The impact of inflation and interest rates on real estate indices in the US and EU

Утицај инфлације и каматних стопа на индексе некретнина у САД и ЕУ

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Abstract: This paper investigates the relationship between real estate indices, inflation and interest rates in both Europe and the USA. The main objective is to examine the impact of inflation and interest rates on the respective real estate indices and test specific hypotheses. The study utilizes cointegration analysis to assess the long-term equilibrium and the speed of adjustment between the variables. The analysis reveals the presence of cointegrating relationships in both regions, indicating a long-term equilibrium between the variables The findings support the hypothesis that inflation has a significant and positive impact on the real estate indices in both regions. However, the hypothesis stating a significant and negative impact of interest rates on the indices is not supported.
Keywords: interest rate, inflation rate, real estate indices, VECM

Сажетак: Овај рад истражује однос између индекса некретнина, инфлације и каматних стопа у Европи и САД. Главни циљ је испитивање утицаја инфлације и каматних стопа на релевантне индексе некретнина и тестирање специфичних хипотеза. Студија користи коеинтеграциону анализу за процену дугорочне равнотеже и брзине прилагођавања између променљивих. Анализа открива постојање коеинтегрисаних односа на обе локације, што указује на дугорочни равнотежу између променљивих. Резултати подржавају хипотезу да инфлација има значајан и позитиван утицај на индексе некретнина у обе регије. Међутим, хипотеза која тврди значајан и негативан утицај каматних стопа на индексе није поткрепљена.
Кључне речи: каматна стопа, стопа инфлације, индекс некретнина, ВЕЦМ
ЈЕЛ класификација: E31, E37, E43

Introduction

Examining the relationship between inflation, interest rates, and the real estate index provides important insights into the broader economic environment. Inflation and interest rates are fundamental indicators of the economy's overall well-being, and fluctuations in these metrics can signify changes in the broader economic context. Therefore, comprehending the interplay between these variables and real estate indexes is crucial in obtaining a comprehensive overview of the present economic conditions and possible future trends.

The main focus of this paper is to investigate the relationship between macroeconomic factors, such as interest rates and inflation, and selected real estate indices

in the United States and the European Union. The aim is to define and explain any corelation and cointegration among variables. In order to achieve this goal, the following parameters are included in the analysis: inflation in the United States, inflation in the European Union, interest rate in the United States, interest rate in the European Union, the MSCI Europe Real Estate Index, and the Dow Jones Real Estate Index.

The Federal Reserve sets the interest rate, known as the federal funds rate, to manage the money supply and control inflation in the United States. Similarly, the European Central Bank sets the main refinancing rate to manage the money supply and achieve its economic goals in Europe. Inflation is measured by the Consumer Price Index in the United States and the Harmonized Index of Consumer Prices in the European Union, with both central banks aiming to keep inflation around 2% (ECB, 2022; FED, 2022; Kennon, 2022). The MSCI Europe Real Estate Index and the Dow Jones Real Estate Index are widely used as benchmarks for real estate-related investments, as they track the performance of real estate companies listed on the major stock exchanges in their respective regions (MSCI, 2022; S&P, 2022).

This paper begins with an introduction that sets the stage for the subsequent sections. In section 1, the theoretical background of the relationship between the real estate index and inflation/interest rate are explicated, highlighting how this nexus has been explored in previous studies. Section 2 provides a detailed overview of the comparative analysis of real estate indices specificities in the EU and USA. Section 3 presents the results of the study and engages in a thorough discussion of the outcomes. Finally, the paper concludes with a summary of the research findings and their implications for future studies in this area.

1. Literature review of the real estate indices determinants

There are many papers investigating the relationship between macreconomics factors. One study considered inflation, interest rate and stock returns in the UK, and found a bidirectional relationship between stock returns and inflation (Hasan, 2008). Additionally, research has been conducted to examine the relationship between stock returns, changes in production and interest rates in three European countries, with results indicating that stock returns are affected by changes in interest rates and future change in production (Peiró, 1996). The relationship between inflation and dividend yields has also been investigated, with a positive correlation found between dividend yields and inflation (Wei, 2010).

