METHOD VaR IN THE CASE OF REAL ESTATES

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Abstract

The aim of this article is to present the mathematical – statistical method VaR (Value at Risk) on the case of real estates. With the method VaR we predicted movements of the prices of real estates in Slovenia, France, Greece, Poland, and Norway. According to the results provided with the method VaR, the volatility of residential properties is different in each observed environment, but it is everywhere negative. In the short term (six months), we can expect minimum reduction of the prices of real estates in Greece (in Athens and other major cities) and the maximum reduction in Poland (in Warsaw and other major cities). Even in the long term (3 years), we can expect the smallest drop of prices in Greece and the largest in Poland.

Key Words

Mathematical – statistical research methods; VaR; real estate.

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INTRODUCTION

Real estates have a set of characteristics that influence their price. These characteristics that determine the price of real estate cannot be directly observed. Thus, we use a variety of statistical and mathematical methods (Sirmans et al., 2006). In the literature, the authors use different methods and models to evaluate real estates: the hedonic model, vector model, multiple regression and other models. The purpose of this paper is to present the mathematical – statistical method VaR (Value at Risk) on the case of real estates.

One of the characteristics of the real estates is market volatility. The method VaR is the world's most recognized method for measuring the market risk. Value at Risk or VaR represents the rate for measuring financial risk (Belles-Samper et al., 2014). It estimates how much a set of investments might lose, given normal market conditions, in a set time period such as a day. VaR (as a distinct concept) did not stand up till the late eighties of the last century. The ground-breaking event was a market meltdown in 1987, which was actually the first important financial crisis. The base of the method VaR was represented in a technical paper entitled Risk metric-technical document. This article contains the basic tools which allowed the institutional investors to assess their exposure to the market risk (Morgan, 1996). Nowadays, the method VaR is most commonly used in the financial field, namely to determine the maximum possible loss of certain investments or assets. With the method VaR we can calculate the maximum loss to be suffered by investors in the certain financial investment at a given confidence level over a specified period.

In the case of buying real estates as an investment for the purpose of trading, the method VaR allows us to determine the maximum potential loss for such investment. The result of the method VaR can be expressed as the maximum expected loss of the property within a specified period of time at a given confidence level (Rogachev, 2006). Leš (2007, p. 14) used method VaR for the simplest properties such as shares and bonds, for assets of derivative financial instruments as well as for assets invested in real estates. When measuring the market risk, the method VaR is also used by non-financial organizations. The method VaR is currently the most popular method for measuring market risk and it complements the standard deviation.

In the following, we use the method Var to determine the volatility of real estate prices in the major cities across selected economic, social, and cultural environments. Moreover, with the method VaR we predict the movement of prices in the future.

THEORETICAL FRAMEWORK

With the method VaR we can predict and manage the financial risk of investments in real estate (Amédée-Manesme & Barthelemy, 2015). In 2009, Gaston showed the usefulness of the method VaR in the case of real estates. Namely, with this method we can get information about the volatility of the real estate market and values of the real estates, which are useful for investors. Moreover, in 2008 Liow studied real estate market with the method VaR and proved that the Asian real estate market is more risky than the other developed markets. Asian real estate market has greater volatility than the European and North American real estate markets, which also implies a higher risk for investors.

Furthermore, Okunev et al. (2000) and Nawawi et al. (2010) concluded that the real estate market and stock market are connected. With the information and knowledge about developments in the stock market we can predict developments in the real estate market, and vice versa (Nawawi et al., 2010).

Let us also mention the following authors: Jin and Ziobrowski (2011), Crocker and Jianping (1994), and Campbell (1991). They all showed that the method VaR is also applicable to real estate markets and not just to stock markets. In the case of buying real estate as an investment for the purpose of trading, the method VaR allows us to determine the maximum potential loss.

METHOD VaR

Risk measure VaR is a mathematical - statistical method based on the standard deviation (Allen et al., 2009). Standard deviation (denoted by σ)is a measure that is used to quantify the average deviation from the mean. If we take the change of real estate price as a measure for profitability of investment and if we take the standard deviation as a measure for risk, we get a measure that shows us what is the return on investment per unit of risk. The standard deviation allows us to compare the risk of individual investments. Moreover, the advantage of the standard deviation is to assess maximum potential losses that may be expected in given periods, e.g., in months, years (Hardy, 2006).

To calculate VaR, there are three basic approaches (Pienza and Bansal, 2001):

- the variance-covariance method,
- the approach based on historical data,
- Monte Carlo simulation.

In our study we used the approach based on historical data (we calculated covariance with historical data for real estate prices) and the variance-covariance method which requires that we estimate an expected (or average) return and a standard deviation (which allow us to plot a normal distribution curve). We calculate VaR as

$$VaR = \sigma \cdot \sqrt{N},$$

where σ is the standard deviation of the return on investment and N is a number of days (in the observed time).

All the following calculations were performed with the program Microsoft Excel. We used an acceptable level of risk α, which is equal to or less than 0,05. This is the standard rate of risk, which is most commonly used in statistical studies.

