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# Correlation Between Credit and Real Estate Prices: Regional Evidence in the City of Salvador

Tyago Oliveira do Carmo

Substitute Professor and researcher

Spatial Economics Research Group and Applied Economics Group, UFBA

E-mail: toliveira54@gmail.com

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**Abstract**

The study investigates the correlation between the supply of credit and the price of housing in Salvador, with an emphasis on regional differences. The objective is to understand how the availability of real estate credit influences the dynamics of prices in different locations. The research uses data on credit at the national level and housing prices at the local scale. The Vector Error Correction Model (VECM) allows us to examine the interactions between these variables over time. The results indicate that the supply of credit has an unequal impact on housing prices in different regions of Salvador. The availability of credit drives the appreciation of properties located in noble areas, while it has negative effects in popular regions. Thus, the availability of credit exerts an asymmetric influence on the real estate market in the city of Salvador.

**Keywords:** Property prices, Salvador, Credit, VECM Model

**JEL Classification:** G21

## 1. Introduction

The aim of this article is to examine the effects of credit supply on housing prices in different locations in the city of Salvador. The literature, for the most part, indicates that the expansion of credit supply drives the appreciation of housing prices (MAGGIO; KERMANI, 2017; SU et al., 2021; WANG; YANG et al., 2024). However, studies such as that of Drift, Haan e Boelhouwer (2024) argue that the magnitude of this impact depends on the amount financed, while Ayberk e Önder (2022) highlight that inefficient credit allocations by banks limit the appreciation of real estate assets. This evidence suggests that the effects of credit supply on housing prices are not yet fully consolidated in the finance literature. Thus, the main contribution of this study is to show that geographic location also influences the relationship

between credit supply and housing pricing, revealing possible asymmetries in the observed effects.

The location of real estate in Salvador can significantly influence the effects of financing on their prices. The hypothesis of this research is that regions with lower purchasing power have a greater demand for real estate financing. This hypothesis is corroborated by the study by Drift, Haan e Boelhouwer (2023), which indicates that lower-income families face greater credit restrictions compared to those with higher incomes (Note 1). In addition, data from the Institute of Sustainable Cities (Note 2) indicate that Salvador faces socioeconomic challenges, including high unemployment rates and low economic growth. Thus, the marked socioeconomic heterogeneity of the city can generate relevant insights for the literature, highlighting the relationship between credit and housing prices in unequal contexts.

The financial literature explores the appreciation of real estate prices mainly through the mortgage market Adelino, Schoar e Severino (2012), Akgündüz et al. (2023), Ayberk e Önder (2022), Drift, Haan e Boelhouwer (2023). In Brazil, however, real estate financing depends on a highly concentrated banking system (Note 3), which can generate different implications. Studies indicate that banking concentration in the country restricts the supply of credit, especially for small and medium-sized companies (CARMO; SANTOS, 2024b; JOAQUIM et al., 2019), evidence that can be extended to the real estate sector. This is because monopoly power creates a level of complexity in the sector, limiting specialization in the demands of the real estate sector (CARMO; SANTOS, 2024a; NEEF, 2023). Thus, the concentrated structure of the Brazilian banking system can produce results that differ from those observed in more competitive markets.

In addition to this introduction, the work contains four more sections. The section 2 shows the database and the methodology applied to obtain the asset forecast. The section 3 presents the empirical models to be used in the research. The section 4 highlights the results of the model. Finally, section 5 presents the final considerations.

## 2. Data

The study uses data from the real estate and banking sectors. Information on housing prices is provided by the Economic Research Institute Foundation (FIPE), while data on the credit market come from the Monthly Banking Statistics by Municipality (Estban), from the Central Bank. The housing prices are analyzed by neighborhood in the city of Salvador. The research classifies these properties into two groups: those located in popular areas and with a lower price per square meter; another group located in noble areas and with a higher price per square meter (Note 4). However, the credit data refer to the availability of real estate financing for all multiple banks operating in Brazil.

Table 1. Descriptive Statistics

| Variables | N | Median | Desv | Min | Max |
|---|---|---|---|---|---|
| Property prices in noble areas | 27 | 8,86 | 0,04 | 8,77 | 8,92 |
| Property prices in popular areas | 27 | 7,84 | 0,11 | 7,53 | 8,14 |
| Credit offer | 27 | 27,38 | 0,05 | 27,31 | 27,48 |

The analysis of housing prices was based on the calculation of the average price per square meter per neighborhood, considering the values available in each year of the sample. After calculating the annual average, the prices of properties located in noble and popular areas were analyzed, in order to allow the analysis of variations in relation to the average behavior of the real estate market. The neighborhoods considered in the sample have a discontinuous characteristic, that is, the same neighborhood is not necessarily present in all the periods analyzed. This discontinuity is due to limitations in data collection and possible fluctuations in the availability of real estate records over time.

