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Abstract

This paper investigates the housing-output growth nexus in Turkey by using quarterly data on real gross domestic product, real house prices and real gross fixed capital formation. The main aim of this paper is to identify indicators, for example, output and real capital formation, which potentially has strong causal relationship with housing prices in Turkey. The data set for this study spans the period; 1987:Q1 to 2016:Q2. Using full sample bootstrap Granger causality test and parameter stability test, we examine the stability of estimated Vector Autoregressive Regressions (VAR), and thus determined whether the full-sample Granger causality inference might be invalid. When the stability of the VAR model is rejected, the Granger non-causality tests are not valid. For this reason, the bootstrap rolling window estimation technique was used to evaluate the Granger causality between the housing variables and the output growth rate. The bootstrap rolling window estimation results show that there is no Granger causality relation in full sample. However, in some sub-periods, these variables have predictive ability for each other.

Keywords: House prices, output growth, Turkey, time varying causality
JEL Classification: C32, O40, R31

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Introduction

There is a rich archive of literature on the relationship between housing investment, housing prices and economic growth. This nexus is deep-rooted in modern economic literature. With a near unanimous claim that housing prices is a predictive factor of economic growth, housing prices, like other expenditure components of gross domestic product, is expected to be positively related with economic growth. Amidu et al. (2016), Badurlar (2008), Chen and Zhu (2008); Hongyu et al (2002), Kuang and Zhou (2010), Simo-Kengne et al (2012), among others, have contributed to this debate. Interestingly, most empirical studies investigated this relationship by applying co-integration and Granger causality on the available full sample data. However, these tests are usually conducted under the assumption of (non)-existence of causal relationship that applies to every point in the full sample. This could be misleading as there could be structural changes in the data which makes the application of this technique impracticable. It is against this backdrop that this paper sought to examine the relationship between housing prices and economic growth in Turkey by applying the bootstrap full sample and subsample rolling window approach. The objective was to address the issue of structural change in the data by applying the rolling window estimation. In addition, the bootstrap Granger causality test in each sub-sample, which is robust in the violation of the regularity conditions, such as the stationarity, integration–cointegration properties, and parameter constancy, was used. Finally, the housing prices and economic growth relation for Turkey was tested using a time varying approach as against the full sample data that assumes a permanent causal link holding in every time period.

Amidu et al. (2016) investigated the interactions between housing investment and economic growth. Their analysis centred on the effect of private housing investment on the aggregate UK economy. Using quarterly data which span 1974 to 2015 for the UK, with a methodology of Granger causality and cointegration test, which are well known in economic literature, they established that the private housing sector investment is an impetus for economic growth. This is a restatement of earlier studies like those of Hongyu et al (2002), Kuang and Zhou (2010), Simo-Kengne et al (2012), among others, who have also established a positive relationship between housing and economic growth.

Hongyu et al (2002), in their study, 'The Interaction between Housing Investment and Economic Growth in China', investigated the interaction between housing investment and economic growth as well as non-housing investment and economic growth. Empirical evidences were drawn from level data from the Annual Survey of Industrial Firms (ASIF) in China between 1999–2007.Their results reveal strong short-run relationship between housing investment and economic growth. Although non-housing investment was also found to have positive relationship with economic growth, the degree of the relationship was, however, less than that between housing investment and growth. In addition, they were able to show that housing investment has a long-run effect on economic growth, while economic growth has a long-run effect on both types of investment. The Implication is that, housing investment is a major determinant of economic growth. Similarly, Chen and Zhu (2008) investigated the short run and long run relationship between the housing investment and economic growth in China by using the cointegration analysis of panel data for the period between 1991q1 and 2007q4. Their result, like that of Hongyu et al, shows a stable long run relationship between non-housing investment, housing investment and GDP in China. Based on the panel Error Correction model, they found bidirectional Granger causality between housing investment and GDP in both the short-run and long-run for the whole country.

