

**QUANTITATIVE ANALYSIS OF THE BEHAVIOR OF NATIONAL MEXICAN  
REAL ESTATE PRICES**

**ANÁLISIS CUANTITATIVO DEL COMPORTAMIENTO DE LOS PRECIOS  
DE LA VIVIENDA EN MÉXICO**

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**ABSTRACT**

**OBJECTIVE:** To explain Mexican home prices using fundamental, macroeconomic variables in order to identify possible financial bubble tendencies within the Mexican national housing market during the period 2005 to 2018.

**MATERIAL AND METHOD:** The present study analyzes quarterly data of Mexican real estate market prices and various fundamental, macroeconomic variables during the period 2005 to 2018. The quantitative research approach of the study is based on descriptive statistics and regression analyses.

**RESULTS:** The main results of the study are as follows: First, a simple comparison between market prices and fundamental values shows some kind of (preliminary) evidence of bubble tendencies on the Mexican national real estate market. Secondly, a more sophisticated regression analysis concludes that especially the fundamental variables *outstanding mortgage volume* and *unemployment rate* can explain real estate market price movements almost perfectly.

**CONCLUSIONS:** The hypothesis of a financial bubble within the national Mexican real estate market is then rejected, in the considered period 2005 to 2018.

**KEY WORDS:** Mexican real estate market. Asset price bubble. Regression analysis.

**RESUMEN**

**OBJETIVO:** Explicar los precios de la vivienda en México utilizando variables macroeconómicas fundamentales para identificar posibles tendencias de una burbuja financiera en el mercado nacional de la vivienda en México durante el período 2005 a 2018.

**MATERIAL Y MÉTODO:** El presente estudio analiza datos trimestrales de los precios del mercado inmobiliario mexicano y diversas variables macroeconómicas fundamentales para el período 2005-2018. El enfoque cuantitativo de la investigación se basa en estadísticas descriptivas y análisis de regresión.

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**RESULTADOS:** Los principales resultados del estudio son los siguientes: Primero, una simple comparación entre los precios de mercado y los valores fundamentales muestra evidencia (preliminar) de una posible burbuja financiera en el mercado inmobiliario nacional de México. Sin embargo, por otro lado, un análisis de regresión más sofisticado concluye que especialmente las variables fundamentales *volumen de créditos hipotecarios* y *tasa de desempleo* pueden explicar casi perfectamente los movimientos de los precios del mercado inmobiliario.

**CONCLUSIÓN:** La hipótesis de una burbuja financiera en el mercado inmobiliario nacional mexicano se rechaza para el período 2005-2018.

**PALABRAS CLAVE:** Mercado inmobiliario mexicano. Burbuja inmobiliaria. Análisis de regresión.

## INTRODUCTION

Various historic examples of real estate bubbles have proven their potential of detrimental consequences for financial and economic systems of different countries. The most severe asset price bubble in a country real estate sector for example resulted in the Subprime Crisis which, beginning in 2007, led to dramatic distortions in the U.S. and international financial and economic sectors. Prior to this crisis, the U.S. housing market presented a significant and long-term increase of real estate prices, i.e. the formation of an asset price bubble. During the last decade also the Mexican real estate market experienced astonishing price increases. In fact, according to SHF (2019) the Mexican National Home Price Index representing Mexican home prices increased steadily by a total of 118 % during the period January 2005 to December 2018. However, it is not quite clear if this rise of market prices is backed by improving fundamental factors and, hence, a simple and normal reaction to improving economic conditions for the Mexican real estate market – or it is based on an alarming speculative process like an asset price bubble.

Hence, the research question of the present paper is as follows: To which degree Mexican home prices can be explained by fundamental, macroeconomic factors during the period 2005 to 2018? In order to respond to the mentioned research question, the present study analyzes quarterly data of Mexican real estate prices (Mexican National Home Price Index) and various fundamental, macroeconomic variables (consumer prices, GDP, population, mortgage volume, residential construction costs, unemployment rate, amount of money in circulation) for the period 2005 to

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2018. The quantitative approach of the methodological design of the study is based on descriptive statistics and regression analyses.

