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PRECIOUS METALS ROLES IN INVESTMENT PORTFOLIO – A COMPARATIVE ANALYSIS FROM THE PERSPECTIVE OF SELECTED EUROPEAN COUNTRIES

Summary: The paper presents conclusions from the research concerned with the effectiveness and roles of precious metals in investment portfolios from the point of view of Austrian, Slovakian and Slovenian investors. The ATX, SAX and SBITOP indices were used to represent the market. The analyses cover the years 2007-2013 taking into account different performance of stock exchange indices at that time. The precious metals to be examined were gold, silver, platinum and palladium.

In most of the periods under discussion, characterized by differentiated stock exchange performance of the three markets, precious metals featured beta coefficient at a low positive or even negative level. This further indicates that there is a low interdependency of their rates of return with the main exchange indices, and consequently these assets may be considered as alternative investments. However, attention should be paid to the fact that each of these metals is characterized by different investment characteristics such as return rate or risk.

Keywords: precious metals, conditional variance, safe haven, beta coefficient.

Introduction

In recent years globalization processes and mobile technologies development have been affecting the expansionary development of financial markets. On the one hand, this increases the risk of a worldwide financial crisis, yet on the other, it provides unprecedented opportunities to invest capital in increasingly more innovative instruments. Apart from conventional assets such as stocks,

bonds or investment funds participation units, there are also alternative investments, in particular, hedge funds, precious metals and other commodities, structured instruments, collectibles or art investments. It is expected that the rate of return on these forms of investment will not be linked to the market, that is, by including them in an investment portfolio one would draw benefits from the diversification of risk.

This paper analyzes the potential benefits and risk coming from precious metals investments through the prism of investors from Austria, Slovakia and Slovenia, taking into account the performance of the main stock exchange indices and the exchange rate in these countries. The aim of the studies is to identify the role precious metals can play in investors' portfolios in selected markets.

1. Commodity investments as an investment portfolio addition

For a long time now the commodity investments have been used as an investment portfolio addition in developed markets, their form being the only thing changing: from future forward derivatives to ETF funds to structured products. In countries with a shorter history of financial exchanges investors more and more frequently decide to add non-conventional assets to their portfolios. Thanks to the ever wider variety of instrument offers and an easier access to modern investment systems lowering financial risk has become possible in reality. Both investors and researchers are interested in the effectiveness of combining various forms of investment, which as a consequence has led to the publication of interesting research results. The analyses show that a portfolio composed of 8 different alternative asset classes makes the volatility fall by 40%; however each subsequent addition causes a much slower reduction, e.g. adding 12 by only 4% [Clare, Motson, 2008]. In the worldwide literature there is a wealth of research papers comprising results of the studies on the investment properties of gold, silver or other precious metals in the US and UK markets. Adding them to a portfolio lowers its risk, oftentimes increasing the return rate and providing a hedge against the negative impact of inflation [Jaffe, 1989; Worthington, Pahlavani, 2006; McCown, Zimmerman, 2007; Conover, Jensen, Johnson, Mercer, 2009]. Complementing a portfolio with a precious metal leads to its diversification. The authors suggest adding it in different shares; from 5% to even 25% [Lucey, 2011]. Gold enjoys the best reputation, yet both silver and platinum have their supporters [Barisheff, 2006]. J. Belousova and G. Dorfleitner, in their work *On the diversification benefits of commodities from the perspective of euro*

investors [Belousova, Dorfleitner, 2012], conducted research on European markets sharing a single currency. The authors conclude that including assets from the group of agricultural produce in the portfolio of an investor from the Euro Zone has no effect on reducing portfolio risk at times when the index falls, whereas industrial metals do not yield the expected benefits from a boom period. As far as the situation in Poland is concerned, the conclusions drawn from the initial research, on the one hand, confirm the findings regarding the international markets where gold is treated as hedging the value of a portfolio (the so called safe haven), yet on the other, using silver or soy increases the level of portfolio risk, without bringing a higher return rate. Moreover, what has been observed is a significant variability of the properties of individual investments in commodities at the time of the drop and growth of a stock exchange index [Walczak, 2014].