Kuang and Zhou (2010) examined the interaction relationship between housing credit, housing investment and economic growth in China. They followed the general definition of the housing investment which is not only comprised of the housing development investment, but also the housing purchase. On the other hand, the housing credit includes the housing purchase loans and the housing development. Their dataset covered 35 large and medium cities in China between the period of 1996 and 2007. The paper addressed the endogeneity issue among the housing credit, housing investment and economic growth by using Generalized Method of Moments (GMM) Estimation. Their findings were: First, economic growth has a greater influence on the housing investment than the impact of housing investment on economic growth. Secondly, housing purchase has a greater impact on economic growth than on housing development. Thirdly, economic growth has a greater impact on housing credit than the housing credit on economic growth. The forth, the housing investment has greater impact on economic growth than the impact of housing credit on economic growth. And the fifth is that housing price has greater impact on housing credit than on interest rate and economic growth.

Simo-Kengne et al (2012) had investigated this relationship, using panel data set from 1996 to 2010, across all nine provinces in South Africa. Their finding was that house price changes have positive relationship with regional economic growth and that the effects vary across regions. Also, Miller et al (2011), analysed the relationship between housing prices and economic growth by comparing the effects of predictable and unpredictable house price changes, used as proxy for the collateral and wealth effects of house prices respectively, on economic growth. Their study was conducted within the context of U.S economy, using quarterly dataset for all 379 Metropolitan Statistic Areas (MSAs) in the U.S from 1980:1 to 2008:2. The broad finding is similar to those of Sime-Kengne; housing prices impact positively on economic growth. Specifically, however, they found the predictable changes in house prices to have about three times more effect of economic growth than the effect of unpredictable changes house prices.

The rest of the paper is organized as follows: Section 2 describes the methodology employed, Section 3 explains data and empirical results and Section 4 presents the conclusion.

Methodology

This paper seeks to investigate if there exist any relationship among these indicators, output and gross fixed capital formation, which can Granger causes housing prices. In the usual Granger causality test of Granger (1969), the null hypothesis is Granger non-causality. On the other hand, the alternative hypothesis is Granger causality. Furthermore, if the null hypothesis is rejected, it shows that the realization of the first variable and itself improve the prediction of the second variable, e.g. first variable (for example, output) does Granger cause on the second variable (housing price or residential investment). Granger non-causality test based on whether the lagged values corresponding to past of the variable are jointly significant or not. The joint restriction includes the Wald, Likelihood ratio (LR) and Lagrange multiplier (LM) statistics for standard Granger causality test in the VAR framework. All three tests assume that the time series are stationary. When the stationary assumption does not hold, they may not have standard asymptotic distributions. Park and Phillips (1989) and Toda and Phillips (1993, 1994), among others, have adequately identified the challenges estimating non-stationary data in VAR models.

A modification of the standard Granger causality test was made by Toda and Yamamota (1995) and Dolada and Lütkepohl (1996) and obtained standard asymptotic distributions when the time series are integrated I (1), i.e. VAR (p), in which p is the lag operator. Their technique involves estimating a VAR (p+1) in levels. Thıs procedure produces valid results regardless of the integration and cointegration properties of the variables.

Monte Carlo simulation studies showed the residual based bootstrap (RB) method has more power over standard asymptotic test whether there is a co-integration or not (Horowitz, 1994; Shukur & Mantalos, 1997a, 1997b, 2000; Hacker & Hatemi-J, 2006; Mantalos & Shukur, 1998; causality between output and housing variables in Turkey. The bootstrap modified LR Granger causality ıs demonstrated usıng the VAP (p) process below:

$$z_t = \Phi_0 + \Phi_1 z_{t-1} + ... + \Phi_p z_{t-p} + \varepsilon_t, \quad \text{t=1, 2,…, T} \tag{1}$$