The paper is divided into five main sections. After this introductory part, the second chapter (Theoretical Background and Context) explains the theoretical, fundamental concepts of the Efficient Market Hypothesis and asset price bubbles. Furthermore, a brief introduction to the Mexican real estate market is presented. The third part (Methodology) presents the underlying dataset and the statistical approach of the study. The fourth section (Presentation and Analysis of Results) presents and interprets the results of the study. Finally, the paper ends with some concluding remarks in chapter five.

## THEORETICAL BACKGROUND AND CONTEXT

### Efficient Market Hypothesis

Neoclassical Capital Market Theories, which assume perfect market conditions as well as rationality of the economic agents, are still nowadays very influential theories in financial teaching and research. At this point, the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965; Mossin, 1966) and the Arbitrage Pricing Theory (Ross, 1976) can be mentioned as examples. Another central concept of the Neoclassical Capital Market Theory is the Efficient Market Hypothesis (EMH) which is based on the studies of Nobel Laureate Eugene F. Fama (e. g. Fama, 1970; Fama, 1991).

According to Fama (1970) a market can be called efficient if market prices correctly reflect at any time all available information. Jensen (1978) adds that within an efficient capital market it is impossible for market participants to systematically gain excess returns above the equilibrium market return. One central result of the EMH is that an asset's market price is equal to its fundamental value (Fama, 1970). As *assets* one can consider for example stocks, commodities or real estate amongst others. In order to better understand the outlined central result of the EMH, at this point, the concepts *market price* and *fundamental value* should be briefly defined.

For simplicity reasons the two concepts should be explained for the example of a stock. According to (AUTHOR OF ARTICLE) the market price of a stock is simply the visible outcome of the market forces demand and supply. Thus, increasing (decreasing) market prices are the consequence of increasing demand (supply) of the asset generated by the market participants. On the other hand,

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the fundamental value of the stock is the result of a challenging financial analysis of the present and future economic perspectives of the enterprise that underlies the stock. In other words, the fundamental value represents what the stock should cost if its market valuation was fair. Hence, for example Alexander, Sharpe and Bailey (2001) use the term *fair value* referring to the fundamental value of an asset.

For the example of real estate, the market price is the current price real estate buyers have to pay in order to acquire a property. As the fundamental value, on the one hand, Martenson (2011) simply identifies the construction costs of the respective property. On the other hand, fundamental values of real estate are influenced by fundamental, macroeconomic variables. There exists a multitude of economic research studies which identify various variables as crucial determinants of real estate market prices. For example, Mikhed and Zemčík (2009) find positive statistical relations between residential real estate prices and the fundamental variables *population growth* and *building costs (construction costs)* and, therefore, identify these variables as important determinants for housing prices. According to BMF (2011) also *GDP growth* needs to be mentioned as a determinant for residential real estate prices as a higher GDP results in growing demand for real estate and consequently in higher real estate prices. Furthermore, IMF (2005a) detects the *unemployment rate* of a country as an important basis with a negative correlation with housing prices as higher unemployment rates lead to fewer demand for real estate. IMF (2005b) finds a positive relation between *mortgage volume* and residential real estate prices. Gerdesmeier, Reimers and Roffia (2009) categorize the *amount of money in circulation (M3)* as a determinant for housing prices as more money in circulation results in higher asset prices in general. Finally, according to Tsatsaronis and Zhu (2004) also the variable *inflation* can be considered for the fundamental explanation of real estate price movements.

