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House prices, Economic Output, and Inflation Interactions in Iran

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Abstract

Many economic theories indicate that house price changes should have real effect on the economy and vice versa. This study investigates the existence of causality among house prices, economic growth, and inflation in Iran using the Toda and Yamamoto approach during the period 1990:1–2008:3. The results show that there is evidence of a significant multidirectional link between house prices, and the macroeconomic factors. The causality tests confirm that GDP and CPI Granger cause house prices, and feedback effects are observed for house prices and GDP. This paper finds no evidence of Granger causality of real house price changes to CPI.

Keywords: House price, GDP, Inflation, Causality, Iran

1. Introduction

The housing market is a large sector of the economy and it is highly possible that the housing market and the economy interact. Reviewing studies of housing market reveals some agreement in identifying the underlying determinants of the house prices. Two of the key drivers frequently cited in the recent run up in house prices have been the rising income levels and the inflation. Less agreement, however, is on the theoretical and empirical approaches used to model these factors.

Iran's asset price has increased rapidly over the last few years. Over the period 1990–2008, prices for houses in Iran rose by almost 330%. From a macroeconomic point of view, the housing sector is an important aspect of the Iran's economy. Therefore the performance of the housing market has a major impact on the overall performance of this economy. In the absence of better knowledge about the relations and specification in modeling macroeconomic impact on the housing sector, the application of the vector autoregressive (VAR) method is a possible alternative.

The primary focus of this article is to analyze empirically the existence of relation between house prices and some macroeconomic variables. There is a relatively recent, growing recognition about the importance of the interactive nexus between housing markets and the macro economy. Therefore the relation between house price and economic growth has important policy implications.

In this paper we provide empirical evidence on the nature of causality between real house prices, real GDP, and inflation. The analysis is performed for Iran economy based on VAR method over the sample period. The novelty of this paper is that the used econometric model explicitly allows us to study the system of variables simultaneously, to provide evidence on causal links between house prices, and other variables. Furthermore, this result would provide a better understanding of relationship between the variables.

It is presumed that macroeconomic variables causes house price changes and not vice versa. But it is being asserted that the nature and direction of causality may vary from one country to the other. A country-specific case study can capture and account for the complexity of the economic environment and history of an individual country. The choice of Iran for this study is also motivated by the fact that it has experienced a significant rise in house prices and inflation in the recent decades.

The paper is organized as follows. The next section begins by reviewing some of the existing studies on house prices. In Section 3, the theoretical framework of house price and macro economy relation is established. Section 4 describes the methodologies employed in this paper. Section 5 reviews the data and presents empirical results of the estimation and Granger causality tests. Finally conclusions are presented in Section 6.

2. Literature review

This part reviews the existing literature about the nexus of the macro economy and the housing market. A review of the literature dealing with house prices over the period of the

rapid price appreciation reveals in studies by Kenny (1999), Roche (1999, 2001, 2003), McQuinn (2004), and Fitzpatrick and McQuinn (2007). The results from these studies would suggest that actual prices are well explained by fundamental factors within the economy.

Earlier studies, which analyzed the effect of macroeconomic aggregates (such as inflation, economic growth, GDP, unemployment, etc.) on the housing sector considered macroeconomic variables as exogenous. So these analyses have not allowed for the fact that the macroeconomic variables are themselves influenced by demand and supply shocks in the housing sector. Among relevant studies, Abraham and Hendershott (1992), using a pooled time-series cross-section regression analysis, explained that economic variables such as employment and income growth, inflation of real construction costs, and changes in real interest rates accounted for about 40% of the variation in regional housing prices.

Baffoe-Bonnie (1998) developed a vector autoregressive (VAR) model, which takes into account the full interaction of the housing sector with the rest of the economy. The results suggest that macroeconomic variables produce cycles in housing prices and houses sold.

Some studies generally find that the estimated elasticities of real house prices with respect to economic fundamentals differ widely, depending on the sample of countries, the period examined, and the methodology used (Annett, 2005; Ayuso, Martinez, Maza, & Restoy, 2003; *Girouard*, Kennedy, den *Noord* & André**,** 2006; Terrones & Otrok, 2004; and Tsatsaronis & Zhu, 2004).