Having analyzed the characteristics of the type of investment in question, one can decide to include it in the portfolio assigning it the role it might play. In the studies carried out by Dirk G. Baur and Brian M. Lucey, the authors, using gold as an example, described the asset type called a safe haven, a hedge and a diversifier [Baur, Lucey, 2010]. According to the proposed definition, a safe haven is an asset that is not interdependent with other assets or portfolios during stock market downturn. It is therefore possible to partially compensate for losses. This specific property need not be present at all times but only during market turmoil. In other periods the correlation can be positive or negative.

On the other hand, a hedge is an asset that is (regardless of times) uncorrelated or negatively correlated with other assets or portfolios on average. An asset of a hedge type does not have properties which could reduce losses in times of economic contraction because its correlation can be positive in times of market unrest and negative during the entire time under study.

A diversifier, that is, a tool for diversification, is an asset which has a positive correlation, yet not a complete correlation, with other assets or portfolios on average. Not unlike the hedge, assets of this type need not reduce losses in extreme market conditions. They will, however, hold an average portfolio value over time.

2. Data scope and methodology

In the research, the analysis was carried out of the main stock exchange indices, the ATX from Austria, the SAX – Slovakia and the SBITOP – Slovenia, as well as of gold, silver and palladium in the period from 31.08.2007 to

31.12.2013. This period of time was chosen to capture the time just before 2008-2009 financial crisis and the post crisis conditions. On the basis of the recorded past closing prices continuously compounded returns were calculated. The basic descriptive statistics for the stock exchange indices are presented in the table below.

Table 1. Descriptive statistics for the rates of return series on the ATX, SAX and SBITOP indices from 31.08.2007 to 31.12.2013

	ATX	SAX	SBITOP
Mean	-0,00037	-0,00049	-0,00090
Standard error	0,000484	0,000303	0,00030
Median	0	0	-0,00062
Standard deviation	0,019315	0,012035	0,01199
Variance	0,000373	0,000145	0,00014
Kurtosis	4,450778	29,55865	8,18810
Skewness	-0,10379	-1,85694	-0,70925
Minimum	-0,10253	-0,1481	-0,08479
Maximum	0,12021	0,118803	0,06763

Source: The author's own study.

Precious metals rates from Thomson Reuters database given in the US dollar were converted into Euro. Time series for observations of the index and metals for the country concerned were date-adjusted after taking into account holidays on which there was no trading. Basic descriptive statistics are included in the table below.

Table 2. Descriptive statistics for the rates of return series on Gold, Silver, Platinum and Palladium from 31.08.2007 to 31.12.2013

	AU	AG	PT	PD
Mean	0,000357	0,000293	4,58E-05	0,000472
Standard error	0,000327	0,000589	0,000405	0,000537
Median	0,000869	0,0015	0,000658	0,000762
Standard deviation	0,013195	0,0238	0,016342	0,021695
Variance	0,000174	0,000566	0,000267	0,000471
Kurtosis	5,196018	7,736405	4,890414	3,990147
Skewness	-0,33211	-1,02173	-0,67273	-0,50413
Minimum	-0,09241	-0,20464	-0,10196	-0,13575
Maximum	0,1005	0,128324	0,094542	0,127951

Source: The author's own study.

The investigation of the role precious metals can play in an investment portfolio provides for determining the interdependency of the return rate on these assets with the index approximating the market behavior. To this end, the analysis period was divided into three sub-periods that could be regarded as growth, decline and stability (trading sideways). In view of the specificity of financial time series, for modeling the conditional expected value and conditional variance the

ARMA-GARCH (1.1) class models were chosen and non-classic distributions of residuals: Student's t and skewed t distribution. The ARMA model (p,q) (*autoregressive moving average model*) was first introduced by Box and Jenkins in 1976 [Box, Jenkins, 1983] and can be employed in modeling stationary or non-stationary time series reduced to a stationary time series. The tool consists of an autoregressive AR part and a moving average MA part. It is given by the following formula:

$$Y_t = \varphi_0 + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \dots + \varphi_p Y_{t-p} + \varepsilon_t + \theta_0 - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \dots - \theta_q \varepsilon_{t-q} \dots \quad (1)$$

where:

Y_t – response variable values at time t , $t-1$, $t-2$, $t-p$,

φ_0, θ_0 – parameters of the model,

p, q – lag value,

ε_t – model residuals at time $t, \dots t-q$.