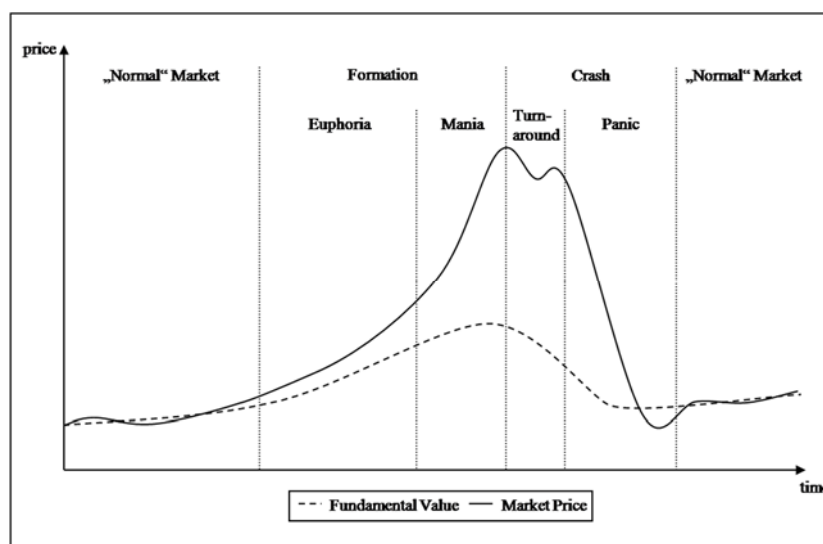
According to the EMH only *fundamental* information is the relevant type of information that is considered by the rational market participants within their investment decisions. Hence, only this type of information has the potential to change the fundamental value of an asset and therefore its market price. Fundamental information can be characterized as new information that indeed changes the economic perspectives of the asset. Other types of information, as for example obsolete or false information as well as rumors, are within the EMH non-relevant information that is not taken into account by the market participants (Fama, 1970; (AUTHOR OF ARTICLE)).

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Based on the EMH's assumption of perfect rationality of the market participants Barberis and Thaler (2002, p. 3) mention: "Put simply, under this hypothesis, "prices are right" – what is simply another way to conclude that according to the EMH markets prices of assets always correctly represent their fundamental values. Although, the idea of perfectly functioning financial markets in which perfectly rational investors assure a perfect valuation process for the respective assets appears fascinating, reality is often different. Multiple so-called capital market anomalies, as for example overreaction (De Bondt and Thaler, 1985) and underreaction (Foster, Olsen and Shevlin, 1984) of market participants to new information or excess volatility of asset prices (Shiller, 1981) represent challenging puzzles in real financial markets which cannot be explained by the EMH. Another well-known anomaly is the concept of an asset price bubble which will be outlined in the following section.

### Asset Price Bubbles

A textbook example of the situation where market prices of assets continuously vary from their fundamental values are the so-called asset price bubbles (financial bubbles). According to Allen and Gale (2005) an asset price bubble can be defined as a situation where the market price of an asset is above the fundamental value. Blanchard and Watson (1982) state that a speculative price movement like a financial bubble is not backed by fundamental information and, hence, does not result in a variation of the fundamental value of the respective asset. Moreover, an asset price bubble is first reflected by a rapid increase of the market price followed by a sharp crash. The following figure 1 combines the two definitions outlined above.



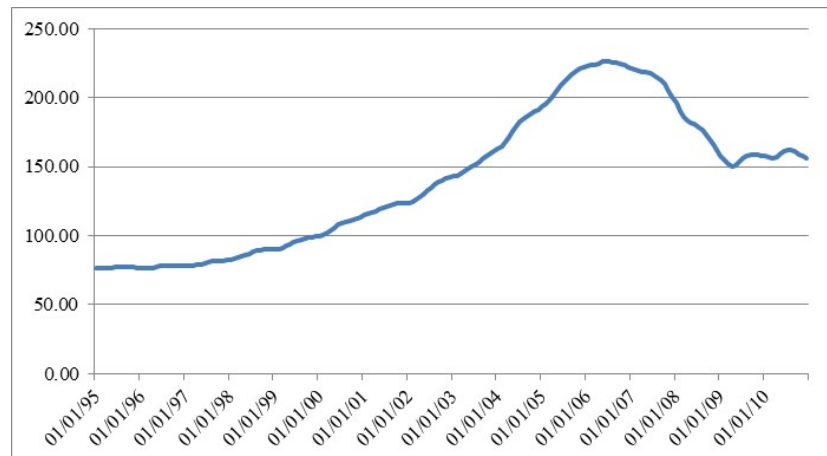
**Figure 1. Typical behavior of market price and fundamental value of an asset during a financial bubble, (Author of article).**

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As can be seen in figure 1, an asset price bubble consists of the two principal phases formation and crash with its subphases euphoria and mania (formation) as well as turnaround and panic (crash). As presented, during the formation of an asset price bubble, which is purely driven by speculative motives of the market participants, the asset's market price grows at a much higher rate than the fundamental value. During the subsequent crash the mispricing is eliminated by an exponential price fall. Taking into account that asset price bubbles are rather rare phenomena on the national and international asset markets, a "normal" market, as can be seen in Figure 1 before and after the bubble, is characterized by short-term and marginal differences between market prices and fundamental values. However, this "normal" market still does not represent a purely efficient market outlined in section 2.1 of the present article. Nevertheless, during "normal" market phases market prices and fundamental values show very similar behaviors and fundamental factors explain sufficiently correct the movements of market prices.