For the purposes of the method VaR we covered various economic, social, and cultural environments: Slovenia, France, Greece, Poland, and Norway. We used the information on prices of real estates in major cities in the period from June 1995 to September 2012 for Slovenia, from March 1999 to June 2012 for France, from March 1997 to June 2012 for Greece, from December 2002 to June 2012 for Poland, and from March 1992 to September 2012 for Norway. The observed periods cover the period of economic growth, when real estate prices were rising, and the period of recession, when real estate prices were falling. The information about the prices of real estates in major cities across selected countries were obtained for Slovenia from the website http://www.slonep.net/info/cene-nepremicnin/preglednica-cetrtletnih-cen-housing-in-jubljana (SLONEP, 2012), for France, Greece, and Poland from the website http://www.tradingecononomics.com (Trading Economics, 2012), and for Norway the data were obtained from the website http: // statline .cbs.nl / StatWeb / publication /? = ees DM & PA = 71533ENG & D1 = 0 & D2 = 0-1 (Stalin, 2012).

RESULTS

For each selected country/city and for different type of real estate we calculated values of VaR taking into account different time period and with respect to the 5% risk level. Tables 1 to 5 present results for each observed country. Here, N is the number of individual type of all real estates included in the analysis. The average is the arithmetic mean. The variance is the expectation of the squared deviation of a random variable from its mean. In particular, the variance is the average squared deviation of the prices (of selected types of real estates) from the arithmetic mean. *Standard deviation* describes the *volatility.* More precisely, standard deviation measures price dispersion of selected types of real estates around the arithmetic mean. VaR values represent the maximum rate of change of prices of selected types of properties in different time periods (half-year, 1 year, 2 years, 3 years).

Table 1: Results for Slovenia

	Studios	***1 bedroom apartments***	***2 bedroom apartments***	***3 bedroom apartments***	***4 bedroom apartments***	***5 or more bedroom apartments***
N	66	66	66	66	36	36
Average	0,016	0,017	0,013	0,013	0,010	0,005
Variance	0,004	0,003	0,000	0,001	0,001	0,003
Volatility	0,063	0,052	0,029	0,035	0,033	0,053
VaR (half-year)	-14,62%	-12,09%	-6,83%	-8,04%	-7,72%	-12,29%
VaR	-0,68%	-17,10%	-9,66%	-11,37%	-10,92%	-17,39%

(1 year)						
VaR (2 years)	-29,25%	-24,18%	-13,67%	-16,08%	-15,44%	-24,59%
VaR (3 years)	-35,82%	-29,61%	-16,74%	-19,69%	-18,91%	-30,11%

Source: Own calculations.

Table 1 shows the results for the case of Slovenia. According to the results, the highest volatility have the prices of studios and five or more bedroom apartments. They are followed by 1 bedroom apartments. On the other hand, 2, 3, and 4 bedroom apartments have the lowest volatility. We found out that the prices of these apartments are much more stable comparing to the prices of other dwellings in Slovenia. Moreover, these apartments have little respond to the developments in the real estate market. By the above calculations, we can say that in the next six months the prices of studios in Slovenia will change for not more than 14,62%, single bedroom apartments for not more than 12,09%, 3 bedroom apartments for not more than 8,04%, 4 bedroom apartments for not more than 7,72%, and 5 or more bedroom apartments for not more than 12,29%. We can predict that, in the short term, the prices of 2 bedroom apartments will be at least changed and the prices for the studios the most. In the long term, the prices of the studios will not change by more than 35,82%, 1 bedroom apartments by more than 29,61%, 2 bedroom apartments by more than 16,74%, 3 bedroom apartments by more than 19,69%, 4 bedroom apartments by more than 18,91%, and 5 or more bedroom apartments by more than 30,11%.

Table 2: Results for France

	Apartments in Paris	***Apartments in Paris and suburb***	***New apartments in Paris***	***New houses in Paris***
N	53	65	53	53
Average	0,023	0,014	0,012	0,011
Variance	0,0003	0,000	0,001	0,003
Volatility	0,019	0,021	0,035	0,061
VaR (half-year)	-4,45%	-4,99%	-8,10%	-14,13%
VaR (1 year)	-6,29%	-7,05%	-11,45%	-19,99%
VaR (2 years)	-8,90%	-9,97%	-16,20%	-28,7%
VaR (3 years)	-10,9%	-12,21%	-19,84%	-34,62%

Source: Own calculations.

Table 2 shows the results for the case of France. Here, we studied the prices of existing apartments in Paris, apartments in Paris and suburb, new apartments in Paris and new houses in Paris. According to our calculations, the prices of existing flats in Paris will change in the short term (half-year) at a rate not higher than 4,45%. On the other hand, the prices for new houses in Paris can be changed for 14,13%. In the long run (3 years), the change of prices of existing flats in Paris will be not more than 10,9%, but the prices of new houses in Paris can be changed for 34,62%.

