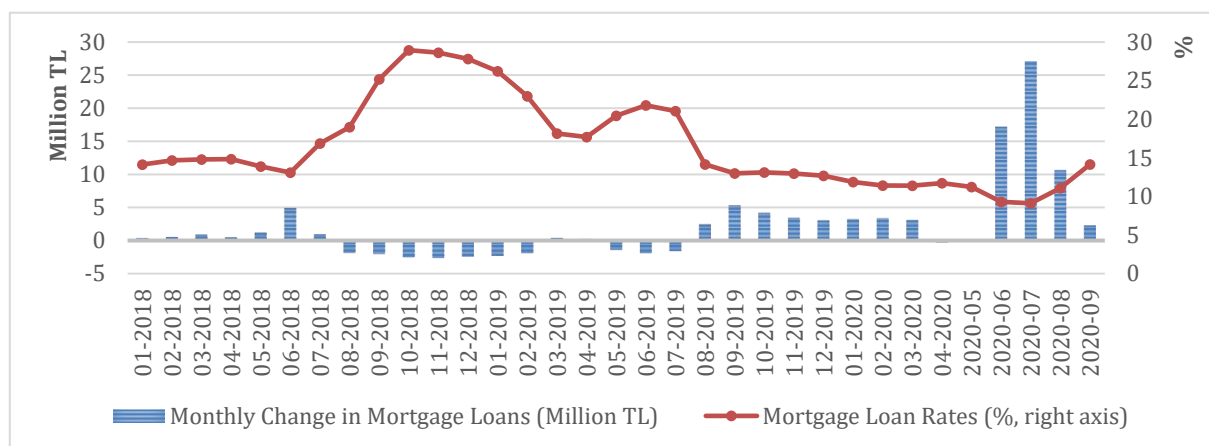


Figure 3. Change in mortgage loans (Million TL) and mortgage loan rate (%).
Source: CBRT, EDDS.

3. Data, econometric methodology and models

3.1. Data

The residential real estate price index is officially calculated monthly and published by CBRT in Turkey for 26 different regions and depends on bank appraisal reports. The second data source for residential real estate prices is relatively new and depends on online home sales advertisements on the Sahibinden.com website, one of Turkey's most prominent real estate websites. Using Sahibinden.com residential real estate price index provides a bigger sample size with 75 cities in Turkey and gives time advantage by announcing one and a half months ago than the index of CBRT. Then we got two different price indexes, one is region-based, and the other is city-based. AR represents the abnormal returns of the residential real estate prices that are obtained by event study and explained in the methodology section (See Appendix A for Figures of ARs and statistical properties of the variables).

We also use city or region-level data, namely inflation and cash loans. Inflation (*INF*) shows the log difference of Consumer Price Index (CPI), which is seasonally adjusted using the Census X12 method and 26 sub-groups and taken from CBRT-EDDS. Cash loans (CL) gathered from The Banks Association of Turkey, Risk Center, shows the log difference of cash loans in the Turkish banking sector for 26 sub-groups and 75 cities.

Two dummy variables were created to capture the effect of the COVID-19 pandemic and the Loan Package on residential prices. COVID-19 dummy is one for April and May, which are the two months that captures the first wave of COVID-19 and measures, i.e., lockdowns, social-distance and curfews, were strong. LP is one for June and July and represents the mortgage loan package, announced by the Turkish government on June 1, 2020, and ends in the first week of August. The mortgage loan package offers lower mortgage rates 0.64% for new residential and 0.74% for second-hand residential⁸, longer

⁸The monthly mortgage rates were between 0.96%–1.16% before the mortgage loan package in the Turkish banking sector.

maturity up to 15 years⁹ and postponed payment option up to 12 months. Further information about dummy variables can be found in the second chapter.