Financial history reports until today multiple examples of asset price bubbles and shows that a variety of different types of assets can be vulnerable to this speculative event. In fact, asset price bubbles are a phenomenon known since the 17th century as a wide-spread speculation in tulip bulbs (tulipmania) between 1634 to 1637 led to severe economic consequences for the Netherlands (Garber, 1989). According to Shiller (2015), the asset price bubble of the New Economy sectors (internet, communication, biotechnology) between 1998-2001 was the largest speculative boom in the history of stock markets as multiple international markets such as the U.S., Germany, France, England, etc. were affected. Recessional tendencies in the USA together with an expansive monetary policy by the Federal Reserve System, as a consequence of the crash of the New Economy Bubble, paved the way to the severest real estate bubble known in history. The so-called Subprime Mortgage Bubble, shown in figure 2, led to a speculative rise in U.S. housing prices, which more than doubled, between 2000 to 2006. During the Subprime crash beginning in 2007 the U.S., but also international financial and economic systems, suffered serious mid- and long-term consequences (Brunnermeier, 2001). U.S. real estate prices are represented in figure 2 by the S&P/Case-Shiller U.S. National Home Price Index.

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**Figure 2. Behavior of the S&P/Case-Shiller U.S. National Home Price Index. Standard & Poor's (2019).**

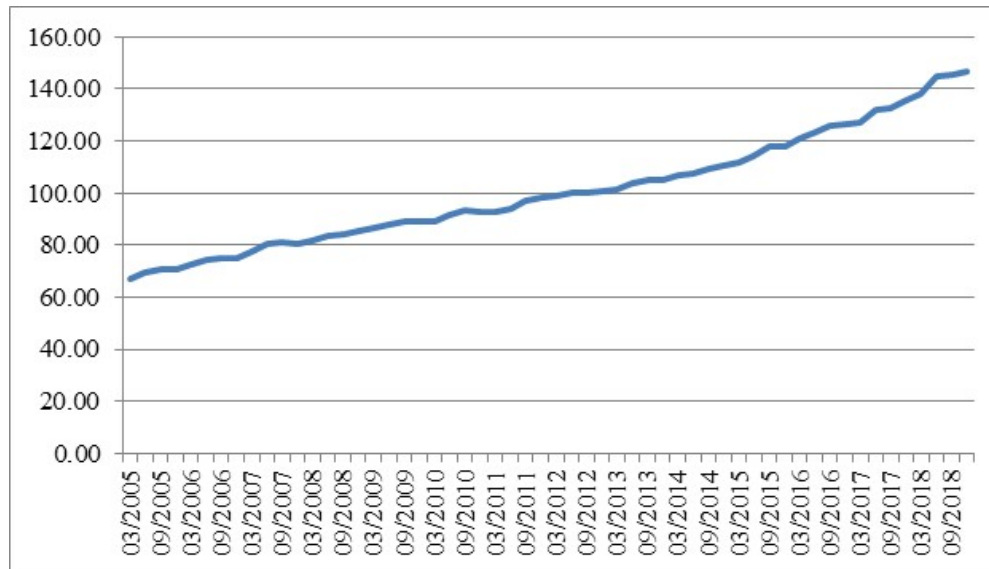
### The Mexican Real Estate Market

According to BBVA Research (2018) the Mexican Real Estate Market is vital for the Mexican economy, considering for example all the economic enteties associated with the construction and financing processes. For example, SHF and CIDOC (2018) calculate that during the period 2013 to 2017 investments in the Mexican real estate sector totaled 277 billion Mexican pesos. Furthermore, the mid- and long-term future of the residential sector appears positive, as for example the debt capacity of households (especially 5 times minimum wage or more) is still able to grow (BBVA Research, 2018). On the other hand, according to CMIC (2019) Mexican residential supply could be negatively affected in the future by increasing costs of the construction sector for raw materials.