Whıle $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})'$ represents a white noise with an expected value of zero, covariance matrix ∑, p ıs the number of lags in the process. For sımplıcıty, VAR (z_t) can be represented in the two sub-vectors below; the first variable relates to a housing variable (house prices or gross fixed capital formation) (z_{ht}) and the second variable relating to Gross Domestic Product (GDP) (z_{yt}). We can, hereby, rewrite equation (1) as:

$$\begin{bmatrix} z_{ht} \\ z_{yt} \end{bmatrix} = \begin{bmatrix} \phi_{h0} \\ \phi_{y0} \end{bmatrix} + \begin{bmatrix} \phi_{hh}(L) & \phi_{hy}(L) \\ \phi_{yh}(L) & \phi_{yy}(L) \end{bmatrix} \begin{bmatrix} z_{ht} \\ z_{yt} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{2}$$

where $\phi_{ij}(L) = \sum_{k=1}^{p+1} \phi_{ij,k} L^k, i, j = h, y$ and *L* is the lag operator defined as $L^k z_{it} = z_{it-k}, i = h, y.$

According to equation (2), the null hypothesis is set as GDP does not Granger cause housing variables. Thıs can be tested by imposing zero restrictions $\phi_{hy,i} = 0$ for i =1, 2, …, p, i.e. GDP does not contain predictive content for a particular housing variables if the joint zero restriction under the null hypothesis:

$$H_0^{HF} : \phi_{hy,1} = \phi_{hy,2} = \ldots = \phi_{hy,p} = 0 \tag{3}$$

are not rejected. As a result, the null hypothesis, that a particular housing variable does not Granger cause on GDP, can be tested by imposing the restriction $\phi_{yh,i} = 0$ for i=1, 2,…, p. This means a particular housing variable does not have predictive content for GDP, if the joint zero restrictions under the null hypothesis are not rejected:

$$H_0^{LI} : \phi_{yh,1} = \phi_{yh,2} = \ldots = \phi_{yh,p} = 0 \tag{4}$$

These Granger causality equations, equations (3) and (4), therefore, should be extended to housing fundamentals (HF) and leading indicator (LI) hypotheses in the following two ways. If we reject the null hypothesis specified under H_0^{LI} in eq. (4) but not reject H_0^{HF} in eq. (3), then the findings support LI hypothesis. However, on the other hand, if H_0^{HF} in eq. (3) is rejected while the H_0^{LI} in eq. (4) is rejected then this evidence is in favour of the HF hypothesis. Consequently, when we cannot reject both null hypotheses, the findings do not support LI and HF hypotheses.

It is then possible the test causality hypothesis in presented in equation 3 and 4 by applying the critical or p-values proposed by the bootstrap technique. This approach, as proposed by Efron (1979), involves construction of critical values from empirical distribution derived for the particular test using the sample data. For the purpose of testing for granger non-causality, the modified causality tests of Toda and Yamamoto (1995), which can be applied on both cointegrated non-cointegrated variables integrated of order 1, was applied using bootstrap approach. The application of Granger non-causality tests is usually conducted under the assumption of time invariant parameters of the VAR model used. However, as a consequence of structural changes this assumption is usually violated. And unfortunately, the inclusion of dummy in the VAR and splitting of sample variables to correct for no the problem of non-constancy in parameters, also come with the challenge of pre-test bias. It is for this reason that the rolling bootstrap approach would be attempted in this study. Also, the bootstrap causality test will be applied to rolling window sub-samples for $t = \tau - l + 1, \tau - l, \ldots, \tau, \tau = l, l + 1, \ldots, T$, where l is the size of the rolling window, to correct for structural changes and their implication of shifting the parameters and the pattern of the causal relationship over time.