The GARCH model introduced by Bollerslev [1986] can be given by the following formula:

$$h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i} \quad (2)$$

where:

h_t – conditional variance,

$P \geq 0, q > 0; \alpha_0 > 0, \alpha_i \geq 0, i = 1, \dots, q; \beta_i \geq 0, i = 1, \dots, p$.

For a metal to be classified either as a safe haven or a hedge the analysis of conditional correlation coefficients was carried out as well as that of synthetic measure of risk, this being beta for the stock market index for each of the distinguished sub-periods. The beta coefficient indicates whether the investment in asset or portfolio is more or less volatile than the market. If the beta is less than 1 that means the investment is less volatile than the market, so can be treated as a safer one. When beta is more than 1 it means that the investment is more volatile, risky than the market.

To evaluate the interdependence between market index volatility and precious metals the constant conditional correlations model proposed by Bollerslev [1990] was used, given by the following formula:

$$H_t = D_t \Gamma D_t \quad (3)$$

where D_t denotes conditional variances matrix with elements $\sqrt{h_i}, \sqrt{h_j}, \dots, \sqrt{h_n}$, and Γ denotes $N \times N$ matrix of conditional correlation coefficients $\rho_{i,j,t}$.

After having estimated the conditional variance-covariance matrices for the indices and metals it was possible to calculate beta. In order to do so, the following formula was used:

$$\beta_{i,t} = \frac{h_{i,M,t}}{h_{M,t}}, \quad (4)$$

where $h_{i,M,t}$ denotes conditional covariance of the rate of returns for the i -th security with the stock market index, and $h_{M,t}$ denotes conditional variance of the rate of return on the market portfolio [Fiszeder, 2005].

3. Research results

In this part the research results with use of the methodology mentioned above on the Austrian, Slovakian and Slovenian markets will be presented. Every country has its own section. In every section the time period is divided into sub-periods according to the behavior of main stock exchange index as ATX, SAX, SBITOP.

3.1. Austria

In Austria, national stock exchange is located in Vienna (*Wiener Börse AG*) and the main index is Austrian Traded Index, ATX. The Figure 1 shows the index quotations for the period 31.08.2007-31.12.2013.

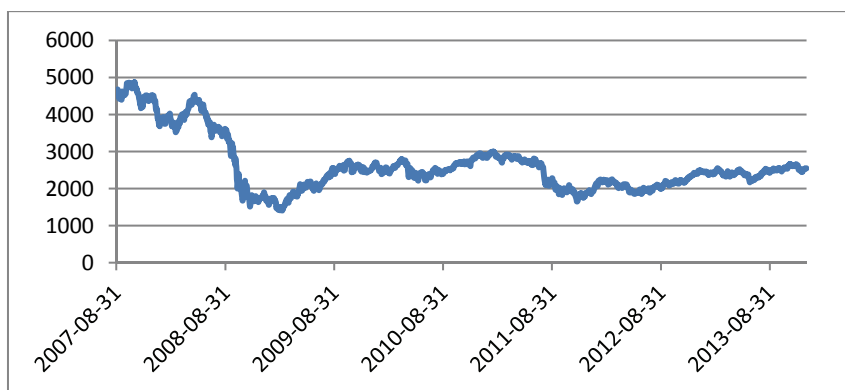


Fig. 1. The ATX quotations during 31.08.2007-31.12.2013

Source: The author's own study based on the [www 1].

On the basis of the main index quotations on the Austrian stock exchange we can distinguish three basic phases the market saw during the period in question: decline, growth and stability (trading sideways). In the table \bar{r} stands for average rate of return, σ means conditional standard deviation and β is the average time-varying beta coefficient.