Figure 3 shows the behavior of the Mexican National Home Price Index calculated by the Federal Mortgage Society (Sociedad Hipotecaria Federal – SHF) for the period 01/2005 – 12/2018. As can be seen in January 2005 the time series started at a value of 67.20 and increased to 146.51 in December 2018 what implicates a total increase of 118 %. The growth path of the index can be characterized as continious and almost lineal. It should be mentioned here that by definition the Mexican National Home Price Index calculates an average of the home price indices of all the 32 Mexican federal states. Hence, individual state indices vary from the National Home Price Index. The strongest price increase for example in the period can be found according to SHF (2019) for Mexico-City (DF) (2005: 59.74 to 2018: 159.5).



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**Figure 3. Mexican National Home Price Index 2005 – 2018. SHF (2019).**

## MATERIAL AND METHOD

As mentioned in section 1, the research question of the present paper is as follows: To which degree Mexican home prices can be explained by fundamental, macroeconomic factors during the period 2005 to 2018? Therefore, the research objective is to explain Mexican home prices using fundamental, macroeconomic variables in order to identify possible financial bubble tendencies within the Mexican national housing market during the period 2005 to 2018.

The quantitative methodology is divided into two stages. Firstly, in section 4.1 numerical data on a quarterly basis for the period 2005 to 2018 for the Mexican National Home Price Index (market price) and the Residential Construction Subindex of the Mexican Producer Price Index (fundamental value) is presented from the Federal Mexican Mortgage Society (SHF) and INEGI in order to realize a simple descriptive comparison of the two time series.

Secondly, linear regressions based on the methodology of Peña Cerezo, Ruiz Herrán and García Merino (2004) are used in order to explain the behavior of the Mexican National Home Price Index. The mentioned original study explains the behavior of Spanish national home prices during the period 1978 to 2000. The variables defined by Peña Cerezo, Ruiz Herrán and García Merino (2004) are presented in table 1.

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Table 1

*Variables defined in Peña Cerezo, Ruiz Herrán and García Merino (2004)*

Dependent variable (Y)	Independent variables (X)
National home price index.	Increase of consumer prices excluding home ownership ( $X_1$ ). Increases of rental fees ( $X_2$ ). GDP ( $X_3$ ). Population within 25 to 34 age group ( $X_4$ ). Reference interest rate for the mortgage market ( $X_5$ ). Outstanding credit volumen ( $X_6$ ). Number of homes completed within certain period ( $X_7$ ). Construction costs ( $X_8$ ).

For the case of the Mexican housing market, table 2 shows the variables defined in the present study based on the original model. As can be seen, similar, but not identical variables to the ones used in the original study of Peña Cerezo, Ruiz Herrán and García Merino (2004) are used. This is the case as the numerical data for some of the original variables is not available. Besides the variables of the present study, table 2 also shows the relationship that these variables have with the study of Peña Cerezo, Ruiz Herrán and García Merino (2004). This relationship is shown in the central column with “→”. The first parenthesis represents the variable used in this paper whereas the second parenthesis indicates the variable in the original study. Note that  $X_6$  and  $X_7$  have no relationship with the variables in table 1. These variables are newly introduced into the model and partly replace three variables of the original study ( $X_2$ ,  $X_5$  and  $X_7$ ). The right-hand column of table 2 shows the expected results for the correlation coefficients. At this point it should be mentioned that all of the variables presented in table 2 were already identified as crucial determinants of residential real estate prices in section 2.1 of the present paper.

The methodology used in Peña Cerezo, Ruiz Herrán and García Merino (2004) consists in performing linear regressions by “steps”. That is, to introduce the independent variables one-by-one to the regression model, in order to determine their statistical significance. The first variable  $X_i$  introduced to the model is the one with the highest correlation with Y. The next independent variable introduced to the model is the one with the second highest correlation and so on. To decide whether the variable introduced is significant or not, the probability value associated to the Fisher test is analyzed together with the increment of the value of  $R^2$ . If the latter is a representative

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value, the variable stays in the model, otherwise it is removed. The results of the regression analysis are presented in section 4.2.