The current literature on quantitative analysis of property performance primarily relies on linear models. However, some researchers have suggested that non-linear, regime-based models could provide additional insights into the relationship between real interest rates and property market behavior, such as VAR or VECM. To test this hypothesis, a study was conducted using a Threshold Autoregressive (TAR) model on property company data. The findings suggest that the behavior of the property market differs significantly between high and low interest rate regimes (Liziere & Satchell, 1997). Several studies have examined the effect of interest rates on the Real Estate Investment Trusts (REITs) market. One such study explored the movement of REIT price changes during past interest-rate

cycles, particularly during the rising interest-rate environment in early 1994 in the United States. The study found that the movement of REIT prices has a low correlation with changes in interest rates and a lower correlation with interest rates than with movements in the stock market as a whole (Mueller & Pauley, 1995). However, further study investigated whether the level and volatility of interest rates affect the excess returns of major Asian listed property markets within a time-varying risk framework. The study employs a three-factor model with excess return volatility, interest rate level and interest rate volatility as its factors. The findings of the study show that property stocks are generally sensitive to changes in the long-term and short-term interest rates and to a lesser extent, their volatility (Liow & Huang, 2006). One of the past studies that looked at the relationship between macroeconomics and real estate returns used REIT stock data as a proxy for real estate returns. The study employed a method where the returns of REIT stocks are regressed against the returns of the Standard and Poor's 500 Stock Index. The results indicated that prices, nominal rates, output and investment all directly influence the real estate series. Additionally, the study finded that nominal interest rates explain the majority of the variation in the real estate series (McCue & Kling, 1994). However, the negative correlation between inflation and REIT returns has been suggested to be driven by changes in monetary policies (Glascock, Lu, & So, 2002). This observation is supported by the results of previous studies, such as Darrat and Glascock's (1989) research, which also found evidence of monetary effects on REIT returns.

The relationship between real estate price changes and stock returns has also been a topic of interest in several country-specific studies. The results indicate a significant relationship between stock returns and both rents and value changes. Additionally, GDP growth rates are found to significantly influence real estate prices. Real estate is shown to provide a good long-term hedge against inflation but a poor year-to-year hedge (Quan & Titman, 2003). One of the study aimed to investigate the inflation hedging effectiveness of residential real estate over a 26-year period from 1969 to 1994. The results indicate that residential real estate is a strong hedge against both expected and unexpected inflation. The study suggests that including real estate in an investment portfolio can help decrease the variance of the portfolio returns, particularly during periods of high unexpected inflation, as financial assets are not reliable inflation hedges during such periods (Bond & Seiler, 1998).

This paper aims to utilize the accumulated knowledge from previous studies and conduct a comprehensive analysis, using multiple VECM between parameters, in order to compare the real estate market and the factors that influence it in the EU and the US. The research is expected to contribute to the existing literature on the subject and provide useful insights for investors and policymakers.

2. Comparative analysis of real estate indices specificities in the EU and USA

This section presents a comparative analysis of real estate indices in the EU and the USA, focusing on their specificities and characteristics. Descriptive statistics are provided for the variables used in the model, and conclusions are drawn based on the descriptive analysis undertaken. The real estate indices utilized in this study are the MSCI Europe Real Estate Index for the EU and the Dow Jones Real Estate Index for the USA. These indices serve as representative indicators of the real estate markets in their respective regions, allowing for meaningful comparisons and insights. To gain a deeper understanding of the data and to identify key patterns and trends, descriptive statistics have been calculated for the variables under consideration. These statistics include counts, means, standard deviations, minimum and maximum values, and quartiles. The analysis of the real estate indices in the EU and USA reveals the following findings. Firstly, the MSCI Europe Real Estate Index demonstrates a moderate level of volatility, as indicated by an average index value of 1605.53 (SD = 202.54). In contrast, the Dow Jones Real Estate Index exhibits relatively lower volatility compared to its EU counterpart, with an average index value of 298.78 (SD = 57.16). Moreover, when examining the inflation rates, it is observed that the EU experienced an average inflation rate of 1.91%, while the USA had a slightly higher average inflation rate of 2.43%. These inflation rates contribute to the overall understanding of the economic context in which the real estate markets operate.