As a precondition for conducting the cointegration test, the varıables will first be tested for unit root using the Augmented Dickey Fuller test (ADF), Phillip-Peron test and the KPSS tests for unit root. Also, the stability of the parameters in the estimated VAR models shall also be tested following the approach proposed by Balcilar and Ozdemir (2013) and Balcilar et al. (2014). This is because, due to structural changes, the parameters and the pattern of the (no) cointegration and (no) Granger causality may vary with time, making the results of the cointegratıon and Granger causality tests highly responsive to sample periods used in the VAR model.

Since the variables in the VAR model may be integrated, most of the tests used for evaluating the temporal stability of VAR models, for example, Andrews, (1993); Andrews & Ploberger, (1994); Hansen, (1992), become inefficient. However, if there exists cointegration among the integrated variables, this variables form a VECM. It becomes important to investigate both the long-run cointegration and the short-run dynamic adjustment parameters for stability. While the stability of the long-run cointegration dynamic adjustment parameter would be tested using the Lc tests of Nyblom (1989) and Hansen (1992), calculated using the fully modified OLS (FMOLS) estimator of Phillips and Hansen (1990), the Sup-F, Ave-F and Exp-F tests of Andrews (1993) and Andrews and Ploberger (1994) will be used to investigate the stability of the short-run parameters. And to avoid the use of asymptotic distributions, the critical values and p-values are obtained using the parametric bootstrap procedure.

Data and Empirical Results:

This paper employs quarterly data spanning the period 1987:Q1 to 2016:Q2. The source of the data is Central Bank of Turkey. The current study is fashioned after Kılıc and Tunc (2013) in terms of House Price (HP). HP is obtained by taking the summation of Building and Housing expenditure on the one hand, and construction based on Gross Domestıc Product (GDP) expenditure within the period under review. This study also made use Gross Fixed Capital Formation in residential investment (GFCF) and GDP, all adjusted using 1998 base year. The variables were considered in their natural logarithm form.

In this study we used Phillips and Perron (1988) (PP) unit root test to examine the stationarity of the series. The non-formal visual inspection reviews that all the series show trend. Therefore, we report results for only intercept and trend. The results of unit root are presented with Mackinnon (1996) critical value in Table 1. The null hypothesis of non-stationary for GDP, HP and GFCF cannot be rejected at the 5% significance level. According to the result, when the series are tested in their first difference, these variables are stationary. It shows that GDP, HP and GFCG are integrated of order one, i.e. I~(1).

Table 1: Unit root test results

	Level	First Difference
Series	(constant and trend)	(constant and trend)
GDP	-3.42	-11.93***
HP	0.16	-7.13***
GFCG	-0.22	-9.00***

*** indicates significance at the 1% level

The result of the parameter stability test is presented below in Table 2 and 3. This test is conducted within the context of the null hypothesis that the parameters are stable by using Sup-F, Exp-F and Mean-F. In table 2, we reject the null hypothesis at both 1 and 5 percent level of significance for house price equation. However, with p-values greater than 5 percent for all three of Sup-F, Exp-F and Mean-F, we failed to reject the null hypothesis, in the output equation, that the parameters are stable. But the rejection of the null hypothesis in at least one of the equations is significant to draw conclusion that the parameters are unstable. Similarly, the parameter stability is rejected for the case of house price and residential investment at 1 percent significance level. Consequently, the results showed the significant evidence of parameter non-constancy exists in all 3 equations.

Table 2: Parameter Stability Tests for HP and GDP VAR (2) Model in Growth Rates

	House Price Equation		Output Equation	
	Statistics	Bootstrap	Statistics	Bootstrap

		p- value[a]		p- value[a]
Sup-F	52.22***	0.00	10.53065	0.41
Exp-F	22.23***	0.00	3.123741	0.34
Mean-F	24.75***	0.00	5.069383	0.21

Notes: *** indicates 1% significance level

[a]p-values are calculated using 1000 bootstrap repetition

Table 3: Parameter Stability Tests for HP and GFCF VAR (2) Model in Growth Rates

	House Price Equation		Residential investment Equation	
	Statistics	Bootstrap p-value[a]	Statistics	Bootstrap p-value[a]
Sup-F	50.51***	0.00	64.12***	0.00
Exp-F	22.60***	0.00	27.67***	0.00
Mean-F	26.25***	0.00	15.67***	0.00