Table 2

*Variables defined for the present study*

Dependent variable (Y)	Independent variables (X)	Expected correlation
Mexican National Home Price Index.	Changes of Mexican Consumer Price Index (INPC) ( $X_1$ ) $\rightarrow$ ( $X_1$ ).	Non-existent
	Mexican GDP ( $X_2$ ) $\rightarrow$ ( $X_3$ ).	positive
	Economically active Mexican population ( $X_3$ ) $\rightarrow$ ( $X_4$ ).	positive
	Outstanding mortgage volume (Mexican commercial banks) ( $X_4$ ) $\rightarrow$ ( $X_6$ ).	positive
	Residential Construction Subindex of the Mexican Producer Price Index ( $X_5$ ) $\rightarrow$ ( $X_8$ ).	positive
	Mexican unemployment rate ( $X_6$ ).	negative
	Amount of money in circulation (M3) ( $X_7$ ).	positive

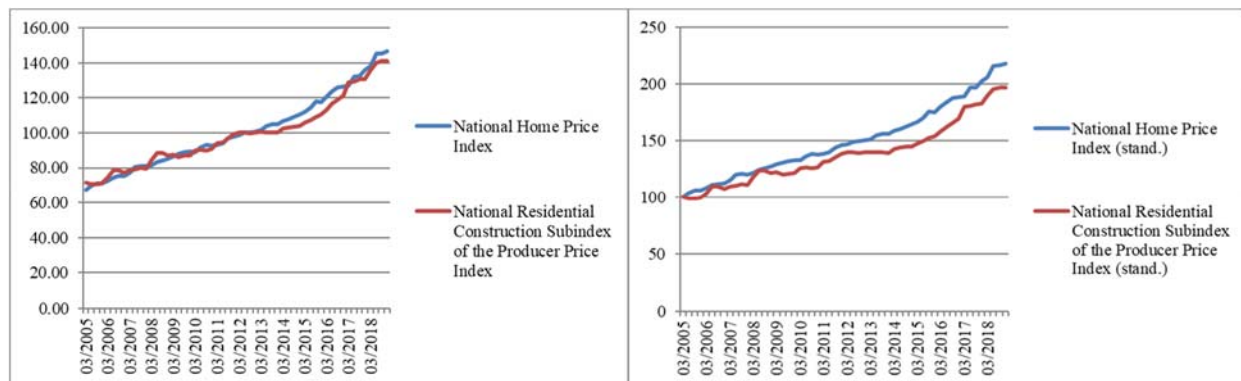
## PRESENTATION AND ANALYSIS OF RESULTS

### Comparison of Mexican Real Estate Prices and Construction Costs

Comparing the historic market price behavior of the U.S. and Mexican real estate markets in the figures 2 and 3, one can find similarities and differences. Both markets for example show a stable and pronounced positive price trend, the U.S. market between 1999 and 2006 and the Mexican market between 2005 until today. However, it needs to be highlighted that the rate of increase is much higher for the U.S. than the Mexican market. During the formation period of the confirmed Subprime Mortgage Bubble (2000-2006) the S&P/Case-Shiller U.S. National Home Price Index increased from a value of 100 (January 2000) to 226.29 (June 2006). Hence, during a period of just 6.5 years, market prices increased by a total of 126 % (Standard & Poor's, 2019). As already mentioned, according to SHF (2019) the Mexican National Home Price Index augmented by a total of "just" 118 % during a 14-year time span (2005-2018). Furthermore, the characteristic exponential market price increase during the formation of an asset price bubble can be identified for U.S. housing prices but not for Mexico. Although Mexican house prices show substantial increases, they show a rather linear growth path.

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As can be seen, a simple descriptive comparison between market prices of a confirmed real estate bubble (U.S. Subprime Mortgage Bubble) and the recent behavior of Mexican real estate prices suggests that the Mexican national market does not appear to undergo a concerning speculative process like an asset price bubble. Another simple way to check for potential bubble tendencies on the Mexican real estate market is to compare the two basic concepts of the definition of an asset price bubble – market price and fundamental value. The result of this comparison can be seen in figure 4.



