Impact of Macroeconomic Variables on Housing Prices in Saudi Arabia: A VAR Approach

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**ABSTRACT**

This paper examines how housing prices are determined by macroeconomic factors in Saudi Arabia, namely, Gross Domestic Product Per capita (GDPP), Consumer Prices Index (CPI), and Unemployment Rate (UNEMP). Quarterly data for a period (2014q1 – 2019q4) were collected from publications of Saudi Arabian Monetary Authority (SAMA). Vector Autoregression Analysis (VAR) is employed to capture the dynamic effect of the variables on housing prices. Granger Causality, Variance Decomposition and Impulse response function are also used. The results show that housing prices are insignificantly and positively related to GDPP, whereas it is negatively related to both (CPI & UNEMP). Only CPI has a significant relationship. The three variables, jointly, have Granger causality on HPI. Variance decompositions show that CPI is the variable with the highest explanatory power over the variation of housing prices, followed by GDPP and the UNEMP respectively indicating that CPI is the most influential determinants for housing prices.

 *Key words:* CPI, GDP, real estate, unemployment, VAR.

**JEL Codes**: A11, B22, J60, R30

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## 1. INTRODUCTION

Real estate market is considered as one of basic providers to socio- economic development in any economy. It has also been acted as an instrument of growth in many countries. The sector assists in creating new job opportunities and playing other important roles in the economy. Housing, in particular, is enormously essential for all people, everywhere and at every time. Housing ownership, for example, offers a sense of safety and privacy. Housing sector is also of high significance to property developers, investors and policy makers.

In addition, housing value for the majority of households constitutes the largest proportion of their wealth and its costs roughly absorb almost one quarter of their disposable income (Muellbauer and Murphy, 2008). Thus, housing values have a considerable impact on the propensity to consume among households. Also changes in housing prices tend to have effect upon economic activities through changes in house behaviour patterns (Case, B. J., et al., 2005). Moreover, housing prices play a crucial role for firms operating in the financial market. Thus, house prices affect the portfolio of many other companies involved with the real estate activities (Panos, P., et al., 2009). Based on this significance of housing, a need arises to discuss and evaluate whether macroeconomic factors affect the housing prices in Saudi economy.

Numerous factors could be identified as the key determinants of housing prices. For instance, GDP, level of money supply, consumer price index, the rate of unemployment, interest rates and so on. These factors may have a negative or a positive relationship with housing prices. Also, the degree to which each of these factor impacts the housing prices varies. Thus, understanding the relationship between housing prices and macroeconomic variables is of much importance while making investment decisions as well as policy formulations. This study is intended to state the following questions: Does a relationship exist between housing prices and GDPP? What is the nature of the relationship between housing prices and CPI? Does the rate of unemployment have its impact on housing prices?

This paper intends to present three hypotheses, mainly, H1: the growth in GDPP has a positive effect on changes in housing prices in Saudi economy, H2: the rate of unemployment has a negative significant effect upon housing prices, H3: there exists a causal relationship between changes in CPI and changes in housing prices.

The major goal of this paper is to identify the main factors affecting the overall housing prices in Saudi economy during the period (2014q1-2019q4). Specifically, the study is intended to assess quantitatively whether major macroeconomic factors such as GDPP, unemployment and consumer prices have any impact upon housing prices.

About significance, the study believes that the macroeconomic determinants of housing prices in Saudi Arabia have not been deeply studied and researched. This study, therefore, tries to fill in this gap. Moreover, it is expected that this study will add to the body of knowledge in existence in the real estate field which will be beneficial to academicians and researcher and provides a good foundation for future research in the field.

The paper is organized as follows: Section 1 presents an introduction, the problem statement, hypotheses, objectives, and significance of the study. Section 2 provides a general overview of Saudi real estate sector and on the housing sector. It also discusses the prevalent available literature on the underlying subject. Section 3 describes data, methodology, and empirical model. Section 4 highlights discussion and results. The final Section provides a conclusion and policy implications.