Notes: *** indicates 1% significance level

[a]p-values are calculated using 1000 bootstrap repetition

Structural changes are determined by the parameter constancy tests. With the presence of structural changes, the dynamic relationship between housing and output will show instability across different sub-samples. This study attempts to reveal this instability by using rolling window regression techniques. The methodology of the rolling window estimators is also known as the fixed-window estimators, involves changing subsample of fixed length and moving sequentially from the beginning to the end of the full sample. This means one observation is added in the forward direction, while, at the same time, dropping one from the end direction for each set of T-*l* set of sub-samples (T being the full sample size and *l* being the number of observation included in each sub-sample). In this study, using a 20 quarter fixed widow, with a 118 observations (starting from 1987:Q1 to 2016:Q2), we estimated 98 subsamples. In this study, optimal rolling window of 20 was selected based on the simulation presented by Pesaran and Timmermann (2005) who posited that the optimal window rolling size depends on the persistence and size of structural breaks. According their simulation, the bias in the AR process is minimized with 20 rolling window size. Also, by performing the causality test using the residual based bootstrap method on each subsample, we would have a total of T-*l* number of causality tests. The justification for the adoption of the rolling technique is drawn on its capacity to allow for changes overtime, in the relationship between the variables. Secondly, it has the capacity to capture the instability across different sub-samples, which is persistent on the presence of structural changes.

The plots of the bootstrap p-values of the rolling test statistics are presented below from figure 1 to 4. In these figures, the horizontal axes show the last observation in each of the twenty-year rolling windows. Figure 1, shows the bootstrap p-values of rolling test statistics. The null hypothesis that house price does not Granger cause output is not rejected at 10 % significance level during the full sample (p value is calculated as 0.81). However, the null hypothesis that house price does not Granger-cause output is rejected during the 1996:Q3-1996Q4, and in the 2004:Q4 at 10% significance level. Therefore, the bootstrap rolling-sample results indicate that house price has weak causal link with output. The LI hypothesis that house price is driven by output is supported, although weakly.

Figure 2, shows the bootstrap p-values for the null hypothesis that output does not Granger cause house price. This hypothesis is not rejected at 10 % significance level during the full sample (p value is calculated 0.27). The result in Figure 2 is indicative of changes in causal link over the sample period. Based on the graph, output has predictive ability for house price during 1992:Q2 - 1992:Q4 and during 1998:Q3-2000:Q3 and during 2003:Q3-2006:Q3 and during 2010:Q4 - 2014Q1. Therefore, it can be concluded that house price clearly has more predictive ability for output. The HF hypothesis that output is driven by housing price is supported.

Figure 3 shows the bootstrap p-values of rolling test statistics, testing the null hypothesis that house price does not Grange cause residential investment. According to the p-values, causal link between house price and residential investment have changed substantially over time. Although, the null hypothesis is not rejected at 10% signficance level in full sample period (p-value is 0.98), it is rejected during three sub-periods that consist of 1993:Q1-1993:Q4, 2006:Q4 and 2012:Q1. From the results, house prices have predictive content for residential investment in three sub-periods.

Figure 4 shows the bootstrap p-values of rolling test statistics, testing the null hypothesis that residential investment does not Granger cause house price. The hypothesis is rejected at 10 % significance level during the full sample (p value is calculated 0.06). However, based on Fig.4, all p-values are not rejected in every sub-period. Therefore Fig.4 also reported substantial changes in the p values over the sample period. This suggests important changes in the causal link over the sample period. The rolling bootstrap sample result shows that residential investment has predictive ability for house prices during 1992:Q3, 2001:Q2-2006:Q1, and 2011:Q1-2016:Q1.