1. Sub-period: 31.08.2007-9.03.2009

	ATX	AU	AG	PT	PD
\bar{r}	- 0,31%	0,10%	0,04%	- 0,03%	- 0,12%
σ	2,76%	1,66%	2,76%	2,47%	3,13%
β	1	- 0,065	0,230	0,004	0,320

Source: The author's own study.

At the time of the financial crisis of 2007-2009 Vienna's trading floor also recorded significant falls. Investing in precious metals at that period would yield real benefits, not only a higher rate of return but also lower risk (with the exception of palladium). Adding gold or platinum to a portfolio could hedge it against loss in its value.

2. Sub-period: 10.03.2009-31.11.2009

	ATX	AU	AG	PT	PD
\bar{r}	0,28%	0,06%	0,11%	0,08%	0,24%
σ	2,12%	1,13%	2,05%	1,76%	1,96%
β	1	- 0,057	0,102	0,089	0,140

Source: The author's own study.

In the growth phase of the exchange index purchasing precious metals would bring lower portfolio risk without enhancing the rate of return. The smallest interdependency is again recorded for gold.

3. Sub-period: 1.12.2009-31.12.2013

	ATX	AU	AG	PT	PD
\bar{r}	0,00%	0,01%	0,01%	0,00%	0,07%
σ	1,45%	1,21%	2,14%	1,19%	1,79%
β	1	-0,064	0,236	0,194	0,509

Source: The author's own study.

At the time of stability on the Austrian market adding precious ore to a portfolio would hardly change its investment characteristics. Palladium turned out to be an interesting case with beta coefficient of 0,509, which is quite a significant value for an alternative investment. Furthermore, this metal saw the highest rate of return of all the assets in question.

3.2. Slovakia

In Slovakia, national stock exchange is located in Bratislava (*Burza cenných papierov v Bratislave*) and the main index is *Slovenský akciový index*, SAX. The Figure 2 shows the index quotations for the period 31.08.2007-31.12.2013.

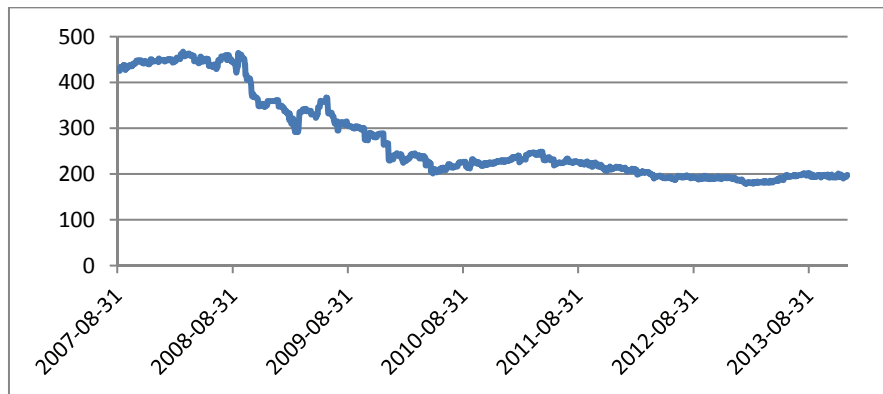


Fig. 2. The SAX quotations during 31.08.2007-31.12.2013

Source: The author's own study based on [www 2].

In Slovakia, in the period under study, it was not easy to distinguish a longer growth phase. Since 2008 the index has lost 50% of its value. In the time interval the distinguished phases included the phase before the crisis, decline and stability. Since Slovakia adopted the Euro in 1.01.2009, up till that time metal rates had been expressed in US dollars converted into the Slovak koruna at the central bank's rate on the day of quotation.

1. Sub-period: 31.08.2007-17.09.2008

	SAX	AU	AG	PT	PD
\bar{r}	0,03%	0,08%	-0,02%	-0,07%	-0,16%
σ	1,61%	1,44%	2,38%	2,10%	2,48%
β	1	0,043	0,117	0,538	0,109

Source: The author's own study.