Interest rate, foreign exchange, stock market variables are used as macroeconomic control variables. Interest rate (INT) indicates the weighted interest rate for the mortgage loan in Turkish Lira (TL). Currency basket (FX) is calculated with equal weights of Euro and US Dollar (effective sales) and shows the log difference of the exchange rate basket. Stock market index (XU100) is the log difference of the Borsa Istanbul 100 Index. After controlling main macro variables, which have a significant role in residential prices, consumer confidence has been added to the model to catch up with the behavioral effect of consumers on residential prices, which is more critical in the COVID-19 pandemic area when considering the sharp decrease in consumer confidence. Consumer confidence index (CCI) is calculated as a log difference of consumer confidence index. All control variables are taken from CBRT-EDDS.

3.2. *Econometric methodology and models*

3.2.1. Econometric methodology: event study

As a first step in event study, abnormal returns for residential prices are obtained according to the constant mean return model as follows:

$$R_{it} = \ln P_{it} - \ln P_{it-1} \quad (1)$$

$$AR_{CMR_{it}} = R_{it} - \bar{R}_l \quad (2)$$

where P_{it} is price of residential real estate for region/city in period t , R_{it} is the natural logarithm of the return for region/city i in month t , \bar{R}_l shows the mean of residential price return for district/city i over the sample period excluding the months of events¹⁰. $AR_{CMR_{it}}$ is an abnormal return described in Equation (2) for region/city i and in period t based on a constant mean return model. Brown and Warner (1980, 1985) found that when compared to sophisticated models, the constant mean returns model yields similar results as the variance of abnormal returns is not reduced much. Abnormal return can be obtained according to the market return model, which depends on the mean of nationwide residential price. We do not prefer the market return model since it does not reflect the sensitivity of region/city residential real estate market on abnormal return for region/city i and in period t .

In Turkey, COVID-19 pandemic was first seen in March. Therefore, the event month is March. The control period, which refers to the pre-event period in this study, is the five-months before March 2020. The post-event period was chosen as the six months¹¹ after March 2020. Therefore, panel regression models include eleven abnormal returns for each sample region or city.

⁹Typically, the maturity rate for mortgage rates in the Turkish banking sector is ten years.

¹⁰01:2010–09:2019 is for region-based data, 01:2018–09:2019 is for city-based data.

¹¹It was also found that the main findings from empirical results did not change when a post-event period for +4 or +5 months was chosen.

3.2.2. Econometric models

After the abnormal returns of the residential real estate prices are obtained, the effect of the COVID-19 pandemic, loan package and other macroeconomic control variables on abnormal returns of residential real estate prices were estimated by panel data analysis. We estimate three Equations are shown by the following Equations.

Model (I): main model:

$$AR_{CMR_{it}} = \beta_0 + \gamma Covid_{it} + \delta LP_{it} + \alpha_1 INF_{it} + \alpha_2 CL_{it} + \epsilon_{it,1} \quad (3)$$

where β_0 is constant term, γ , δ , α_1 , and α_2 are coefficients to be estimated, $\epsilon_{it,1}$ is the residuals of the Model (I). $AR_{CMR_{it}}$ is the abnormal return for a sample region/city i determined using the constant mean return model for the event window, i.e. $[-5, +6]$ months. $Covid_{it}$ is a dummy variable equal to one for April and May; as explained before covering the effect of the first wave of COVID-19 pandemic on abnormal return of the residential prices, and zero otherwise. LP_{it} is another dummy variable, which is one for June and July captures the effect of loan package; INF_{it} is inflation rate for region/city i at time t ; CL_{it} denotes the growth rate of cash loans in Turkish banking sector for region/city i at time t ; $\epsilon_{it,1}$ is the residual term.

Model (II): Adding macroeconomic control variables:

$$AR_{CMR_{it}} = \beta_0 + \gamma Covid_{it} + \delta LP_{it} + \alpha_1 INF_{it} + \alpha_2 CL_{it} + \alpha_3 FX_t + \alpha_4 INT_t + \alpha_5 XU100_t + \epsilon_{it,2} \quad (4)$$

where β_0 is constant term, γ , δ , α_1 , α_2 , α_3 , α_4 , and α_5 are coefficients to be estimated, $\epsilon_{it,2}$ is the residuals of the Model (II). Model (II) is an augmented model with macroeconomic control variables that are highly associated with residential price growth. Where FX_t is the return of currency basket, INT_t is the mortgage loan rate, $XU100_t$ is the return of the Borsa Istanbul.

