Robust Determinants of Housing prices in Iran: Bayesian Averaging of Classical Estimates (BACE)

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Abstract

This study identifies and estimates the effective factors on housing prices over period 1996 to 2017 in terms of model uncertainty and with BACE approach. The statistical data of 18 variables including 15 external variables (socioeconomic variables) and 3 internal variables (housing sector variables) affecting housing price according to the theoretical foundations and experimental studies have been used for this research. The results suggest that the growth of urban population, household income, the unemployment rate, the average cost of 1-square-meter building, expected inflation, income inequality, oil revenues growth, liquidity, and exchange rate are the most effective variables in housing price pattern in Iran. There is no strong evidence of effectiveness of other variables on housing price over the period of this research. The results can be used for creating appropriate patterns for explaining the issues related to housing price and better management of housing sector policies.

Keywords: housing price, Classical Estimates Approach Estimation Approach (BACE), uncertainty

Jel Classification: R31، C11، H5

1. Introduction

Before the global financial crisis, it was thought that investment analysis and the level of price and production of housing sector were not different from investment, price level, and total production of goods and services to be in need of receiving special attention. However, since the great financial crisis, housing has gained much more attention in the macroeconomics literature, as it became clear that housing was much more important than it was previously recognized. A distinctive characteristic of housing is that it is not only an asset (the land and residential units) but also a consumption good (in the form of housing services). As a consumption good, housing services have the largest weight in the consumption bundle of the typical household, and, for most households, their house is their most important asset. As such, shocks that affect the cost of housing consumption or the price of houses are likely to have first-order effects on the welfare of most households. (Dias et al. 2019).

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As the main variable of the housing sector, which is responsible for assigning economic resources, informing and providing investors with the required signals, price will fulfils it duties correctly if it is not affected by multiple deviations (Gholizadeh and Kamyab, 2011). Macro-economy and housing market are related to each other. In other words, the price of housing is affected by factors such as income changes, construction cost, interest rate, etc (Herr & Hottenrott, 2016).

In order to investigate the effect of different factors on housing price, a range of variables have been introduced as the factors affecting the price in the housing sector in the experimental and theoretical studies, but all of these variables cannot be considered in a model in the common and classic econometric methods. To have a proper model, econometric specialists have faced uncertainty in choosing variable and model selection (type, number, and the composition of variables). Bayesian model averaging (BMA) is an appropriate alternative to other methods and approaches for variable selection.

2. The main purpose: The current study identifies and estimates the factors affecting the price of housing during the period from 1996 to 2017 under the model uncertainty conditions using BACE approach.

2-1. Theoretical background, method and data

Considering the fact that a vital part of each statistical analysis is the problem of model selection and the variables present in the model, econometric specialists have been faced with uncertainty in choosing variable and model selection (type, number, and the composition of variables). BMA is a model-building strategy that considers the model uncertainty in the results related to the estimated parameters. This model is an efficient means for discovering the most probable models and estimating their posterior features. However, in their article, *Xavier Sala –Martin*, *Gernot Doppelhofer*, and *Ronald Miller* (2004) referred to a technique for parameter estimations averaging—Bayesian Averaging of Classical Estimates (BACE)—which can measure the importance of certain potential explanatory variables. This approach is an alternative to BMA.

BACE is the extended form of BMA in which the estimations of all models, which are in fact adopted from the Bayesian concept, are combined with a set of classical estimations using ordinary least squares (OLS) obtained given the previous different assumptions. While in the BACE approach, averaging of models is done based on Bayesian principle, this method uses the prior information and a method from the classical econometrics family.

In order to obtain the required results, in the current research, the calculations are performed on all models in the model space. Considering the number of variables under study (18 independent variables), the number of the existing models (based on the presence or absence of each variable) in the space is 2^{18} models, which include more than 262000 regression models. In other words, the model space includes 2^{18} models, and considering the model uncertainty

assumption, i.e., without applying personal choice to model selection, all models should be investigated and all models data should be used to come to a conclusion. Determining the explanatory variable, which has a strong relationship with the housing price, is based on the probability of being in the model (posterior probability). We assume that the posterior probability is equal for all determinants of housing price, i.e. no housing price-related variable has been given priority, and BACE approach helps us to find the most probable one.

According to the study conducted by *Moral Benito (2010)*, variables with posterior deviation less than their posterior mean have a certain effect on the dependent variable. Accordingly, nine variables, including urban population growth, currency rate, unemployment rate, household income, income inequality, construction cost per square meter, expected inflation of oil incomes, and liquidity have the posterior probability of presence higher than 0.5, and by having posterior deviation less than posterior mean, their positive or negative effect on the economic growth can be detected.

3. Findings and Conclusion

With the total number of possible models and parameters setting for the MC^3 algorithm with a total number of 180000 Monte Carlo iterations and 10% burn-in via prior binomial distribution model with averaging model size of 9 and calculating and investigating the effect of the statistical data of 18 variables, including 15 external (socio-economic) and 3 internal variables (housing sector), which affect housing prices based on theoretical principles and empirical studies, it was found that the effect of nine variables (growth of urban population, households income, unemployment rate, average cost per meter square of building, expected inflation, income inequality, oil incomes growth, liquidity, and currency rate) was significant and these variables maintained their effect in the presence of other variables. In other words, they were non-fragile variables. The effect of all these variables on housing price was in agreement and consistent with the obtained theory and their posterior coefficients were significant and reliable.

In spite of having high posterior probability of presence, the positive or negative effect of two variables "interest rate" and "coin price" on housing price cannot be detected due to having posterior standard deviation higher than the posterior mean.

According to the main results of this research, awareness of the consequences of population changes in terms of size and urbanization rate considering the high price of housing in Iran's economy can be effective and suitable for future planning and policy making. In order to control housing price in Iran's economy, population adjustment policies, including changes in the size and structure of population should be taken into account by policymakers and managers in the area of economy and population. Considering the effect of households' income and given that in addition to consumption demand, there is a huge investment

demand in the housing market, the government should adopt certain criteria to restrict housing investment behaviors, such as restricting the number of houses of individuals.

The economic development of Iran is not balanced in different regions. A great portion of the population has migrated to developed cities, leading to rapid growth of housing prices and urban *Booms* and busts in *economic activity* in any region will lead to population growth and density. Therefore, the proportionally distributed economic activity leads to proportional distribution of population. Thus the effect of income inequality on access to housing reduces and the stability returns to this market to some extent and the efficiency level increases.

Moreover, liquidity is also indicative of the effect of money multiplier coefficient and the performance of banks, and generally, the credit system. As this variable is an exogenous variable in relation to the housing sector and it is determined outside this sector and mainly by policymakers, it is necessary to control money multiplier coefficient by banks.

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