Figure 1: Bootstrap p-values of LR test statistic testing the null hypothesis that HP does not Granger cause GDP

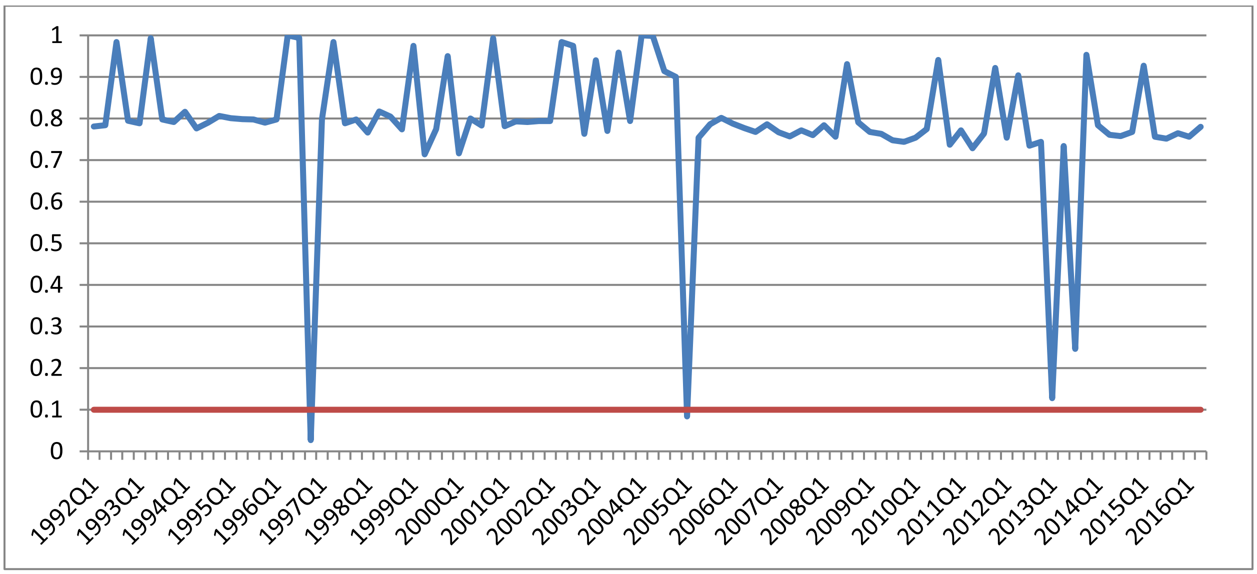


Figure 2: Bootstrap p-values of LR test statistic testing the null hypothesis that GDP does not Granger cause HP