A few studies utilize dynamic models such as Vector Autoregression (VAR) and the concept of Granger causality to study how house price changes may affect the economy. Chen and Patel (1998) examine dynamic causal relationships between house price and its five determinants, including total household income, short-run interest rates, stock price index, construction costs, and housing completions, in Taipei. They find that all five determinants Granger cause house prices, but only house prices and stock price index have a bilateral feedback effect. Apergis (2003) analyzes the dynamic effects of housing loan rates, inflation and employment on the price of new houses sold in Greece. An error correction vector autoregressive (ECVAR) model is used to model the impact of the macroeconomic variables on real house prices. Variance decompositions show that the housing loan rate is the variable with the highest explanatory power over the variation of real housing prices, followed by inflation and employment.

Leung (2004) provides a selective survey of efforts focused upon interplay between the housing markets and macro economy. The results of Ortok and Terrones (2005) show that house prices have more effect on macroeconomic factors and not vice versa.

A study by Gallin (2006) challenges the traditional view of the long-run equilibrium relationship, arguing that the traditional co-integration approach has low power and uses the panel data test for the US and found no evidence of co-integration. Égert and Mihaljek (2007) show that house prices in central and Eastern Europe (CEE) are determined to a large extent by the underlying conventional determinants of house prices and some transition-specific factors.

McQuinn and O'Reilly (2008) assess the linkages between money, credit, house prices and economic activity in industrialized countries. There is evidence of a significant multidirectional link between house prices, monetary variables and the macro economy. Beltratti and Morana (2010) conclude that there is bidirectional relationship between house price and macroeconomic factors for G7 countries.

Hilde and Dag Henning (2010) find that house prices react immediately and strongly to a monetary policy shock. Furthermore, the fall in house prices enhances the negative response in output and consumer price inflation. But Gupta, Jurgilas and Kabundi (2010) indicate that house price inflation responds negatively to monetary policy shock, so that the responses are heterogeneous across the middle-, luxury- and affordable-segments of the housing market.

The empirical results of Adams and Füss (2010) indicate house prices to increase in the long-run by 0.6% in response to a 1% increase in economic activity while construction costs and the long-term interest rate show average long-term effects of approximately 0.6% and −0.3%, respectively.

There are other strands of the research focusing on the house prices and financial market (Chen, 2001; Benjamin, Chinloy & Jud, 2004; Kishor, 2004; Iacoviello, 2004, 2005; Gerlach & Peng, 2005; Greiber & Setzer, 2007; Adalid & Detken, 2007).

Chegeni, and Asgari (2007); Ja'fari Samimi, Elmi, and Hadizadeh (2007); Khiabani (2003); Nasrollahi, Tayebi, Shajari, and Forutan (2009); and Zarepour (2006) study the factors influencing house prices in Iran. All these studies conclude that some macroeconomic variables such as real production, inflation, stock prices, exchange rate, and liquidity have impact on the dynamic behavior of house prices.

Although the co-integration technique has been used lately by some researchers in the housing market, the focus is on modeling house prices rather than testing the causality. Furthermore, most studies focus on the link between economic variables and house prices explore the link only in one direction. This paper makes a contribution to the growing literature by providing additional evidence in the context of Iran housing market. The empirical outcomes of the subsequent studies on this subject, which differ in terms of the time period, various characteristics of the considered economy, econometric techniques, and the proxy variables used in the estimation, have reported mixed results and are not conclusive to present policy recommendation that can be applied across countries.

3. Causality Relationships

There seems to be a consensus among economists and policy makers that house prices have been playing an important role in fueling the growth of the economy. Indeed, many economic theories indicate that house price changes should have real effects on the economy. The wealth effect of house prices may partially contribute to the impact of house prices on economic growth, and there are likely other mechanisms through which house prices directly affect economic production. First, increasing house prices may indicate excess demand or strengthening of the housing market, which in turn may lead to more construction and more residential investment. Moreover, increasing house prices are likely associated with

increasing land prices, which may affect investment decisions. Both changes in residential and commercial investment may directly affect economic production. Second, increasing house prices are often associated with increasing trading volume, which would be associated with more service provided by real estate agencies and mortgage lenders. Third, decreasing house prices may increase the default probability for mortgages, which in turn may disturb the financial market and thus negatively affect economic growth.