**Figure 4. National Home Price Index vs. National Residential Construction Subindex of the Producer Price Index 2005-2018. SHF (2019) and INEGI (2019).**

Market prices of the Mexican real estate market (blue line) are represented in figure 4 by the National Home Price Index of the Federal Mortgage Society and fundamental values (red line) by the National Residential Construction Subindex of the Producer Price Index published by INEGI. On the left hand side absolute values of the respective indices are shown. As already mentioned, the National Home Price Index increased by a total of 118 % from 67.20 (January, 2005) to 146.51 (December, 2018). The National Residential Construction Subindex of the Producer Price Index, as a proxy for residential construction costs, augmented in the same period by 96.6 % from 71.76 to 141.05. Hence, within the period under investigation real estate market prices increased more than construction costs what can be seen clearly on the right hand side of figure 4. Here, for a better comparison of the two time series, both of them are standardized to a value of 100 in January 2005.

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It can be seen that especially beginning in 2013 until today there exists a quite remarkable gap between market prices and fundamental values. Thus, firstly the Mexican real estate market cannot be identified as an efficient market according to Fama's EMH. Secondly, considering the simple definition of an asset price bubble of Allen and Gale (2005), some kind of evidence for the possible existence of an asset price bubble on the Mexican national real estate market cannot be denied. Nevertheless, as already mentioned, there is no exponentially growing price trend neither a growing gap between market prices and fundamental values – both typical characteristics for an asset price bubble. It seems necessary to analyze further the Mexican real estate market to obtain a clearer idea of the existence or non-existence of bubble-like tendencies.

### Results of the Regression Analysis

According to the methodology outlined in section 3, linear regression analysis is performed introducing the independent variables  $X_i$  to the model according to the correlation matrix for the selected variables defined in table 2. The results for the correlation matrix in table 3, show that 5 out of 7 variables are strongly and positively correlated with  $Y$ . Only the variables  $X_1$  and  $X_6$  are just marginally correlated with  $Y$ . Moreover, the relationships between coefficients  $X_i$  with  $Y$  (i.e. the direction of the statistical relations) are the expected ones. For example, the expected relationship between  $X_1$  and  $Y$  is "non-existent" as it is marginally positive below 0.1. This can be justified as the Mexican Consumer Price Index represents the price level of an index basket of basic living expenses, and real estate investments are not considered within this index basket.

The independent variables  $X_2$ ,  $X_3$ ,  $X_4$  and  $X_7$  are positively correlated with  $Y$  as expected. According to the economic theory outlined in section 2.1, a higher GDP ( $X_2$ ), a greater economically active population size ( $X_3$ ), a higher mortgage volume ( $X_4$ ) and a higher amount of money in circulation ( $X_7$ ) increase the demand for residential real estate and like this its market prices. Furthermore,  $X_5$  also shows the expected positive relationship with  $Y$  as higher construction costs, simply result in a higher value of real estate market prices. Finally,  $X_6$  shows a slightly negative correlation with  $Y$ , which also is expected since higher unemployment rates lead to a decreasing demand and also a decrease in market prices for residential real estate.

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Table 3

*Correlation between variable Y and variables X*

	Mexican National Home Price Index (Y)
Changes of Mexican Consumer Price Index ( $X_1$ ).	0.0863
Mexican GDP ( $X_2$ ).	0.9939
Economically active Mexican population ( $X_3$ ).	0.9656
Outstanding mortgage volume ( $X_4$ ).	0.9959
Residential Construction Subindex of the Mexican Producer Price Index ( $X_5$ ).	0.9888
Mexican unemployment rate ( $X_6$ ).	-0.1642
Amount of money in circulation ( $X_7$ ).	0.9832

Starting with the introduction of the variables  $X_i$  into the model outlined in section 3, one can see that  $X_4$  is the first variable to be introduced because of its maximum correlation coefficient. Expression (1) shows the results from the introduction of  $X_4$  to the statistical model. The significance level is presented in parenthesis for each coefficient value. Moreover, the value for the  $R^2$  adjusted is shown. The result is a highly adjusted model as 99.2% of the variability of  $y$  is explained by  $X_4$ . This is as expected because the correlation between  $X_4$  and  $Y$  is positive and as high as 0.9959.

$$Y = 47.9 + 0.00011X_4 \quad R^2 = 0.9917 \quad (1)$$

(<0.01)    (<0.01)