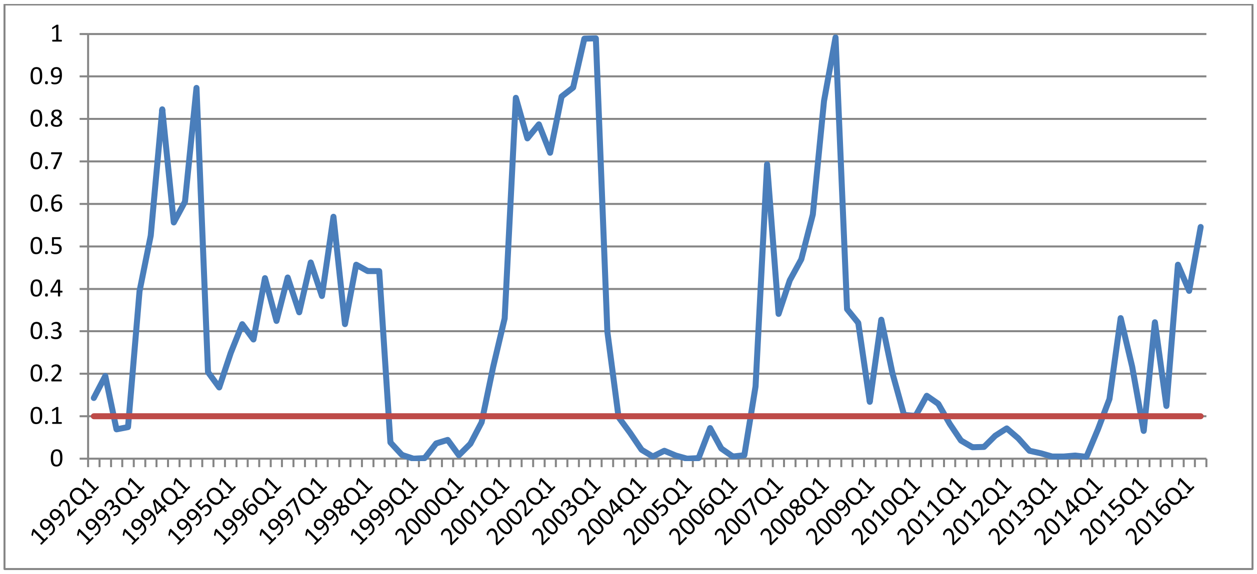


Figure 3: Bootstrap p-values of LR test statistic testing the null hypothesis that HP does not Granger cause GFCF

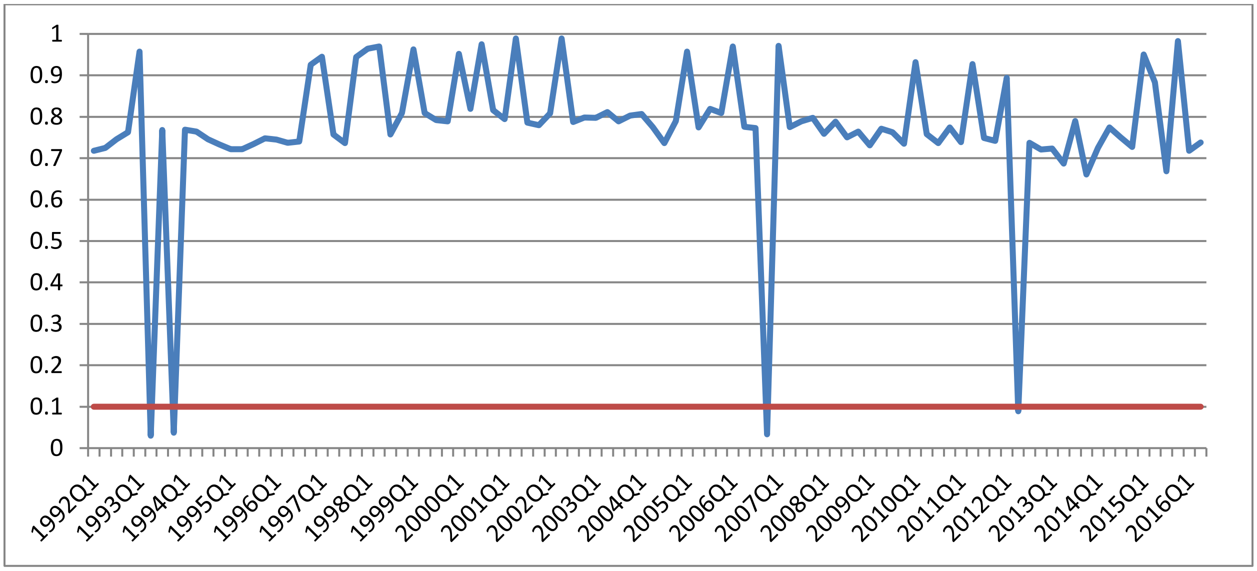
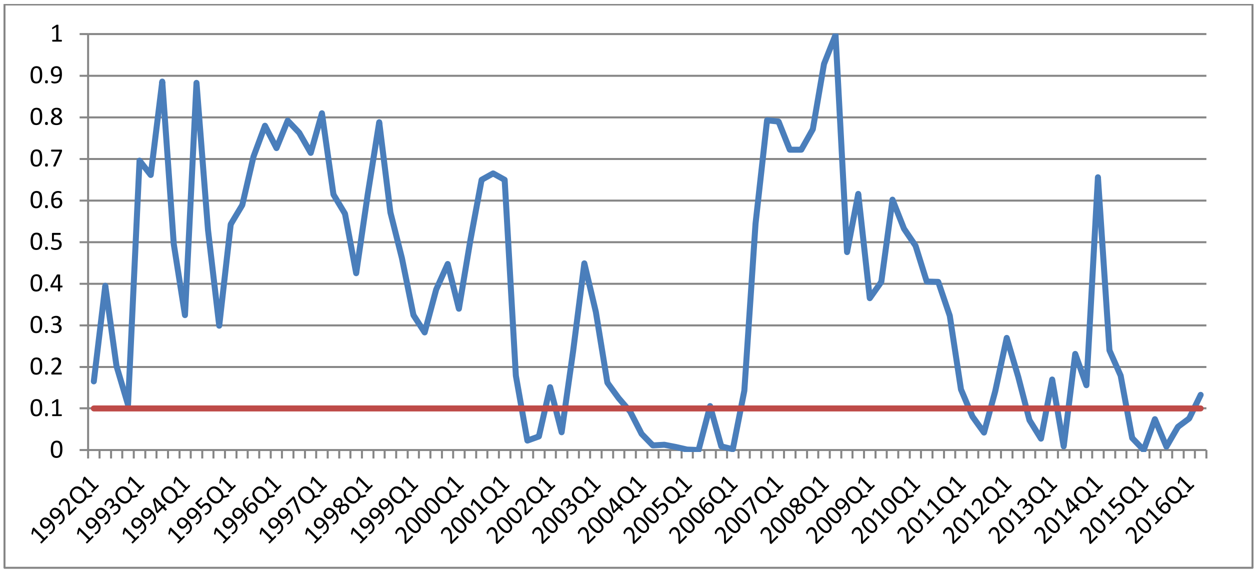