In a rapid growing economy, economic growth will certainly push the income and house prices to rise. Previous studies usually presume that there exists a stable relationship between house prices and income. Malpezzi (1990, 1999) analyzed house price and income by positing a long-run equilibrium ratio between typical house prices, and income.

Theory based on the permanent income hypothesis suggests that housing consumption in any particular period is a stable function of the average income over the current cycle. However, this permanent income hypothesis does not appear to be sufficient to explain the fluctuations in house prices. This is because housing is a multidimensional commodity that can be regarded both as a durable consumer good and as an asset for investment (Chen, Tsai & Chang, 2007).

In addition to economic growth, other economic variables, such as inflation or money supply, can affect house prices. With regard to the impact of inflation on the housing sector, different views have been held (Feldstein, 1992; Poterba, 1992). In particular, Feldstein (1992) indicated that increasing inflation serves to reduce people's incentive to invest in real estate, which in turn lowers housing demand. On the other hand, it can be argued that inflation causes nominal housing payments and construction costs to rise, which implies a lower housing demand.

While comparative studies of causal links between house prices and macroeconomic variables are important, a large proportion of house price volatility is endogenous to the market. Most time-series such as GDP or inflation exhibit persistent upward trend over time. House prices, similar to those series, have continuously increased for a long time. As Reichert (1990) rightly points out, "housing markets are not entirely isolated and distinct submarkets, for they in turn react to key housing trends as well as to various national factors."

The relationships between house price and its determinants are complex because of their nature. Theoretically, house price determinants are expected to be exogenous variables. However, in most cases, two-way relationships could be existed, meaning that house prices may also affect these determinants. So, it is important to determine a directional relationship between these variables. An increase in GDP leads to increase in both demand for housing and prices. On the other hand, income also has a feedback effect from house prices. This is due to the fact that a house represents an accumulation wealth of a household that rises with the appreciation of the house prices.

Based on theory and empirical results of Iran exchange rate is another important factor on house prices. Rising exchange rate increases housing market demand to maintain the assets value, which in turn increase the house price. Therefore this variable is also included in the

model. In considering a model of house prices we define the actual house prices, Gross Domestic Production, and Consumer Price Index variables as the main variables in an endogenous model. Then, exchange rate as an additional variable is included and a four variable model is estimated.

4. Data and econometric methodology

4.1 Data

The set of data series used in the empirical analysis comprises real GDP, the consumer price index (CPI), real house prices, and the exchange rate. The data used in the study is quarterly and covers the period 1990:1 to 2008:3. The data measured in constant 1997 prices are drawn from the Central Bank Balances of Iran. We used the CPI rather than alternative measures of the aggregate price level, mainly for the reason that central bank's inflation targets usually refer to some kind of consumer price index.

All the series are transformed into logarithms. First, it is necessary to determine whether the variables are difference stationary or trend stationary. This is done by testing the null hypothesis that each variable included in the model contain a unit root.

4.2 Econometric methodology

The VAR approach makes minimal theoretical demands on the structure of the model, and it employs a common lag for all variables in all equations. Sims, Stock, and Watson (1990) and Toda and Phillips (1993) pointed out that in a system that contains unit roots, standard Wald statistics based on ordinary least-squares (OLS) estimation of level VAR model for testing coefficient restrictions have nonstandard asymptotic distributions and cannot be applied to mixed integration orders. Toda and Yamamoto (1995) proposed a simple procedure requiring the estimation of an "augmented" VAR, even when the variables have different orders, which guarantees the asymptotic distribution of the MWald statistic.

Therefore, the Toda-Yamamoto causality procedure has been labeled as the long-run causality test of the coefficients of VAR. For this purpose, a VAR is estimated with lag order of $(k+d)$, where d is the maximum order of integration of the variables in the system and k is the VAR order. Then, the Granger causality is tested by performing hypothesis tests in the VAR, ignoring the additional lags. Based on this procedure, linear and nonlinear restrictions can be tested using standard asymptotic theory. The procedure is valid, since $k \geq d$.