The second variable introduced to the model is  $X_2$ , as determined by table 3. The linear regression model is shown in Expression (2) and according to the value in parenthesis it is seen that  $X_4$  and  $X_2$  are significant. However, when comparing both values of  $R^2$  (adjusted) in Expressions (1) and (2), the proportion added to the percentage of variation of  $Y$  explained by  $X_4$  and  $X_2$  is quite low (only 0.0014). This implies that  $X_2$ , despite that it is significant, does not add a significant proportion to  $R^2$ . Another analysis from Expression (2) is that both of the partial correlations (or coefficients) are very low, which indicates that a change of a unit in both values of  $X_4$  and  $X_2$  does not represent a real change in  $Y$ . Ultimately, as  $X_2$  does not contribute to the model in a significant way, it is removed from the model.

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$$Y = 38.64 + 0.00007X_4 + 0.000002X_2 \quad R^2 = 0.9931 \quad (2)$$

(<0.01)    (<0.01)    (<0.01)

The same iterations are performed with the other 5 variables  $X_5$ ,  $X_7$ ,  $X_3$ ,  $X_1$  and  $X_6$  which are introduced to the model in that order. Results are similar to the results of  $X_2$  outlined above, except for  $X_6$ . The linear regression model when  $X_6$  is introduced is shown in Expression (3). The results indicate that the proportion added to the value of  $R^2$  (adjusted) is slightly significant, when comparing Expression (1) with Expression (3). That is, the proportion of the variation of  $Y$  that is explained by the independent variables is increased by 0.012. Moreover, the partial correlation coefficients are statistically significant (see values in parenthesis) and also are significant in the sense that the increment of one unit on the value of  $X_4$  and  $X_6$ , gives an acceptable increment on the value of  $Y$ .

$$y = 52.4 + 0.00012X_4 - 0.989X_6 \quad R^2 = 0.9929 \quad (3)$$

(<0.01)    (<0.01)    (<0.01)

In order to comply with the no multicollinearity principle, the correlation between the variables  $X_4$  and  $X_6$  is calculated and the result is -0.1292, which suggests that there is no multicollinearity in the model.

## CONCLUDING REMARKS

The research objective of the present study was to explain Mexican home prices using fundamental, macroeconomic variables in order to identify possible financial bubble tendencies within the Mexican national housing market during the period 2005 to 2018. The methodological approach was two-fold. Firstly, using descriptive statistics real estate market prices were compared to fundamental values. Secondly, through a linear regression model the behavior of Mexican national home prices were explained by a variety of fundamental, macroeconomic factors.

As can be seen in the results of the present study, there is evidence for and against the possible existence of an asset price bubble within the Mexican national housing market. However, it appears that the evidence against a real estate bubble on the national level is stronger.

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In section 4.1 a simple descriptive comparison of market prices (Mexican National Home Price Index) and fundamental values (National Residential Construction Subindex of the Producer Price Index) shows that during the period 2005 to 2018 market prices increased at a higher rate than fundamental values. Thus, considering the simple definition of an asset price bubble by Allen and Gale (2005), there is some kind of evidence of a real estate bubble on the Mexican national level. Furthermore, since market prices and fundamental values vary over a prolonged period of time, the Mexican national housing market cannot be described as a perfectly efficient market according to Fama (1970).

In Section 4.2 a more sophisticated analysis of the behavior of Mexican real estate market prices, using a linear regression model, comes to the conclusion that there is no asset price bubble on the national real estate market in Mexico. According to the applied analysis, a simple model which takes into account the variables outstanding mortgage volume ( $X_4$ ) and Mexican unemployment rate ( $X_6$ ) can explain the behavior of the Mexican National Home Price Index during 2005 to 2018 almost perfectly ( $R^2 = 0.9929$ ). Therefore, the quality of the model does not leave any space for possible speculative tendencies which could result in a financial bubble.

Nevertheless, it needs to be emphasized that the outlined results apply for the Mexican national real estate market as all the variables, taken into account, are on a national basis. It seems interesting to reproduce the study on a regional level in order to find evidence for or against the possible existence of a regional real estate bubble. A suitable example for this regional study could be Mexico City as here one can find the countrywide highest growth rates for real estate prices in the last years.

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