Model (III): Adding behavioral effect:

$$AR_{CMR_{it}} = \beta_0 + \gamma Covid_{it} + \delta LP_{it} + \alpha_1 INF_{it} + \alpha_2 CL_{it} + \alpha_3 FX_t + \alpha_4 INT_t + \alpha_5 XU100_t + \alpha_6 CCI_t + \epsilon_{it,3} \quad (5)$$

where β_0 is constant term, γ , δ , α_1 , α_2 , α_3 , α_4 , α_5 , and α_6 are coefficients to be estimated, $\epsilon_{it,3}$ is the residuals of the Model (III). Model (III) is the most comprehensive model in which the consumer confidence index is included. This model shows the growth rate of consumer confidence and measures the behavioral effect of consumers on residential prices during the event window.

The panel data analysis part of this study includes three stages. In the first stage, the existence of unit and time effects was investigated to decide whether the data will be combined horizontally and vertically. In panel data analysis, the model in which there are only unit effects or only time effects are called a one-way model, and the model with unit and time effects at the same time is called a two-way model. In the study, the likelihood ratio (LR) test was used to determine whether the model was one-way or two-way. In the second stage, after investigating the existence of unit and time effects in panel regression analyzes, Hausman test was used to determine whether the effects were constant or random. In the last stage, the model decided according to the Hausman test result was estimated with the one-way random time effects model, and the obtained findings were examined in detail¹².

¹²See Greene (1993, 2000, 2001).

4. Empirical findings

4.1. Regional level models

The main and augmented regression model results given in Equations 3–5 are presented in Table 1. Inflation positively affects abnormal returns in the main model, the augmented model (II), where exchange rate, interest rate and stock market variables are added, and the model (III), where consumer confidence is added. The inflation effect is positive as expected, and the effect is significant statistically at 1% for model (I) and (II), and 10% for model (III). It is seen that the increase in inflation rate has an upward effect on abnormal returns of residential prices, which is valid for all three models.

Table 1. Main and augmented model regression results (Regional Level).

Variables	Model I (a)	Model II (a)	Model III (a)
β_0	-0.0038*	0.0751***	0.1137***
<i>Covid</i>	0.0254***	0.0265***	0.0008
<i>LP</i>	0.0036***	-0.0169***	-0.0222***
<i>INF</i>	1.2710***	0.8518***	0.2241*
<i>CL</i>	-0.0122*	-0.0141*	-0.0023
<i>FX</i>		-0.1825***	-0.0041
<i>INT</i>		-0.0057***	-0.0088***
<i>XU100</i>		-0.0199***	0.0376***
<i>CCI</i>			0.0995***

Note: ***, **, and * denote significance levels of 1%, 5% and 10% respectively. (a) indicates that the model is established on a regional basis. The LR test statistics for the two-way model that tests whether the time and unit effect of the three models given in Appendix B: Table B1 are at the same time are statistically significant at 1% level. It is seen that the predicted models have unit and time effects. When only the existence of unit effects was examined, it was found that there were no unit effects in all three models. According to the results of the one-way model that examines the time effects, LR statistics are statistically significant at the level of 1% for all three models. It is concluded that there are time effects in the Equation. After determining the existence of time effects, Hausman test was conducted for three models in order to determine whether these effects are constant or random. The Hausman test statistics calculated are 0.15, 0.46 and 1.22, respectively. The result is statistically insignificant. The H_0 hypothesis, which is established as the difference between parameters is not systematic, cannot be rejected. According to these results, the random effects estimator is valid on time effects. (See: Appendix-Table B1, Table B2 and Table B3). According to the results, a one-way random time effects model has been estimated for all three models and the results are given in Table B1. The results given in Table B1 were estimated with the resistant estimator. The models do not suffer in terms of diagnostic and specification problems.