## 2. Real Estate in KSA and Literature Review

### 2.1 Real -Estate Market and Residential Sector in KSA: Overview

Over the last few decades, the Saudi real estate market has witnessed a continuous change and development. Housing sector has been a target of several monetary and fiscal policies. In addition, the sector has seen permanent economic reforms, where both public and private sectors are prepared to take

initiatives and play the required role in developing the real estate market. Despite the current conditions in the Saudi real estate market, it is expected that the sector might remain positive as a result of government initiatives to address key challenges facing the housing sector in Saudi Arabia. The government has also made other regulatory efforts such as the white land tax, the large housing schemes and the mortgage law to deal with barriers facing the housing market.

In addition, other factors such as demographic factors will continue its impact on demand for the housing market in Saudi Arabia. This includes a high percentage of youth population which has registered a substantial growth rate over the past decades. On a macroeconomic level, the economy is expected to gradually cope with the new strategy in oil prices as it diversifies away from its dependence on this sector in line with new socioeconomic visions and reforms. Moreover, the implementation of various urban initiatives and investment in infrastructures are considered other catalysts factors for development and growth in the housing sector.

As for housing price index (HPI) for the Kingdom of Saudi Arabia, it was recently issued by the Saudi Credit Bureau (SIMAH). It was created from a sample of more than 40,000 real estate records that were provided by some of the major mortgage service providers in the Kingdom, and it measures the changes in residential property prices quarterly, from 100 basis points that were set in the first quarter, 2013. HPI was calculated using a technique called Hedonic Regression, which is the same statistical technique, used by some major housing price indicators in other countries, such as the United Kingdom, Australia, and the United States.

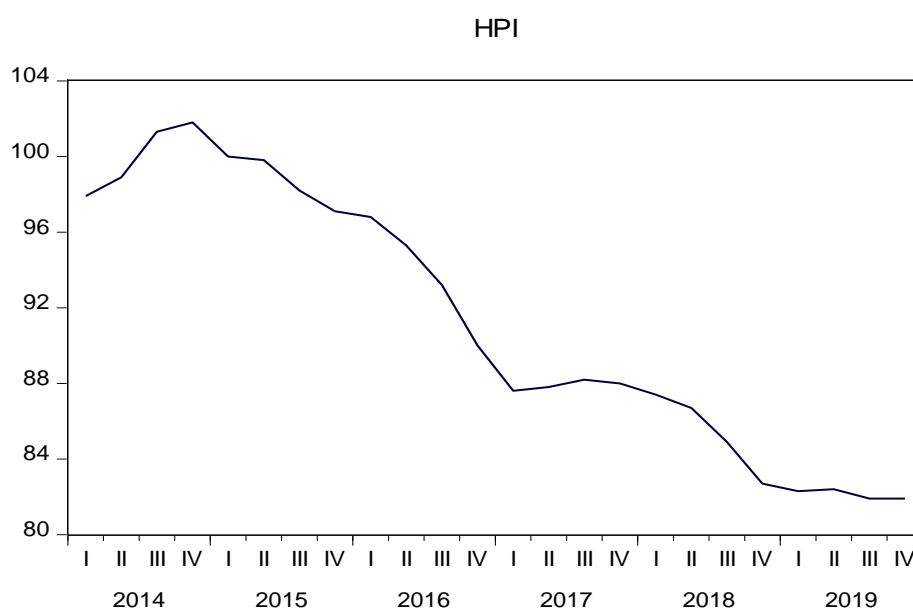**Figure 1.: HPI During the period (2014 Q1 – 2019 Q4)**



Figure 1 reflects that housing prices witnessed noticeable changes in real estate price indicator in Saudi Arabia for the period under study from the first quarter of the year 2014 and up to the fourth quarter of 2019 in which the arithmetic mean of the indicator reached 91.3 with a standard deviation of 6.67. Figure 1 also indicates that housing prices were declining during the period as the value of residential prices indicator was 97.9 at the beginning of the period and then took a slight upturn in the third quarter of 2014 reaching 101.8 before taking a downward trend up to the year 2019 reaching its lowest level at 81.9 in the fourth quarter of 2019. This was due to several factors among which was the fall in demand for residences because of the economic crisis and the plummet in the oil revenues of the Kingdom in addition to the reduction in the numbers of expatriates in the Kingdom which also led to a reduction in demand for residences and the consequent reduction in prices.