However, this characteristic does not undermine the objectives of the research, given that the analytical focus lies exclusively on the dynamics of housing prices in regions with higher and lower purchasing power. This methodological approach seeks to capture temporal and structural variations in the real estate market without introducing bias resulting from the selection of neighborhoods. Thus, the analysis provides a robust and reliable view of the fluctuations in property prices over the period studied, in line with the central objectives of the study.

The descriptive statistics information presented in Table 1 shows a greater standard deviation for properties with prices below the average. This indicates greater variability in these prices. This variation is observed in the range between the minimum and maximum values. The next sections will present the VAR models and their results.

## 3. Empirical Analysis

This study will use two econometric models, the Vector Autoregressive (VAR) and the Vector Error Correction (VECM). The VAR is widely recognized in the literature for its application in housing price forecasting and in the analysis of the relationship between real estate asset prices and macroeconomic variables (MEULEN et al., 2011; PANAGIOTIDIS; PRINTZIS, 2016; MAGGIO; KERMANI, 2017; DRIFT; HAAN; BOELHOUWER, 2024). In addition, the VAR model is frequently employed to investigate the dynamics and interactions between economic variables in various contexts (SASIKUMAR; ABDULLAH, 2017; ANTWI et al., 2020; CARLSSON; HOLM, 2021). Given the methodological and empirical relevance of this model, its mathematical formulation for this study is presented below:

$$y_t = \mu + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_p y_{t-p} + \epsilon_t \quad (1)$$

Where $y_t$ is an nx1 vector with all endogenous dependent variables at time t; $\mu$ is the nx1 vector of the intercept; $\beta$ is the nxn coefficient matrix; $y_{t-1}$ is the vector of lagged values of n variables and $\epsilon_t$ is the independent and identically distributed vector.

The VAR model is written in matrix form as:

$$\begin{bmatrix} y_{1,t} \\ . \\ . \\ . \\ y_{n,t} \end{bmatrix} = \begin{bmatrix} \mu_1 \\ . \\ . \\ . \\ \mu_n \end{bmatrix} + \begin{bmatrix} \beta_{11}^{(1)} & \cdots & \beta_{1n}^{(1)} \\ . & & . \\ . & & . \\ . & & . \\ \beta_{n1}^{(1)} & \cdots & \beta_{nn}^{(1)} \end{bmatrix} \begin{bmatrix} y_{1,t-1} \\ . \\ . \\ . \\ y_{n,t-1} \end{bmatrix} + \ldots + \begin{bmatrix} \beta_{11}^{(p)} & \cdots & \beta_{1n}^{(p)} \\ . & & . \\ . & & . \\ . & & . \\ \beta_{n1}^{(p)} & \cdots & \beta_{nn}^{(p)} \end{bmatrix} \begin{bmatrix} y_{1,t-p} \\ . \\ . \\ . \\ y_{n,t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ . \\ . \\ . \\ \varepsilon_{nt} \end{bmatrix}$$

The Vector Autoregressive (VAR) method incorporates a set of statistical tests widely recognized in the literature: the Augmented Unit Root test, Granger causality, the impulse-response function, and the Johansen cointegration test (ANTWI et al., 2020; CARLSSON; HOLM, 2021; KUNJAL, 2023). The Augmented Unit Root test verifies the stationarity of time series, identifying whether the mean and variance of the data remain constant over time. The Granger causality analysis assesses the direction and significance of the causal relationship between variables, contributing to a robust specification of the model (DROUMAGUETA; WARNEB; WOZNIAKC, 2015).