The effect of cash loans on abnormal returns is negative. While this effect is significant at 10 percent in model (I) and model (II), it is insignificant in model (III). Although the expected effect of loans on prices is positive, the model results show a negative sign, and an increase in cash loans reduces abnormal returns of residential prices during the event window. The answer can be obtained by understanding the effect of COVID-19 on cash loans. Cash loans include all personal and commercial loans, and the distribution of cash loans is around on the long-run average 20% consumer loans, 5% of housing loans and 75% commercial loans. It is seen that the commercial loans given by public banks within the scope of combating COVID-19, Business Loans and Commercial Installment Loans

increased significantly in April 2020 (10% and 17%, respectively). The effect of cash loans, specifically Business Loans and Commercial Installment Loans, on abnormal returns can be expected to be negative as these loans are mostly used for working capital needs into the negative effects of COVID-19 on revenues. Housing loans could not be included in the model as a separate variable, as they could not be obtained on a regional or city basis.

Macroeconomic control variables were added in model (II). The currency basket variable is negative and significant in model (II) but insignificant for model (III). The effect of foreign currency on abnormal returns is controversial as two opposite effects are valid simultaneously. The depreciation of the Turkish Lira against the currency basket increases the net worth of the households through the foreign exchange deposit accounts, which significantly increased due to high dollarization in Turkey for the last two years, especially in the COVID-19 period. Besides this positive wealth effect, weaker Turkish Lira may result from non-residents' capital outflows from Turkey and creates a negative capital effect, which negatively affects residential prices.

As expected, mortgage interest rates on abnormal returns of residential prices are negative and statistically significant at 1% level for both models. The positive effect of inflation and the negative effect of interest rates on abnormal returns are apparent and expected. The effect of the stock exchange on abnormal returns of residential prices is negative for model II (a) but positive for model III (a). Lastly, consumer confidence has a positive and significant effect at the 1% level. The COVID-19 pandemic has created a sharp and grand downfall in consumer confidence. It is considered that the increase in consumer confidence directly affects the consumer's spending decisions and that the consumer who feels safe can make long-term decisions such as residential purchases more easily.

COVID-19 and loan package dummy variables have an unexpected sign in our regional based models. The main reason is that the residential price index obtained by CBRT shows a significant rise in May. It can be seen in Appendix: A-Figure A1, A2 for CBRT data and Figure A3 and A4 for Sahibinden.com data. While the average abnormal return at the regional level is 5.58% in May, it is 1.42% in May at city-level data. Whereas an increase in average abnormal returns in June and July is 1.81% and 0.55% respectively at the regional level, they are 5.27% and 3.50% at the city level. These results are also valid at the regional and city level data (see Figure A2 and A4).

COVID-19 dummy variable measures the impact of COVID-19 on the abnormal returns of April and May when the closure and go-out bans are the most intense in Turkey. The COVID-19 dummy is positive for all models and significant at 1% for model I (a) and model II (a). This finding indicates that when the impact of COVID-19 was the highest in these two months, abnormal returns of housing were positively affected by this situation. The expected sign of the COVID-19 dummy variable is negative since we know that these two months are named as COVID-19 recession period. As explained in section two, the residential sales recorded historically lowest in April 42.783 and May with 50.936 because of negative health concerns, stay-at-home orders and economic uncertainty. In the next section, we will see that the coefficients of the COVID-19 dummy turn negative at city-level data.

On the other hand, the loan-package dummy variable, which measures the impact of the mortgage loan package in June and July, is positive for the main model, but negative and significant for other models. As explained in the second section, we named the months of June and July as the expansion period of the mortgage loan package since the residential sales in Turkey had a historical record in June by 190.012 and in July by 229.357. Our expected sign of a loan package dummy is positive by reflecting the price effect of the expansion period. In the next section, we will see the coefficients of the loan package dummy turns positive at city-level data.