**2.2 Literature Review**

Jaya G. Prabhu Parrikar (2019) conducted an empirical study on the influence of GDP, interest rates, housing credit, exchange rate and inflation with House Price Index in India during the period 2010 Q1 - 2017 Q4. The study employed correlation and multiple regression analysis, the Johansen cointegration test and VECM to identify the dynamic relationship in short run as well long run. The study concluded that GDP, exchange rates, housing credit and inflation have strong positive correlation with house price index except for weak negative correlation with interest rates. The Vector Error Correction Model observed unstable long run association however there is presence of short run casual association of GDP, housing credit and interest rates with House price index. The study observed the absence of long run association of macroeconomic factors especially the GDP and House Price Index.

Korkmaz (2019) aimed to verify whether residential areas in Turkey are affected by the general inflationary pressures, specifically in the housing price index (HPI). Data was used from 2010: 01 to 01: 2019 and the Consumer Price Index (CPI), as well as the Producer Price Index. The causal relationship between the variables was analyzed by Konya Causality Test (2006). The main results indicate that HPI causes inflationary pressures in some residential areas of Turkey.

Shen Chen, et al (2018) examined the impact of monetary policy on housing prices in China using a VAR model. Granger causality tests, impulse response functions, and variance decompositions are used to analyze the impact of two monetary policy variables, market-based short-term interest rates and money supply, on housing prices. The results showed that a contractionary monetary policy will cause the growth rate of housing prices to decline in China. In particular, a positive shock to market-based interest rates measured by the 7-day interbank offered rate has a significant and negative effect on housing prices in a range from five months to one and a half years after the shock takes place. However, the paper finds no evidence that supports the significant impact from money supply on housing prices. The results imply that the market-based short-term interest rates are effective monetary policy instruments for the central bank to conduct its policy to affect housing prices.

Yufang W, et al (2016) investigated the main factors affecting housing price in Shanghai. The study adopted an econometric model using seven explanatory variables, per capita disposable income in Shanghai, land transaction price index, construction cost, urbanization rate, interest rate, CPI of residence and investment in real estate in Shanghai. The study reached out that only interest rate reflected poor explanatory while the other six variables could be good explanatory variables for the housing price.

T.S. Ong (2013) intended to analyze housing price in Malaysia during (2001 – 2010) using regression analysis. The study considers six independent variables namely population, GDP, labor force, interest rates, inflation rates and Real Property Gain Tax. The study concluded that house prices were significantly linked with GDP, population and RPGT. Thus, there exists a positive relationship between income and housing prices.

Julius (2012) studied the determinants of residential real Estate prices in Nairobi. Her objective was to identify factors that have their impact upon the real estate market. In particular she investigated how interest rates, level of money supply, rate of inflation, employment rate and population growth affected house prices. Using secondary data, a multivariate regression was used to estimate the relationships. The study found out that employment growth and the level of money supply have their clear effect upon real estate market and its influence on real estate prices. An increase in interest rates reduces residential real estate prices.

**3. Data, Methodology and the Empirical model**

**3.1 Source of Data**

The empirical analysis was carried out using quarterly data from 2014q1-2019q4. The variables used in the study consist of changes in housing prices index (HPI), levels of general price measured by consumer prices index (CPI), unemployment measured by employment rates (UNEMP) and Gross

Domestic Product Per capita (GDPP). The data have been collected from the official annual statistics from the governmental authorities. The details of all independent and dependent variables are summarized in Table (1).