A time series *Yt* Granger causes another time series *Xt* if present value of *X* can be better predicted by using past values of *Y* than by not doing so, considering also that other relevant information (including the past values of *X*) are used in either case. If both of these events occur, there is a feedback effect. Considering the augmented VAR(2):

$$v_t = \alpha + \beta v_{t-1} + \gamma v_{t-2} + e_{vt}$$

Where $Vt=(x_1, x_2, x_3)'$, α is a (3×1) vector of constants, β, γ are (3×3) coefficient matrices, and e_{vt} denotes white noise residuals.

To affirm that x_2 does not Granger cause x_1, we will test the parameter restriction by constructing the usual Wald test based on least-squares estimates. The Wald statistic follows an asymptotic Chi-square distribution with degrees of freedom equal to the number of "zero restrictions".

5. Empirical Analysis

The effects of house price changes on consumption (via the wealth effect or the collateral effect) and saving are important channels through which house price changes ultimately affect the output of the economy. Our study aims to understand the aggregate effects of house price changes on some macro economic variables. Conditioning VAR models seem to be able to mitigate the simultaneity problem since both house price changes and GDP growth are endogenous in the models.

The variables used in the empirical analysis are the housing price index (LHP), the growth rate of GDP (LGDP), the rate of inflation in consumer prices (LCPI), and the exchange rate (LER). However, the causal relationships between house prices and its determinants have not been sufficiently captured in Iran.

First, a model with the main three variables is estimated. Then, an additional model is provided with the inclusion of exchange rate to compare the results with those obtained based on basic model. So, we can find the importance of exchange rate changes on house prices and if it affects the previous relations.

5.1 Unit root tests

Before proceeding TY process, unit root tests is required to obtain the maximal integration order of variables. Table 1 reports the results of unit root tests. The unit roots are tested by using the augmented Dickey-Fuller (ADF) test, and the results are reported in table 1.

Table 1. Results of the Dickey-Fuller unit root test in levels and first differences

Variables	Level		First differences	
	Intercept	Intercept and trend	Intercept	Intercept and trend
LHP	-1.25(0)	-1.54(0)	-9.68(0)*	-9.85(0)*
LCPI	-1.45(6)	-2.29(5)	-2.10(4)	-2.69(5)
LGDP	1.73(4)	-1.12(4)	-4.99(3)*	-5.57(3) *
LER	-2.44(0)	-1.04(0)	-8.42(0)*	-9.14(0)*

Note: The number in parentheses indicates the appropriate order of lag lengths determined via SIC.

denotes statistically significant at 5% level.

The results of ADF test fail to reject the unit root hypothesis at the 5% level of significance in the case of Intercept and trend. However, testing first differences of series shows that LHP, LGDP and LER are found to be integrated of order one and LCPI is integrated of order two.

5.2 Empirical results of long-run Granger causality

Given that all the series are not integrated of the same order, the TY procedure to test for Granger causality appears to be the appropriate method. We have determined the maximum order of integration (d) to be 2. The optimal lag length (k) based on Schwarz information criterion (SC) and adjusted LR test statistic is 1. We then estimate a system of VAR in levels with total lags of 3 as follows:

$$\begin{bmatrix} LHP \\ LGDP \\ LCPI \end{bmatrix} = \beta_0 + \beta_1 \begin{bmatrix} LHP_{t-1} \\ LGDP_{t-1} \\ LCPI_{t-1} \end{bmatrix} + \beta_3 \begin{bmatrix} LHP_{t-2} \\ LGDP_{t-2} \\ LCPI_{t-2} \end{bmatrix} + \beta_2 \begin{bmatrix} LHP_{t-3} \\ LGDP_{t-3} \\ LCPI_{t-3} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \end{bmatrix}$$

Since diagnostic test results do not seem to be pointing out serious violations of the common assumptions, we can proceed to the Granger causality test on the first k parameters on the other variable in the VAR (d+k) (Soytas, 2006).