4.2. City level models

The model results depending on 72 city data in Turkey are presented in Table 2. The inflation variable has a positive effect on all three models, which is the same as region-level data; however, this effect appears to be statistically insignificant. The effect of cash loans on abnormal returns of residential prices is negative in all three models and significant in 5%. The conclusion that an increase in cash loans reduces the abnormal return of residential prices is the same as the regional model. As explained earlier, Business Loans and Commercial Installment Loans, a large part of cash loans, increased significantly in April 2020 due to the stimulus package focusing on mitigating the harmful effect of the COVID-19 pandemic on small and medium-sized enterprises (SMEs). Most SMEs used these loans as working capital to compensate for a sudden reduction in their revenues. As a result, the effect of cash loans on abnormal returns of residential prices, contrary to the expectations, came with a negative sign in all models regardless of city or region level.

Table 2. Main and augmented model regression results (city level).

Variables	Model I (b)	Model II (b)	Model III (b)
β_0	0.01062***	0.0075	0.0282
<i>Covid</i>	0.00007	-0.0066	-0.0174**
<i>LP</i>	0.0329***	0.0309***	0.0303***
<i>INF</i>	0.1197	0.1754	0.1445
<i>CL</i>	-0.0153**	-0.0157**	-0.0153**
<i>FX</i>		0.1315	0.2299***
<i>INT</i>		-0.0009	-0.0019
<i>XU100</i>		0.0350	0.0566**
<i>CCI</i>			0.0412**

Note: ***, **, and * denote significance levels of 1%, 5% and 10% respectively. (b) indicates that the model is established on a city basis. Hausman test statistics of the models were 0.05, 0.18 and 0.04, respectively, and were statistically insignificant. According to the results obtained, it is seen that a two-way random effects model is suitable for all three models (see Appendix: B-Table B4, Table B5 and Table B6). Each of the models given in the table are two-way random effects model results. The models do not suffer in terms of diagnostic and specification problems.

The currency basket, which measures the exchange rate effect, is positive for model II (b) and significant for model III (b), in contrast with the negative coefficient at regional level models. Currency basket depreciated significantly in March-April and August due mainly to COVID-19 outflow from emerging countries. As previously explained in the regional level model, depreciation of the Turkish Lira against currency basket has two opposite effects on residential prices. Weaker Turkish lira increases the net worth of households' foreign exchange deposit accounts, which increased around 37 billion US dollar during the event window period and reached 119 billion US dollar at the end of September, 2020¹³. On the other hand, depreciation in Turkish Lira may be the result of non-residents' capital outflows from Turkey and creates negative capital effects, which affect residential prices negatively. In our city based model results indicate that the positive net worth effect is stronger than negative capital effect in Turkey during the event window.

¹³CBRT-EDDS, Money and Banking Statistics, Foreign Exchange Deposits, Real Persons.

The effect of the stock exchange on abnormal returns of residential prices is positive and significant for model III (b) but insignificant for model II (b). An increase in stock exchange reflects the recovery for profit expectations of corporations under the COVID-19 pandemic and has a positive income effect on household wealth. Lastly, consumer confidence has a positive and significant effect, the same as the regional level. As explained earlier, the COVID-19 pandemic has created a deep uncertainty on income. Therefore, an increase in consumer confidence supports the residential purchase by easing the customer's long-term decisions.

As explained in the regional level model results, the difference between abnormal returns of regional and city-level data in May, June and July determines the sign of COVID-19 and loan package dummies (see Figure A1, A2 for CBRT data and Figure A3 and A4 for Sahibinden.com data). A COVID-19 dummy variable is positive in the main model and negative in the augmented model II (b) but insignificant for both models and negative and significant for model III (b). The negative sign of COVID-19 dummy in model III (a), which was defined in April and May, when the closure and go-out bans were the most intense in Turkey, indicates that the COVID-19 pandemic has a negative effect on abnormal returns of residential prices as expected.