The impulse-response function allows quantifying the impact of exogenous shocks, such as changes in the supply of credit, on property prices over time. The Johansen cointegration test examines the existence of long-term relationships between the dependent and independent variables. This test will enable the use of the Vector Error Correction Model (VECM). The VECM is useful in estimating the short-term effect for both variables and the long-term effect of time series data, (USMAN et al., 2017). Thus, according to Usman et al. (2017), Peleshchak et al. (2024), the VECM model is specified as follows:

$$\Delta y_i = c + \Pi y_{t-1} + \Sigma \Gamma \Delta y_{t-1} + \epsilon_t \quad (2)$$

Where $\Delta$ is the differentiation of y; y is the vector of endogenous variables; $\epsilon$ is the residual vector; c is the intercept vector; $\Pi$ is the cointegration coefficient matrix, $\Pi = \alpha\beta'$, $\alpha$ is the adjustment vector and $\beta$ the cointegration vector; and $\Gamma$ is the k x k coefficient matrix.

The determination of the optimal number of lags for Equation 1 and Equation 2 was based on the minimization of statistical information criteria. Specifically, the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) were applied, as established in the methodological literature (SASIKUMAR; ABDULLAH, 2017; USMAN et al., 2017; CARLSSON; HOLM, 2021). These criteria are widely used to specify the econometric model. However, the study also used sample size to define lags. According to Lütkepohl (2005), Hamilton (2020), samples smaller than 50 are considered short, which suggests the use of a lagged value less than or equal to 2 or 3. Thus, the study used a lag of order 2 in the

estimations.

## 4. Results and Discussions

This section reports the results obtained for the tests between the variables and the estimation of the VAR and VECM models. The first test performed was the Granger causality test, whose results indicate the existence of a correlation between the variables. The evidence, however, diverges between the two types of price. The price of properties located in noble areas presents a bidirectional correlation with the supply of credit, that is, the supply has an effect on the price while the price has an effect on the supply of credit. The evidence of a simultaneous relationship between the variables suggests the presence of endogeneity, which implies that the variables are mutually determining and can be used together to predict each other's effects (KUNJAL, 2023). On the other hand, the price of properties located in popular areas of the city of Salvador presents a direct correlation, that is, the supply of credit has a significant effect on the price of properties, but not an inverse relationship.

Table 2. Results for Granger Causality Test

| Variables | F-statistic | Prob |
|---|---|---|
| Property Prices (Noble Areas)-Credit | 75,87* | 0,01 |
| Property Price Credit (Noble Areas) | 3,24* | 0,04 |
| Property Prices (Popular Areas)-Credit | 2,76. | 0,07 |

The results obtained from the Granger causality test indicate, from a statistical point of view, that the variables can be validly included in the model. However, studies by Adelino, Schoar e Severino (2012), Maggio e Kermani (2017) point to a simultaneous relationship between housing prices and credit supply. Thus, the expectation is that real estate prices also influence credit availability.

In addition to the causality test, the literature also suggests the impulse-response function for a more in-depth analysis (KUNJAL; PEERBHAI, 2021; CARLSSON; HOLM, 2021; KUNJAL, 2023). This function allows us to evaluate the reaction of the dynamic system, both in the present and in future periods, to a shock in the variables in question (CARLSSON; HOLM, 2021). The study makes a projection for the next 6 months. The results indicated that the positive impact on real estate prices due to credit supply, however, dissipates in the following periods. However, the effects are unequal among housing prices. Real estate located in noble areas of Salvador increases in response to the supply of credit, while the price of real estate located in peripheral areas is less valued.

The information from Figure 1 shows the impulse-response function starting with lag number 1. The behavior of housing prices in relation to the period immediately prior to the credit

shows a growth trajectory for real estate located in noble areas and for those located in popular regions. The data indicate a reduction in the price of real estate in peripheral areas. Thus, the impulse-response function suggests that the selection of lagged values influences the dynamics of housing prices, regardless of location.


Figure 1. Impulse-Response Functions (1 lag)

However, the Akaike Information Criterion (AIC) analysis suggests that the lag should be used up to 7. Thus, the impulse response function was performed for lag 7 (Figure 2). The results show that the price of real estate in noble regions of the City of Salvador increases in the next seven periods. However, housing in popular regions reduces over time. Finally, the real estate in the entire sample fluctuates over time.