**Table (1)**

**Detailed Dependent and Independent Variables**

| Variables | Proxy | Unit measurement |
|---|---|---|
| | | Dependent variables |
| Housing Price Index (dependent variable) | HPI | Index (2014-11= base year) |
| | | Independent Variables |
| Gross Domestic Product | GDPP | Amount in Riyals (cumulative figures) |
| Consumer Price Index | CPI | Index (2012-13= base year). |
| Unemployment Rates | UNEMP | Rates Quarterly data |

**3.2 Methodology and Proposed Empirical Model**

The VAR model usually assumes all the variables are endogenous and can give better forecasts. The main purpose of this study is to examine the association of macroeconomic factors on Housing Price Index. The dependent variable is the House Price Index (HPI) and the independent variables are namely GDP, inflation rates (CPI) and unemployment rates (UNEMP). The empirical model of this research could be specified as below, in first difference:

$$HPI_t = \beta_0 + \beta_1 GDPP_t + \beta_2 CPI_t + \beta_3 UNEMP_t + u_t \quad \textbf{(1)} \text{ where:}$$

HPIt = House Price Index (Index, 2010-11=100)

GDPPt= Gross Domestic Product per capita in KSA

CPIt= Consumer Price Index (used as proxy for inflation).

UNEMP= the level of unemployment

μt = error term

**4. Discussion and Results**

**4.1. Unit root analysis**

The explanatory variables were tested for unit root non-stationarity by using unit root test proposed by Augmented Dickey-Fuller (ADF). The hypothesis that the variables GDPP, CPI and UNEMP contain a unit root could not be rejected at 5% significance level.

For each variable, the paper uses the following equation:

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \sum_{i=2}^{p} \psi_i \, \Delta Y_{t-i+1} + \varepsilon_t \qquad (2)$$

where Y is the variable of interest, $\Delta$ implies the change, t is the time trend, p is the number of time lags, and $\varepsilon_t$ is the white noise residual with zero mean and constant variance. The parameters $\alpha_0 \gamma$ and $\psi_i$ are to be estimated. If the parameters are significant, one rejects the null hypothesis and there is no unit root. The data series for the concerned variable is stationary.

Table (2) reflects the results of the Augmented Dickey-Fuller (ADF) for the time series data of the three model variables. The results based on the ADF unit root tests show that HPI, GDPP, CPI and UNEMP are non-stationary in level but they are stationary in first difference at 5% significance level.

**Table (2)**

**Unit Root Tests using ADF Tests Statistics**

| Variables | Levels | 1st Difference(intercept) |
|---|---|---|
| DHPI | -1.180541 | -4.249564* |
| DCPI | -1.011369 | -4.430873* |
| DGDPP | -1.297742 | -3.850264* |
| DUNEMP | -0.954340 | -6.194106* |

Note: * represents significance at 5% level respectively

## 4.2 Estimates and regression analysis

   To assess the relationship between housing prices and macroeconomic factors, regression analysis is carried out. The results of regression analysis are presented in Equation (3) and Table (3). The coefficients of GDPP seem to be positively affecting the housing prices and the p-value returned indicates insignificance at 5% significance level. Results in conformity with (Balázs, É. and Dubravko, M. 2007). However, the variable of (UEMP) was shown to exert a negative insignificant effect on housing prices. Results which are in line with (Abelson, P., Joyeux, R., Milunovich, G., & Chung, D. (2005, Dias-Serro (2005), Qingyu, Zhu (2010) and Turnbull et. al. (1982). Finally, the explanatory variable (CPI) reveals its reversal effect on (HPI) which is statistically significant. As is known, housing demand decreases in the case of a decrease in the purchasing power of people who demand housing, i.e., in high inflationary environments. Housing prices also decrease due to the decrease in housing demand. Therefore, inflation can have a decisive impact on house prices. Results which are in consistency with (Arestis, P. and González, A.R. 2014). Finally, the adjusted R- squared adjusted was 0.974, which implies that the model can explain 97.4% of the variations in housing prices and the goodness of fit is very good. The signs of the coefficients are in line with the literature.
The estimated equation of the model could be written as follows:

$$DHPI = 1.274DHPI\ (-1)\ -0.104DCPI\ (-1) + 5.96E\ DGDP\ (-1)\ -0.203685DUNEMP\ (\ -1)\ -14.749 \qquad (3)$$

**Table (3)**

**Model Estimates (Dependent Variable: DHPI)**

| Method: Least Squares (Gauss-Newton / Marquardt steps) | | | | |
|---|---|---|---|---|
| Sample (adjusted): 2014Q3 2019Q2 | | | | |
| Included observations: 17 after adjustments | | | | |
| DHPI = C(1)*DHPI(-1) + C(2)*DCPI(-1) + C(3)DGDP(-1) +C(4) DUNEMP( -1) + C(5) | | | | |
| | Coefficient | Std. Error | t-Statistic | Prob. |
| C(1) | 1.273838 | 0.119596 | 10.65122 | 0.0000 |
| C(2) | -0.104406 | 0.037761 | -2.764888 | 0.0171 |
| C(3) | 5.96E-06 | 5.46E-06 | 1.091523 | 0.2965 |
| C(4) | -0.203685 | 1.296004 | -0.157164 | 0.8777 |
| C(5) | -14.74898 | 26.88392 | -0.548617 | 0.5933 |
| R-squared | 0.974746 | Durbin-Watson stat | | 1.176678 |
| Adjusted R-squared | 0.966328 | Log likelihood | | -22.66872 |
| S.E. of regression | 1.092719 | F-statistic | | 115.7945 |
| Sum squared resid | 14.32841 | Prob(F-statistic) | | 0.000000 |

  Source: Author's Computation using EViews 11.0 Software

### 4.3 Granger Causality

The paper utilized Granger causality test to check the causal relationship. Table (4) shows the results of the Granger causality test in the VAR model. Data reflects a two-way Granger causality between (CPI) and House Price Index (HPI). CPI can cause House Price Index to change, and the effect is obviously significant. The change of CPI is more reflected in the change in housing prices index since the p-value of CPI is 0.0057 which is less than 5%. These findings are similar to the finding of Korkmaz, O. (2020). As well, the explanatory variables, jointly, has Granger causality on HPI.

**Table (4)**

**VAR Granger Causality (Dependent variable: DHPI)**

Sample: 2014Q1 2019Q3
Included observations: 17

| Excluded | Chi-sq | Df | Prob. |
|---|---|---|---|
| DCPI | 7.644604 | 1 | 0.0057 |
| DGDPP | 1.191423 | 1 | 0.2750 |
| DUNEMP | 0.024700 | 1 | 0.8751 |
| All | 13.33310 | 3 | 0.0040 |

Source: Author's Computation using EViews 11.0 Software

### 4.4 Test of Source of Volatility

In order to provide further insight into on the relationships of house price and its determinants, the variance decomposition and impulse response function are calculated. These two approaches give an indication of the dynamic properties of the system and to evaluate the relative importance of the variables beyond of the sample period.

### 4.4.1 Impulse Response Functions

The impulse response functions show the dynamic behavior of the model by examining the response of variable aftershocks to the other variables. They describe the impact of a VAR model to other endogenous variables. The housing price index responds to CPI, GDPP and unemployment shocks leveling off after 10 quarters from the initial shock.