On the other hand, the loan-package dummy variable, which measures the impact of the mortgage loan package in June and July, is positive and significant at a 1% level for all models. As explained in the second section, as a historical record, mortgage loans reached 17.1 billion TL in June and 27 billion TL in July thanks to a mortgage loan package, which offers lower mortgage rates, extending maturity and deferred payment. In the regional model, the loan package dummy variable, which is positive for the main model but negative for other models, turns positive in the city-based model, as expected. The model results support the view that the loan incentive package was successful in increasing residential prices.

5. Conclusions

This paper investigates the effect of COVID-19 pandemic on the residential real estate prices in Turkey using event study. The models measure the effect of COVID-19, loan package, macroeconomic and behavioral control variables on abnormal returns of residential real estate prices during the event window. Event window covers an eleven-month period from October 2019 to September 2020. We use the five months in the pre-event period as the control period; March 2020 as the event month since the first COVID-19 case appeared in Turkey; and the post-event period refers to the next six months following March.

We employ two different residential price indexes to obtain abnormal returns. The first one is official data and the second one is Sahibinden.com residential real estate price index. The latter depends on the online home sales advertisements on Sahibinden.com website and gives us two main advantages, (i) early announcement of the data about one and half months before and (ii) including 75 cities instead of 26 sub-regions. As discussed in the paper, using city level data affects the main results of the models. Abnormal returns for residential prices are obtained using a constant mean return model for each region/city.

Two dummy variables were created to capture the effect of COVID-19 pandemic and loan package on abnormal returns of residential real estate prices. COVID-19 dummy reflects the effect of April and May 2020, when the first wave of COVID-19 hit Turkey and measures such as lockdowns, social-distance and curfews were the most intense in the event window period. Loan package dummy takes one for June and July and captures the effect of the mortgage loan package

announced by the Turkish government accompanied with lower mortgages rates, longer maturity and postponed payment option.

We estimate three different models. The main model consists of inflation and cash loans for each region/city as well as COVID-19 and loan package dummies. We add foreign exchange, mortgage loans and stock exchange as macroeconomic control variables for the second model. In the third model, consumer confidence was added as a behavioral effect variable. All models estimated two different abnormal returns reflecting the residential prices at the region and city level. Our most comprehensive model for city level data, the augmented model III (b), including macroeconomic control variables and behavioral effect is our best model as it fits the data and reflects the data based results obtained by section two. According to the results obtained with this model, COVID-19 pandemic has a negative effect, and loan package has a positive and significant effect on abnormal returns of residential prices, as expected. Inflation has positive and mortgage loan rates have negative effects, but both of them are insignificant. These results also support the idea that abnormal returns of residential prices are more strongly associated with loosening in credit conditions than interest sensitivity.

The effect of cash loans on abnormal returns of residential prices is negative during the event window. This unexpected relationship between cash loans and abnormal returns may be linked with the extraordinary effect of COVID-19 on the working capital of SMEs. Most of the SMEs used these loans as working capital to compensate for sudden reduction in their revenues. Increase in currency basket, equal weights of Euro and US Dollar, has a positive effect on abnormal returns by increasing the net worth of households' foreign exchange deposit accounts. Stock exchange has a positive effect on abnormal returns by affecting household wealth positively. Lastly, consumer confidence has a positive effect on abnormal returns since an improvement in customer confidence supports the residential purchase by easing the making long-term decisions for customers.

The paper has some suggestions for future studies or public and private institutions. The main constraint of the paper emerged from data availability. The lack of city-based and monthly data in banking-based data in Turkey or their late disclosure prevented separating the effect of or including the credit/income-based variables into the model. Cash loans are an example of this. Cash loans are obtained from the Banks Association of Turkey in a monthly aggregated form. On the other hand, although mortgage loans, commercial loans and other types of loans are in the BRSA database, these data are published quarterly. COVID-19 has increased the importance of studying as micro-based as possible. It is essential to publish such data with high frequency and low delay. Then institutions should reconsider their data responsibility in the light of the COVID-19 pandemic.

Conflicts of interest

The authors declare no conflict of interest.

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