Figure 4: Bootstrap p-values of LR test statistic testing the null hypothesis that GFCF does not Granger cause HP



Conclusion

This article examined the dynamic relationship between gross domestic product, housing prices and residential housing investment in Turkey. Bootstrapped rolling Granger non-causality test was used to examine the time varying causal links for these variables. The data series cover the period; 1987:Q1 to 2016:Q2. We set two different VAR models; first model includes house price and gross domestic product while the second model includes house price and investment. Using Sup-F, Exp-F and Mean-F to determine the stability of the parameters, it was found that the VAR models have instable parameters. Therefore, bootstrap rolling window estimation was used to show that Granger causality cannot be generalized for different sub-samples. The null hypothesis that house price does not Granger causes gross domestic product is rejected at 10 percent significance level. These results indicate the bootstrap p-values of the rolling test cannot be rejected in full sample except the residential investment and house price. House price has predictive ability for gross domestic product during the 1996:Q3-1996Q4 and 2004:Q1. Gross domestic product has predictive ability for house price during 1992:Q2- 1992Q4, 1998:Q3-2000:Q3, 2003Q3-2006Q4 and 2010:Q4-2014-Q1. According to the p-values, causality between house price and residential investment have changed substantially over time. The result shows that house prices have predictive content for residential investment during 1993:Q1-1993:Q4, 2006:Q4 and 2012:Q1. Although, residential investment does not Granger cause house price in full sample, we found substantial changes in the p values over the sample period in which residential investment has predictive ability for house prices during 1992:Q3, 2001:Q2-2006:Q1, and 2011:Q1-2016:Q1. In sum, there is Granger causality between house price and gross domestic product, and house price and residential investment at different periods. As well, gross domestic product has stronger predictive ability for house price in our sample.

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