**Figure (2)**
**Response to Cholesky One S.D. (d.f. adjusted) Innovations**



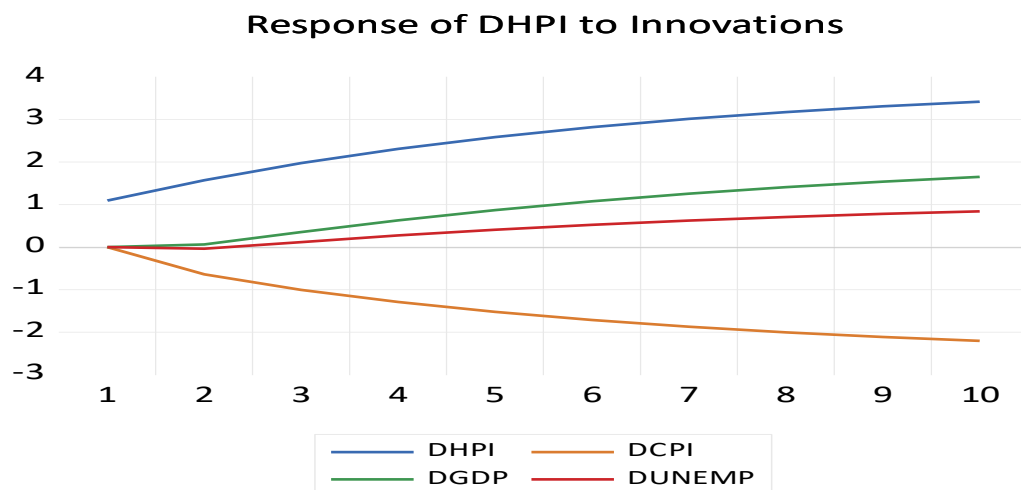Response of DHPI to Innovations

Table (5) and Figure (2) illustrate the response functions of housing prices to a unitary shock of the endogenous variables are correlated. It is evident that housing prices have direct relationships with the variables GDPP. However, the variables (CPI & UNEMP) have a negative relationship with housing prices. In the forward shock GDPP, positive housing prices fluctuate in the first two quarters, then continue to increase in the next eight quarters. GDP has a positive impact on prices in a short time, the long-term impact on prices is not significant. Moreover, in the forward shock CPI, negative housing prices fluctuate in the first four quarters, then continue to decrease in the next six quarters. CPI has a negative impact on prices in a short time; the long-term impact on prices is highly significant. Similarly, in the forward shock UEMP, negative housing prices fluctuate in the first three quarters, and then continue to decrease in the next seven quarters. Unemployment has a negative impact on prices in a short-time; the long-term impact on prices is insignificant.

### 4.4.2 The Dynamic Analysis: The Variance Decompositions

As a part of dynamic analyses, the test of Variance Decomposition (VDC) is conducted. This section determines quantitatively the degree of importance of the various macroeconomic aggregates, which influence housing prices beyond the sample period. (VDC) test is carried out in order to forecast the error variance between all the variables of the study for the next 10 quarters. Variance decomposition of VAR model is able to give the relatively important information of the random fluctuations in samples.

Table (5) reports the variance of the forecast error of housing prices and its decomposition into proportion attributable to random innovation shocks to each macroeconomic variable, including its own. The results showed that among the source of variance in HPI fluctuations, the impact itself is the first source of variance, which is the most obvious in the first period, accounted for 100%. With prolonged periods, the price fluctuations gradually reduced the impact on its own, and in the long-term it seems there is 64% rely on their own internal development. CPI is the variable with the highest explanatory power over the variation in housing prices. The CPI increases by 15.6% in the short-run and the impact of CPI increased to 23.2% in the long-run. Shocks in both GDPP and UNEMP explain about 1.4% and 0.170% in the short-run and only 10.2% and 2.5% in the long-run respectively. This suggests that shocks to the GDPP, CPI and unemployment explain about 36% of the movement of the house price index, indicating that that variables are not good at transmitting the effects of the shocks to the housing market and implies that there are other variables to be included in the model.