In the analyzed period only gold was able to add some shine to a market portfolio approximated by the SAX index. Including other ores would provide no advantage to investors due to the average negative rate of return and higher risk.

2. Sub-period: 18.09.2008-7.05.2010

	SAX	AU	AG	PT	PD
\bar{r}	-0,16%	0,04%	0,10%	0,05%	0,08%
σ	1,66%	1,48%	2,38%	1,91%	2,42%
β	1	-0,006	0,066	0,039	0,074

Source: The author's own study.

During the financial crisis when the index kept losing daily on average 0,16%, all precious metals gained in value, although this entailed higher risk. What draws attention at this time interval is a very small beta for all precious ores.

3. Sub-period: 10.05.2010-31.12.2013

	SAX	AU	AG	PT	PD
\bar{r}	-0,01%	-0,01%	0,00%	-0,03%	0,03%
σ	1,51%	1,22%	2,21%	1,17%	1,76%
β	1	-0,047	-0,090	-0,025	-0,040

Source: The author's own study.

In the last time interval we observe a small interdependency with the index for all the metals. What is interesting here is a negative rate of return on gold encountered for the first time.

3.3. Slovenia

In Slovenia, stock exchange is located in Ljubljana (*Ljubljanska borza*). The blue-chip index *SBI TOP* serves as the Slovene capital market benchmark. The Figure 3 shows the index quotations for the period 31.08.2007-31.12.2013.

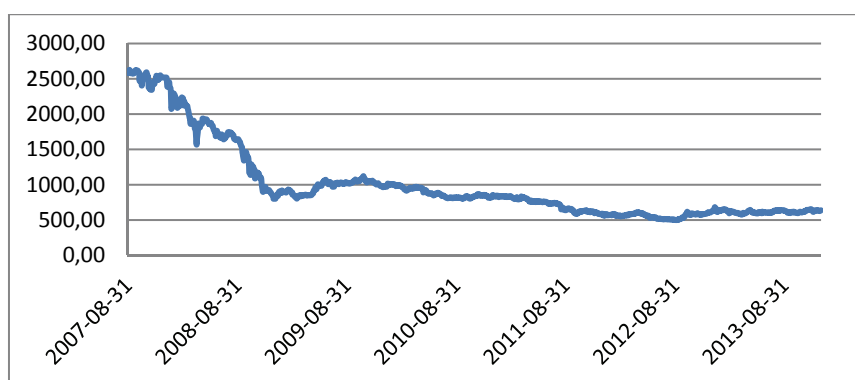


Fig. 3. The graph showing the SBITOP index quotations during 31.08.2007-31.12.2013

Source: The author's own study based on [www 2].

The main index on the stock exchange in Ljubljana significantly weakened in the period concerned. In addition, while analyzing the graph it can be noted that since 2010 there has been a clear decline of interest on the part of investors. Two decline intervals were distinguished: more and less dynamic and one with a positive rate of return. The Slovenian stock exchange, not unlike the Austrian one, is a member of CEESEG (Central and Eastern European Stock Exchange Group). Currently there are 54 companies quoted on the Stock Exchange¹.

1. Sub-period: 31.08.2007-2.09.2009

	SBITOP	AU	AG	PT	PD
\bar{r}	-0,19%	0,07%	0,04%	-0,02%	-0,04%
σ	1,73%	1,56%	2,58%	2,49%	2,73%
β	1	-0,076	-0,015	-0,077	-0,026

Source: The author's own study.

During the phase of a strong index fall all metals had a low beta coefficient, but only with gold is the volatility lower. Investing in platinum or palladium would not have improved investment characteristics of the portfolio.

2. Subperiod: 3.09.2009-1.05.2012

	SBITOP	AU	AG	PT	PD
\bar{r}	-0,04%	0,23%	0,26%	0,20%	0,31%
σ	0,87%	2,84%	3,92%	3,23%	4,23%
β	1	-0,070	0,016	0,011	-0,015

Source: The author's own study.