The main lesson is related to the link between inflation and GDP on the one hand, and housing prices on the other. The test results suggest that the null hypothesis of Granger non-causality from economic growth and inflation to house prices can be rejected. Furthermore, the hypothesis that CPI does not Granger cause economic growth cannot be rejected at the 5% significance level. Therefore, we find evidence that there is a unidirectional causality from CPI to house price. This implies that the inflation can be used as a leading indicator for future house prices in Iran and reducing CPI seems to be an active way to reduce LHP (Table 2).

Table 2. Granger-causality test results

Equation	LHP	LGDP	LCPI	
Model 1: house prices, economic growth, and consumer price index				
LHP	-	29.43(0.00)*	8.94(0.00)*	
LGDP	4.34(0.03)*	-	5.77(0.01)*	
LCPI	1.00(0.31)	0.38(0.53)	-	
Model 2: house prices, economic growth, consumer price index and exchange rate				
	LHP	LGDP	LCPI	LER
LHP	-	11.94(0.00)*	7.94(0.00)*	2.05(0.15)
LGDP	1.98(0.08)**	-	4.63(0.03)*	7.00(0.00)*
LCPI	0.35(0.55)	1.58(0.20)	-	0.54(0.46)
LER	0.07(0.78)		0.39(0.52)	-

* and ** represent significance at the 5% and 10%. level.

Significance implies that the column variable Granger causes the row variable.

Moreover, the test results suggest that the null hypothesis of Granger non-causality from

house prices to GDP can be rejected. So, there is bidirectional causality between GDP and house price. This result is consistent with that of other studies for Iran which confirm the effect of macroeconomic variables on house prices. We expected to observe some feedback effect from house prices to GDP. This feedback effect is observed in our result. It is believed that GDP growth summarizes the information contained in other more direct measures of household income, such as unemployment and wages. The result is to some extent consistent with those reported by Beltratti and Morana (2010) and Ortok and Terrones (2005) which consider the feedback effect of house price on the economy.

The results of second model, which includes the exchange rate in the model, are consistent with the previous results. But the hypothesis of non-Granger causality between house price and exchange rate cannot be rejected at the 5% level of significance. Based on previous studies in Iran, exchange rate changes affect housing demand but it is not confirmed in this study. It may be due to the fact that exchange rate effect on the house price is rather indirect, which interact through import mechanism.

6. Conclusions

The housing market is one of the most volatile sectors of the economy. The link between house price and income has received a great deal of attention from both researchers and government policy makers because of the remarkable changes in assets price over the past few decades. For economists who believe that the economy can be usefully manipulated through government policy, the housing market is an important lever in that management process.

This paper investigates the causal relationships among house prices, economic production, and inflation, using the relatively new time series technique known as the Toda-Yamamoto method for Iran. The model is estimated using quarterly data from 1990:1 to 2008:3.

We test the Granger Causality between GDP growth and house price changes and inflation in both directions. The empirical analysis of this paper shows that there is evidence of a significant multidirectional link between house prices, and the macroeconomic factors. In the first model the results of causality tests confirm that the two house prices determinants (GDP and CPI) Granger cause house prices, and feedback effects are observed for house prices and GDP. This paper finds no evidence of Granger causality of real house prices changes on CPI. In the second model, which contains exchange rate, the evidence suggests that causality between house prices and exchange rate is not found in any directions. But the previous relation between house price, GDP, and inflation is confirmed.

As Sellin and Walentin (2008) describe, when demand for housing increases, more housing is built and capital investment increases. Then, GDP, which comprises the total sum of consumption, housing construction and investment. It can be considered that sudden changes in the housing sector will be of no importance to the macroeconomic variables. Inversely, one can consider how sudden changes in other parts of the economy have impacts on the housing sector. Actually, there is a larger effect in this direction.

Finally, there are a number of policy implications and useful insights into the sources of

variability for housing policy consideration. Depending upon the nature of long-term relationship among variables, different countries may resort different strategies. In Iran due to the high inflation and high proportion of housing costs in consumer cost portfolio, house demand increase would result in more inflation. So, it is necessary to improve housing production capacity and to provide competitive conditions for investors in this market.

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