**Table (5)**

**Variance Decompositions of DHPI**

| Period | S.E. | DHPI | DCPI | DGDP | DUNEMP |
|---|---|---|---|---|---|
| 1 | 1.092719 | 100.0000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 2.021819 | 89.88421 | 9.978792 | 0.103553 | 0.033441 |
| 3 | 3.024179 | 82.85751 | 15.56266 | 1.409877 | 0.169953 |
| 4 | 4.075769 | 77.70681 | 18.58999 | 3.158401 | 0.544798 |
| 5 | 5.151905 | 73.84894 | 20.34706 | 4.832982 | 0.971017 |
| 6 | 6.234053 | 70.89515 | 21.43424 | 6.297860 | 1.372748 |
| 7 | 7.309110 | 68.58244 | 22.14341 | 7.545123 | 1.729022 |
| 8 | 8.367886 | 66.73429 | 22.62656 | 8.600827 | 2.038319 |
| 9 | 9.403965 | 65.23080 | 22.96788 | 9.496144 | 2.305177 |
| 10 | 10.41292 | 63.98879 | 23.21650 | 10.25924 | 2.535472 |

Source: Author's Computation using EViews 11.0 Software

### 4.5 Post Estimation Tests

### 4.5.1 Serial Correlation LM Test

The probability of the observed R- squared is more than 0.05, and is satisfactory, and so the null hypothesis of absence of serially correlated residuals (i.e. autocorrelation) is not rejected, as reflected in Table (6).

**Table (6)**

**Breusch-Godfrey Serial Correlation LM Test**

| Null hypothesis: No serial correlation at up to 1 lag | | | |
|---|---|---|---|
| F-statistic | 1.397225 | Prob. F(1,11) | 0.2621 |
| Obs*R-squared | 1.915980 | Prob. Chi-Square(1) | 0.1663 |

Source: Author's Computation using EViews 11.0 Software

### 4.5.2 Heteroskedasticity Test

The probability of the observed R- squared is greater than 0.05, and is satisfactory, and so the null hypothesis of absence of Homoskedasticity is not rejected as shown in Table (7).

**Table (7)**

**Heteroskedasticity Test: Breusch-Pagan-Godfrey**

| Null hypothesis: Homoskedasticity | | | |
|---|---|---|---|
| F-statistic | 1.157685 | Prob. F(4,12) | 0.3769 |
| Obs*R-squared | 4.733558 | Prob. Chi-Square(4) | 0.3157 |
| Scaled explained SS | 1.538966 | Prob. Chi-Square(4) | 0.8197 |