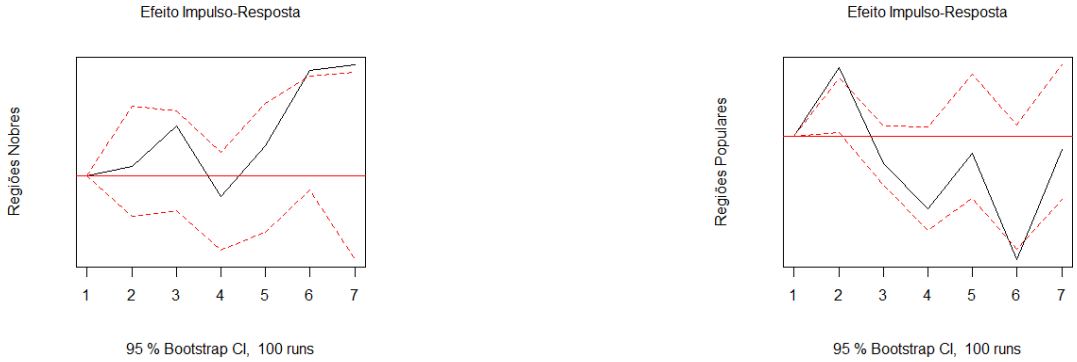


Figure 2. Impulse-Response Functions (7 time lags)

Based on the evidence obtained in the initial tests of the model, the study continues with the estimation of Equation 1. The results presented in Table 3 were obtained using a lag of order 2 (Note 5). The study by Carlsson e Holm (2021) recommends the use of the Schwarz Information Criterion (SIC) to determine the lags. In contrast, Drift, Haan e Boelhouwer (2023) suggests that the choice of lags should be based on the Akaike Information Criterion (AIC). The study by Wen (2017) uses the AIC and SIC measures. On the other hand, the research by Drift, Haan e Boelhouwer (2024) proposes that the order of the lags be defined

based on the economic characteristics of the region. Thus, this research used the AIC and BIC indicators. However, the series used in this research is short (size equal to 27), so the model was estimated using a lag equal to 2.

The results of Table 3 show that the parameters for the three models analyzed were not statistically significant. This evidence indicates that the credit market has little influence on the acquisition of real estate. However, much of the literature suggests that the availability of credit increases the price of real estate. Thus, the results identified in this work do not corroborate the studies.

Table 3. VAR Model Estimation

| Dependent variable | Property Prices | |
|---|---|---|
| Models | I | II |
| Intercept | 0,62 | 36,43 |
| | (6,14) | (24,92) |
| Property price(-1) | 0,81 | -0,13 |
| | (0,21) | (0,26) |
| Property price(-2) | -0,24 | -0,23 |
| | (0,22) | (0,33) |
| Credit offer(-1) | 1,95 | 11,67 |
| | (2,71) | (11,78) |
| Credit offer(-2) | -1,84 | -12,61 |
| | (2,90) | (12,49) |
| Observations | 25 | 25 |
| AIC | -332,57 | -261,18 |
| BIC | -320,38 | -248,99 |

The results for Equation 1. Columns I and II perform estimations for the price in the noble and popular areas, respectively. ., ∗, ∗∗ and ∗∗∗ denotes a statistical significance different from 10%, 5%, 1% and 0% respectively

The Dickey-Fuller and Phillps Perron unit root tests indicated that housing prices and financing supply may be non-stationary. Given this evidence, the study performed the Johansen cointegration test, which evaluates the number of cointegrated vectors for the estimation of the Vector Error Correction (VECM) model (CARLSSON; HOLM, 2021; DRIFT; HAAN; BOELHOUWER, 2024). The results of the Johansen test indicated the presence of cointegration, with a single cointegrated vector, as presented in Table 4. Given

this, the study performs the estimation using the VECM model (Table 5).

Table 4. Johansen Cointegration Test Statistics

| Stroke Statistics | Noble Properties | Popular Properties |
|---|---|---|
| None | 96,89*** | 24,50** |
| At most 1 | 19,80*** | 9,97** |
| Maximum Eigenvalue | Noble Properties | Popular Properties |
| None | 77,09*** | 14,53* |
| At most 1 | 119,80*** | 9,97** |

The evidence obtained for the ’credit supply’ parameter presents contradictory results between property prices in popular and noble areas. The price of properties in noble regions exerts a positive and statistically significant effect. The parameter for the price of properties in popular areas is negative and statistically significant. The hypothesis of this research is that popular regions are not impacted by the availability of credit, which may suggest either the absence of a need for financing or a probable credit restriction (JIN et al., 2024). In addition, the expansion of the supply of public projects such as: My House, My Life; Decent Housing Program; Green and Yellow House; and Popular Housing are some examples of programs that aim to facilitate access to housing for the low-income population. In this way, the population with lower purchasing power becomes less exposed to traditional bank financing. The increase in the elasticity in the supply of popular properties reduces the price (SHI, 2022).