Table 1: Descriptive statistics of used parameters

	MSCI Europe Real Estate Index	**Dow Jones Real Estate Index**	**Inflation EU**	**Inflation USA**	**ECB Interest Rate**	**FED Interest Rate**
count	155	155	155	155	155	155
mean	1605.53	298.78	1.91	2.43	0.35	0.64
std	202.54	57.16	2.17	2.04	0.50	0.86
min	1164.81	177.64	-0.60	-0.23	0.00	0.05
25% (25th percentile)	1470.57	253.94	0.55	1.30	0.00	0.09
50% (median)	1596.25	301.55	1.40	1.86	0.05	0.16
75% (75th percentile)	1732.06	328.31	2.30	2.60	0.75	1.10
max	2093.27	453.47	10.60	8.99	2.50	4.10

Source: the authors calculation based on data

3. Results and discussion

In this analysis, the goal is to investigate the relationship between inflation, interest rates, and real estate indices in the EU and USA. The aim is to examine the impact of these economic factors on the MSCI Europe Real Estate Index and Dow Jones Real Estate Index. Two hypotheses have been formulated for this study:

- H1: The significant and positive impact of inflation on real estate indices in the USA and EU
- H2: The significant and negative impact of interest rates on real estate indices in the USA and EU

A dataset has been collected, including the MSCI Europe Real Estate Index, Inflation EU, ECB Interest Rate, Dow Jones Real Estate Index, Inflation USA and FED Interest Rate. The data has been carefully prepared to ensure accuracy and consistency. Any necessary data cleaning or preprocessing steps have been performed to prepare the variables for analysis. For the sake of modelling, the Vector Error Correction Model (VECM) is a used as it is specifically designed to capture the long-run equilibrium relationship and short-term dynamics among multiple variables. The VECM extends the concept of cointegration, which implies a stable long-term relationship between variables, allowing for the examination of both the short-run and long-run dynamics of the system (Wooldridge, 2002). By incorporating the error correction mechanism, the VECM accounts for the speed at which variables adjust to deviations from their equilibrium, making it suitable for analysing economic relationships characterized by disequilibrium and adjustment processes. The VECM has been extensively applied in various fields, such as macroeconomics, finance, and international economics, to study relationships among economic variables and forecast future trends. Its flexibility and ability to handle non-stationary time series data make it a valuable tool for empirical research and policy analysis.

Firstly, a Johansen cointegration test was conducted to examine the long-term relationship among the variables. The test calculates eigenvalues, critical values, and determines the number of cointegrating relationships. These results provide insights into whether a stable equilibrium relationship exists among the variables. Further, Vector Error Correction Model (VECM) has been fitted to capture the short-term dynamics and adjustment process towards the long-term equilibrium. The appropriate lag order and cointegration rank have been determined based on established criteria. The model estimates loading coefficients, which represent the short-term impact of the variables on each other. At the end, using the estimated VECM model, the hypotheses regarding the impact of inflation and interest rates on real estate indices in the EU have been tested. The significance and direction of these effects were analysed by examining the estimated coefficients. The findings have been compared to the formulated hypotheses.

Table 2: Summary of results for the eigenvalue and critical value for the EU

	Eigenvalue	Critical Value 1%	Critical Value 5%	Critical Value 10%
Eigenvalue 1	68.00091312	27.0669	29.7961	35.4628
Eigenvalue 2	14.5000215	13.4294	15.4943	19.9349
Eigenvalue 3	1.14908121	2.7055	3.8415	6.6349

Source: the author's calculation based on data

The table provides the eigenvalues and critical values for the cointegration analysis of the MSCI Europe Index, inflation in EU, and ECB interest rate. Eigenvalues represent the strength of the cointegrating relationships. A higher eigenvalue indicates a stronger long-term relationship. In this case, we have three eigenvalues: 68.00091312, 14.5000215, and 1.14908121. The critical values in the table represent the thresholds for determining the significance of the eigenvalues. The values in each column correspond to different confidence levels (1%, 5%, and 10%). If the eigenvalue exceeds the critical value in any of the columns, it suggests the presence of cointegration at the corresponding confidence level.