Table 3: Results for Poland

	Apartments in Warsaw	***New apartments in Warsaw***	***Apartments in other cities***	***New apartments in other cities***
N	28	28	28	28
Average	0,019	0,017	0,019	0,017
Variance	0,005	0,003	0,006	0,003
Volatility	0,069	0,050	0,075	0,055
VaR (half-year)	-16,21%	- 11,74%	-17,54 %	-12,80%
VaR (1 year)	-22,92%	-16,61%	-24,80%	-18,11%
VaR (2 years)	-32,42%	-23,49%	- 35,07%	-25,61%
VaR (3 years)	-39,71%	-28,76%	-42,95%	-31,36%

Source: Own calculations.

In the case of Poland, we observed the prices of existing and new apartments in Warsaw and in other major cities of Poland. Numbers in Table 3 show that we can expect in the period of six months the smallest change of the prices of new dwellings in Warsaw (VaR = -11,74%) and the biggest change of the prices of existing dwellings in other major cities of Poland (VaR = -17,54%). Similar, looking at the long term, the prices of existing apartments in major cities of Poland can be changed the most (max 42,95%) and the least the prices of new apartments in Warsaw (max 28,76%).

Table 4: Results for Greece

	Apartments in Athens	***New apartments in Athens***	***Apartments in other cities***	***New apartments in other cities***
N	24	24	24	24
Average	-0,005	-0,005	-0,002	-0,003
Variance	0,000	0,001	0,001	0,001
Volatility	0,019	0,026	0,026	0,024
VaR (half-year)	-4,61%	-6,13%	-5,96 %	-5,53%
VaR (1 year)	-6,53%	-8,67%	- 8,42%	-7,82%
VaR (2 years)	-9,23%	-12,26%	-11,91%	-11,06%
VaR (3 years)	-11,30%	-15,02%	-14,59%	-13,54%

Source: Own calculations.

Table 4 shows the results for the case of Greece. Here, we studied the prices of existing and new apartments in Athens and other major cities of Greece. According to our results, in the short run, the prices of existing apartments in Athens will change not more than 4,61%. On the other hand, the prices of new flats in Athens can be changed for 6,13% in a half-year term. In the long run, the prices of existing apartments will change not more than 11,30% and the prices of new flats not more than 15,02%.

Table 5: Results for Norway

	Apartments in Oslo	***Independent houses in Oslo***	***Terraced houses in Oslo***
N	82	82	82
Average	0,019	0,017	0,019
Variance	0,000	0,001	0,001
Volatility	0,028	0,030	0,029
VaR (half-year)	-6,42%	-7,00%	-6,68%
VaR (1 year)	-9,08%	-9,90%	-9,44%
VaR (2 years)	-12,84%	-14,01%	-13,35%
VaR (3 years)	-15,72%	-17,15%	-16,35%

Source: Own calculations.

The last observed city was Oslo, the capital city of Norway. According to the accessible data, we have done calculations for the prices of apartments, independent houses and terraced houses in Oslo. By the results in Table 5, we can predict that in the short term the prices of apartments in Oslo will be changed not more than 6,42%, the prices of independent houses not more than 7,00%, and the prices of terraced houses not more than 6,68%. In the long run, the prices of apartments in Oslo will be the least affected (Var = -15,72%). On the other hand, the most affected will be the prices for independent houses (Var = -17,15%).

CONCLUSION

The purpose of the research was to analyse residential real estates in various economic, social, and cultural environments: in the main cities of Slovenia, France, Greece, Poland, and Norway. Selected environments have different economic characteristics, different real estate market, and different legislation which regulates the real estate market. On the basis of analysing the results of scientific findings in the field of real estates and we conducted a survey with the mathematical - statistical method VaR. We have detected a trend in the movement of prices of real estates in the capital cities of the selected countries and forecasted price developments in the future. The statistical analysis was related to the time period from 1996 to 2012.

The method VaR measures the potential loss over a fixed period for a given confidence interval. For example, if the one month VaR on an asset is 1 million EUR (with the level of risk $\alpha \leq 0{,}05$), then there is a 5% chance that the value of the asset will drop more than 1 million EUR over any given month. This method is commonly used for investments to determine the extent and occurrence ratio of potential losses in the portfolios.

According to the results provided with the method VaR we can expect minimum reduction of the prices of real estates in Greece (in Athens and other cities) and the maximum reduction in Poland (in Warsaw and major cities). Even in the long term, we can expect the smallest drop of prices in Greece and the largest in Poland. Moreover, the highest volatility of the residential properties have: in the case of Slovenia studios, in the case of France new family houses in Paris, in the case of Greece new apartments in Athens, in the case of Norway family houses, and in the case of Poland existing apartments in big cities. On the basis of these results we confirmed that the prices of real estates are not stable and, thus, the change of prices is greater.

At the end, let us point out that the predicted volatility of prices of residential real estate varies between the observed environments. Thus, each research environment should be considered separately, regardless of the current globalization and universal mathematical - statistical method. On the other hand, the methodology which we used in the survey is reproducible in any other economic, social, and cultural environment and on any group of respondents. Moreover, the used method is a proven way of obtaining representative and credible data.

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