During the phase of a milder decline of the index spanning about 2,5 years we record a very low volatility. Daily average return rate was positive for all precious metals at that time and at a much higher level than the stock exchange, yet this entailed a multiple higher risk.

3. Sub-period 2.05.2012-31.12.2013

	SBITOP	AU	AG	PT	PD
\bar{r}	0,01%	-0,07%	-0,10%	-0,02%	0,02%
σ	0,96%	2,37%	2,98%	2,58%	3,12%
β	1	0,029	-0,001	0,068	0,085

Source: The author's own study.

¹ As of 29.10.2014, as cited in [www 3].

At the time of stability on the Slovenian stock exchange, investors seeking assets that would improve their portfolio properties would also have been disappointed with precious metals investments. A significantly higher average volatility with no return rate that could compensate this was not encouraging in terms of employing capital.

Summary

The aim of this paper was to investigate the role precious metals can play in investment portfolios of Austrian, Slovakian and Slovenian entities. In order to identify investment characteristics of these assets daily average return rates, standard deviation and time-varying beta coefficient were adopted. On the basis of the analysis of the results we can conclude that gold can be regarded as the asset type defined as a safe haven on all markets in the periods under study. In the Slovakian and Slovenian markets silver exhibits similar properties, yet with higher volatility than gold and the index. For the Austrian market, on the other hand, it can be regarded as a diversifier. Platinum was a safe haven for investors on the Slovenian market and a diversifier for those operating on the Austrian and Slovakian markets. Palladium could play the role of a diversifier in a portfolio with the Austrian index, while being a safe haven for Slovenian and Slovakian investors.

In most of the periods under discussion, characterized by differentiated stock exchange performance of the three markets, precious metals featured beta coefficient at a low positive or even negative level. This further indicates that there is a low interdependency of their rates of return with the main exchange indices, and consequently these assets may be considered as alternative investments. However, attention should be paid to the fact that each of these metals is characterized by different investment characteristics such as return rate or risk. While gold and platinum as a rule had lower volatility than the stock exchange index, the same could not be said about silver and palladium. In addition, while including these assets in a portfolio their mutual correlations would need to be taken into account.

The presented results represent only a part of the broader research on alternative investments characteristics for portfolios in different markets. The results also complement the studies carried out by the author with the focus on describing the issue from the perspective of investors from developing European countries. In further studies the analyses presented here should be more extensive and complementary, particularly by taking into account time-varying nature of investment characteristics of individual assets.

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**ROLA METALI SZLACHETNYCH W PORTFELU INWESTYCYJNYM
– ANALIZA PORÓWNAWCZA Z PERSPEKTYWY
WYBRANYCH PAŃSTW EUROPEJSKICH**

Streszczenie: W artykule przedstawiono wnioski z badań dotyczących potencjalnych korzyści i ryzyka wprowadzenia do portfela inwestycyjnego walorów odzwierciedlających zmiany cen metali szlachetnych z punktu widzenia inwestora austriackiego, słowackiego oraz słoweńskiego. Za reprezentację rynku posłużyły indeksy ATX, SAX, oraz SBITOP. Rozważania dotyczą lat 2007-2013 i uwzględniają odmienne zachowanie indeksów giełdowych w tym czasie. Pod uwagę wzięto cztery metale szlachetne: złoto, srebro, platynę i pallad.

W większości rozpatrywanych okresów, które charakteryzowało odmienne zachowanie indeksu giełdowego na trzech omawianych rynkach, metale szlachetne cechowały się współczynnikiem beta na niskim dodatnim lub nawet ujemnym poziomie, co wskazuje na niewysoką współzależność ich stóp zwrotu z głównymi indeksami giełdowymi, a co za tym idzie – umożliwia rozpatrywanie tych aktywów jako inwestycji alternatywnych. Należy jednak zwrócić uwagę, że każdy z tych metali charakteryzuje się innymi własnościami inwestycyjnymi, takimi jak stopa zwrotu czy ryzyko.

Słowa kluczowe: metale szlachetne, warunkowa wariancja, *safe heaven*, współczynnik beta.