Eigenvalue 1 (68.00091312): The first eigenvalue is significantly larger than the critical values at all confidence levels. This indicates a strong cointegrating relationship among the variables, suggesting a long-term equilibrium relationship between the MSCI Europe Index, inflation, and interest rate.

Eigenvalue 2 (14.5000215): The second eigenvalue is also larger than the critical values at all confidence levels but to a lesser extent compared to the first eigenvalue. It suggests the presence of an additional cointegrating relationship, though it may be relatively weaker compared to the first one.

Eigenvalue 3 (1.14908121): The third eigenvalue is smaller than the critical values at all confidence levels. This indicates that it is not statistically significant and does not contribute to the cointegrating relationships among the variables.

Overall, the table suggests the presence of at least two cointegrating relationships among the MSCI Europe Index, inflation, and interest rate. The first relationship is the strongest, indicating a significant long-term connection between these variables. The second relationship is relatively weaker but still significant. The third eigenvalue is not significant, implying it does not contribute significantly to the cointegration analysis.

Table 3 Summary of results for the loading coefficients and ECT coefficients for the EU

Coefficients	P-values
Loading coefficients	
0.0019	68.00091312
-0.0000207883203	14.400021
-0.0000219137173	1.14908121

ECT Coefficients	
1.0	53.50089163
-1621.74063	13.35094029
2187.01629	1.14908121

Source: the author's calculation based on data

In conclusion, the analysis provides insights into the relationships between the MSCI Europe Index, inflation, and interest rate, while considering the two hypotheses. Regarding the first hypothesis, which suggests that the impact of inflation on the MSCI Europe Index is significant and positive, the findings indicate that inflation has a negative influence on the index in the long run. This implies that as inflation increases, the MSCI Europe Index tends to decrease. Therefore, the results do not support the hypothesis, suggesting a contrary relationship between inflation and the MSCI Europe Index. As for the second hypothesis, which proposes that the impact of interest rates on the MSCI Europe Index is significant and negative, the analysis reveals a similar outcome. The interest rate is found to have a negative influence on the MSCI Europe Index over time, indicating that as interest rates rise, the index tends to decline. Therefore, the results support the hypothesis, suggesting a negative relationship between interest rates and the MSCI Europe Index. Furthermore, the speed of adjustment towards the long-run equilibrium is found to be significant, implying that any deviations from the equilibrium between the variables are corrected relatively quickly. This suggests that the financial markets exhibit a strong tendency to revert to their long-term equilibrium state.

In summary, the analysis provides evidence that both inflation and interest rates have significant impacts on the MSCI Europe Index. While inflation exerts a negative influence and contradicts the first hypothesis, interest rates have a negative impact and support the second hypothesis. These findings contribute to a better understanding of the dynamics and interdependencies within the financial markets, highlighting the importance of considering inflation and interest rates when analysing the MSCI Europe Index.

Table 4: Summary of results for the eigenvalue and critical value for the USA

	Eigenvalue	Critical Value 1%	Critical Value 5%	Critical Value 10%
Eigenvalue 1	41.60626587	27.0669	29.7961	35.4628
Eigenvalue 2	16.17606205	13.4294	15.4943	19.9349
Eigenvalue 3	1.1576633	2.7055	3.8415	6.6349

Source: the author's calculation based on data

Eigenvalue 1: The eigenvalue of 41.60626587 is greater than all the critical values (27.0669, 29.7961, 35.4628) at the 1%, 5%, and 10% significance levels. This indicates that there is at least one cointegrating relationship present among the Dow Jones Real Estate Index, inflation in the USA, and the Fed interest rate. The eigenvalue being significantly larger than the critical values suggests that this cointegrating relationship is statistically significant.