Table 5. VECM Model Estimation

| Dependent variable | Property Prices | |
|---|---|---|
| Models | I | II |
| Intercept | 8,98* | -37,03** |
| | (6,14) | (11,60) |
| Property price(-1) | 0,09 | 0,71 |
| | (0,17) | (0,39) |
| Property price(-2) | -0,10 | 0,08 |
| | (0,18) | (0,30) |
| Credit offer(-1) | 0,55 | 16,22 |
| | (2,33) | (11,12) |
| Credit offer(-2) | 6,47* | -42,57** |
| | (2,39) | (10,78) |
| Cointeq1 | -0,28** | -1,28** |
| | (0,11) | (0,40) |
| Observation | 27 | 27 |
| AIC | -332,57 | -30,32 |
| BIC | -320,38 | -297,13 |

The results for Equação 2. Columns I and II perform estimations for the price in the noble and popular areas, respectively. ·, *, ** and *** denotes a statistical significance different from 10%, 5%, 1% and 0% respectively

## 5. Final Considerations

The results of this research demonstrate that the increase in the supply of credit has a significant impact on the appreciation of the price per square meter of properties located in noble areas of the city of Salvador. However, this appreciation occurs asymmetrically, highlighting inequalities in access to credit. Economic agents with less credit restrictions have greater purchasing capacity, which intensifies demand and, consequently, the appreciation of properties. Thus, it is concluded that the credit market plays a central role in the formation of prices in the real estate sector, while at the same time contributing to the expansion of spatial disparities, generating an unequal appreciation of properties in the urban space of Salvador.

The unequal appreciation of the real estate sector in certain regions reduces the capacity to generate jobs and income, impacting the quality of local economic dynamism. This scenario can lead to a reduction in families' consumption capacity and in tax collection, affecting the supply of essential public services. As a consequence, the socioeconomic inequalities existing in Salvador tend to deepen. In this context, greater specialization and targeting of real estate credit emerges as a viable alternative for economic activity, promoting more balanced and

inclusive development in the urban space of the municipality.

Given the evidence presented, the study presents weaknesses and suggests some analyses for future research. The first is related to the monopolized structure of banks in Brazil. The concentration of the sector may represent a restriction on the development of the real estate sector in Salvador. The literature indicates that the banking monopoly limits access to credit, which may affect the dynamics of the real estate market in several ways. In addition, some studies suggest that the low specialization of banks in the provision of real estate credit may hinder adequate financing for different segments of the market. In this context, future research could explore the relationship between the market power of banks and the availability of financing in the real estate sector, expanding the understanding of the investments of banking concentration in the local economy.

Another aspect to be presented in future research is related to the econometric model. The identification of a negative coefficient for property prices in peripheral areas suggests that property valuations do not necessarily increase with the availability of credit, possibly due to factors such as access to credit or other conditions for property acquisition. However, this relationship may also reflect the limitations of the econometric model used, requiring a more in-depth methodological approach to capture more accurately the effects of property price variations on the availability of credit. Thus, improving models that measure the relationship between credit and property prices would make it more efficient to measure the effects of real estate financing on property prices in regions such as the city of Salvador.

Finally, this study determines noble and popular regions based on the value per square meter. However, this measure runs the risk of not signaling local socioeconomic characteristics. In view of this, it is suggested that future research use parameters correlated with neighborhood characteristics, such as the Urban Property and Land Tax (IPTU). Properties with higher IPTU values indicate that the neighborhood has a greater supply of local urban infrastructure. Another relevant factor related to sampling refers to the number of neighborhoods included in the analysis. This quantity must be sufficient to allow generalization of the results in the different regions of the city of Salvador. Therefore, selecting the database based on IPTU and improving the definition of the number of neighborhoods would make the sample more representative.

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## Notes

Note 1. This evidence is widely documented in the financial literature, which demonstrates that economic agents with more limited resources, such as small businesses, tend to demand more credit compared to those with larger resources (FAZZARI; HUBBARD; PETERSEN, 1987; RYAN; O'TOOLE; MCCANN, 2014).

Note 2. The study by Carvalho e Pereira (2015) also shows significant inequality in the city of Salvador.

Note 3. See Carmo, Santos e Ribeiro (2023).

Note 4. This strategy was adopted due to the lack of data on the Urban Property Tax (IPTU) at the neighborhood level.

Note 5. Greene (2000) suggests that the use of longer lags may restrict the interaction between the variables.

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