Source: Author's Computation using EViews 11.0 Software

### 4.5.3 Stability

The long-term coefficients stability is tested by the short-term dynamics. Once the VAR model is estimated, testing the cumulative sum of the recursive residuals (CUSUM) is applied to assess the stability of the parameters in the long-run. According to the graphical representation, CUSUM and CUSUMSQ (Figures 3 &4) reveal a satisfactory plot of the recursive residuals at the 95% significance level, which implies that none of the parameters falls outside of the critically dotted lines. This empirically dismisses any trace of inconsistent parameter estimates and further enhances the standard significance of the conventional test statistics without a trace of nuisance parameters.
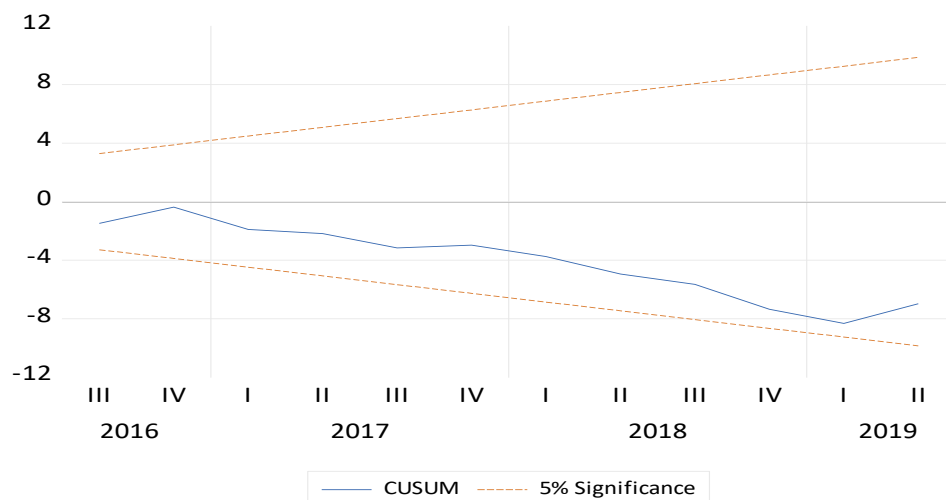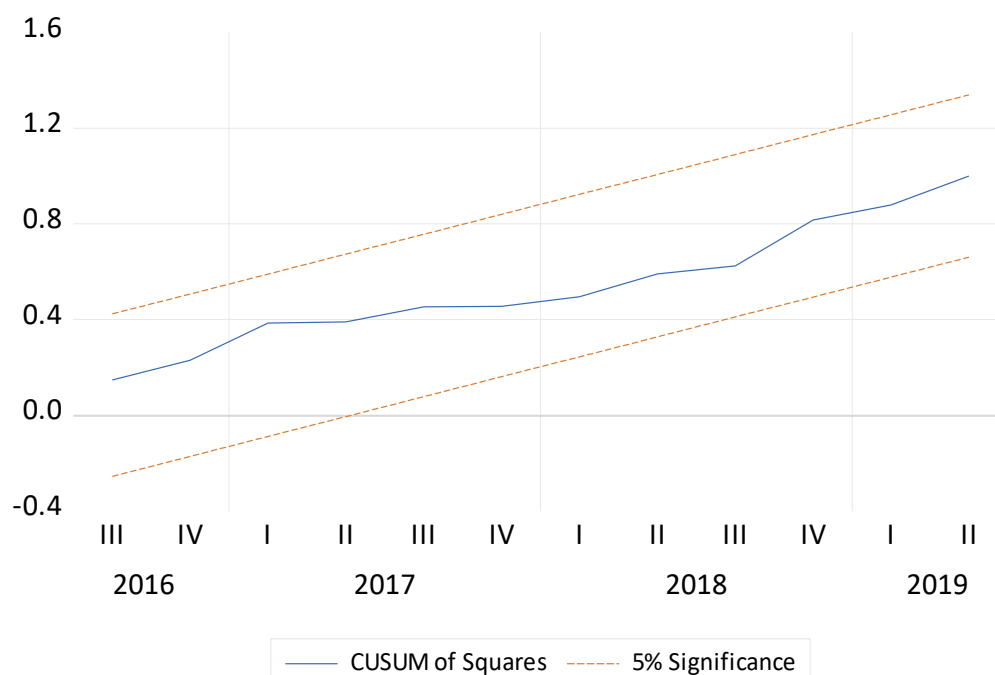
**Figure (3)**

**Figure (4)**



These diagnostic tests confirm the validity of the model and as such, the model can therefore be relied upon for analysis and policy formulation by relevant government authorities and state planners.

## 5. Concluding remarks and policy implications

The main objective of this paper was to analyze the dynamic effects of certain macroeconomic variables (i.e., GDPP, CPI and UNEMP) on housing prices in KSA. The study provides a VAR framework to analyze the relationship between house prices and those variables in KSA during the period (2014q1-2019q4). The results show that housing prices are insignificantly and positively related to GDPP, whereas it is negatively related to both (CPI & UNEMP). Only CPI has a significant relationship. The three variables, jointly, have Granger causality on HPI. More specifically, variance decompositions show that CPI is the variable with the highest explanatory power over the variation in housing prices, followed by unemployment and CPI respectively. After combining the results of both the variance decompositions and impulse response functions, certain policy implications should be indicated. Once CPI is shown to be the most influential determinants for housing prices, the future course of housing prices in KSA could be assessed.

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