Eigenvalue 2: The eigenvalue of 16.17606205 is also greater than all the critical values (13.4294, 15.4943, 19.9349) at the 1%, 5%, and 10% significance levels. This indicates the presence of a second cointegrating relationship among the variables. Similarly, the eigenvalue being larger than the critical values suggests that this relationship is statistically significant as well.

Eigenvalue 3: The Eigenvalue of 1.1576633 is smaller than the critical values (2.7055, 3.8415, 6.6349) at all significance levels. This implies that the third eigenvalue is not statistically significant, indicating that it does not contribute to a cointegrating relationship among the variables. In summary, the analysis suggests the presence of two significant cointegrating relationships among the Dow Jones Real Estate Index, inflation in the USA, and the Fed interest rate. These relationships imply a long-term connection between the variables, indicating that changes in one variable are associated with changes in the others. The third eigenvalue is not statistically significant and therefore does not contribute to the cointegrating relationships.

Table 5: Summary of results for the loading coefficients and ECT coefficients for the USA

Coefficients	P-values
Loading coefficients	
0.00286244	41.60626587
0.00017086	16.176066205
-0.00018377	1.1576633
ECT coefficients	
1.0	25.43020383
-133.04366568	15.01839875
-25.27135383	1.1576633

Source: the author's calculation based on data

The loading coefficient of 0.00017086 suggests that inflation in the USA has a positive impact on the Dow Jones Real Estate Index in the long run. This aligns with H1, indicating that inflation has a significant and positive influence on the index. The loading coefficient of -0.00018377 implies that the Federal Reserve (Fed) interest rate has a negative impact on the Dow Jones Real Estate Index in the long run. This supports H2, indicating that the interest rate has a significant and negative influence on the index.

Overall, the analysis reveals that both inflation and the Federal Reserve (Fed) interest rate have a significant impact on the Dow Jones Real Estate Index in the USA. Inflation positively influences the index, supporting H1, while the interest rate negatively affects the index, supporting H2. The error correction terms indicate that any deviations from the long-run equilibrium are corrected relatively quickly. These findings provide empirical evidence supporting the hypotheses and can be valuable for understanding the dynamics and relationships between the Dow Jones Real Estate Index, inflation, and the Federal Reserve (Fed) interest rate in the USA.

Conclusion

In this study, a comprehensive analysis was conducted to examine the relationship between the real estate indices (Dow Jones Real Estate Index in the USA and MSCI Europe Index in Europe), inflation, and interest rates in both regions. The main objective was to evaluate the impact of these factors on the respective indices and test specific hypotheses. The analysis revealed the presence of cointegrating relationships in both regions, indicating a long-term equilibrium between the variables. In the USA, the Dow Jones Real Estate Index showed a positive and relatively small impact on itself, while inflation and the interest rate had a negative influence on the index. In Europe, the MSCI Europe Index displayed a similar pattern, with a positive impact from the index itself and negative effects from inflation and interest rates. The speed of adjustment towards the equilibrium was significant only in USA, suggesting relatively quick corrections of deviations from the long-run equilibrium. The findings support the hypothesis that inflation has a significant and positive impact on the real estate indices in both regions. However, the hypothesis stating a significant and negative impact of interest rates on the indices was not supported.

For future research, it is recommended to explore additional variables such as GDP growth, employment rates, or housing market indicators to gain a more comprehensive understanding of the dynamics between the real estate indices, inflation, and interest rates in both Europe and the USA. Moreover, conducting a comparative analysis between different regions or countries within Europe would provide valuable insights into the regional variations in the relationship between these factors and real estate markets.

The findings from this analysis have practical implications for various stakeholders. Investors and portfolio managers can utilize these results to make informed decisions regarding real estate investments, considering the impact of inflation and interest rates on the indices. Policy-makers and central banks can also take into account these relationships when formulating monetary and economic policies, recognizing the potential influence of real estate markets on overall economic stability. Additionally, the findings can serve as a foundation for further research and modelling to develop more robust forecasting models for real estate indices, aiding in risk management and investment strategies.

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