

## FACTOR ANALYSIS OF PLATINUM AND PALLADIUM PRICES DURING SELECTED PANDEMIC PERIODS

Assist. Prof. Mariya Yaneva, PhD  
Burgas Free University

## ФАКТОРЕН ЦЕНОВИ АНАЛИЗ НА ПЛАТИНА И ПАЛАДИЙ ЗА СЕЛЕКТИРАНИ ПАНДЕМИЧНИ ПЕРИОДИ

ас. д-р Мария Янева  
Бургаски свободен университет

**Abstract:** During different time periods, precious metals have been used as a means of payment and trade between economic entities, and some of these metals have also found application in the industrial-production sector. The purpose of the scientific development is to analyze the interrelationship between the factor time and value for the precious metals – platinum and palladium in a time period selected by the author, through regression analyzes

**Key words:** precious metals, platinum, palladium, commodity market, regression analysis.

**Абстракт:** През различни времеви периоди благородните метали са използвани като средство за разплащане и търговията между икономическите субекти, част от тези метали са намерили приложение и в индустриално-производствения сектор. Целта на научната разработка е да анализира взаимовръзката между фактор време и стойност за благородните метали – платина и паладий в селектирани от автора времеви периоди, чрез регресионни ценови анализи.

**Ключови думи:** благородни метали, платина, паладий, суровинен пазар, регресионен анализ.

Precious metals are inherently corrosion-resistant chemical elements of the metal group. Due to their specific structure, they have financial and economic value. There are many precious metals, which in turn have different chemical properties and structures. Platinum and palladium are among the most preferred for investments that are also used in industries. In this regard, they are the subject of scientific research, as the main goal of the development is to analyze the price values of the two precious metals and their interrelationship with the time factor for a period of time selected by the author.

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In a chronological aspect, noble metals in ancient times have been used as a means of payment and trade between economic entities. In modern times, they are still used as a means of trade, retaining their investment interest for investors and entrepreneurs. Of course, many noble metals find widespread application in the industrial sector, and some of them are essential components for creating innovative and technologically advanced products. [1]

Some of the most popular noble metals in society are gold, silver, platinum, rhodium, and others, but there are others. One of them is palladium, a member of the platinum group, which has properties similar to platinum, characterized by a low melting point and is a preferred metal for use in the automotive industry. In this context, the noble metals palladium and platinum can be interchangeable in the automotive industry.

The natural deposits of palladium and platinum on a global scale are not abundant. Author's research indicates that, expressed in billions of tons worldwide, are: for platinum – 5, gold – 4, silver – 75, osmium – 1.5, and for other noble metals of the platinum group – less than 1, which makes palladium a rare noble metal and increases its value.[2]

The main factor that affects financial markets for trading in investment products and specialized commodity markets is supply and demand.[3] The author believes that in addition to the aforementioned, there are many other factors that affect the price of palladium, including:

- ❖ *geopolitical* – the main countries in which palladium is mined are: Russia and South Africa, which together provide palladium mining of about 75%, as well as Canada, the USA and Zimbabwe;
- ❖ *realized recycling, which is an alternative way to extract palladium* – higher price values stimulate economic agents to recycle palladium catalytic convectors;
- ❖ *the price of the US dollar* – when the price of USD 1 decreases, the price of 1 palladium increases and vice versa;
- ❖ *other factors* – a set of factors influencing the value of palladium can be economic, geopolitical, inflationary, the result of the COVID crisis since the end of 2019 and other factors.

The author's analysis of the ways to invest in palladium are grounds for selecting them as the main ones:

- ❖ *physical purchase of palladium by economic agents*, incl. payment of commissions, premiums, costs associated with transport activities and subsequent costs for storage of the investment product;
- ❖ *buying shares of palladium mining corporations* – this activity is associated with expected high profitability and liquidity, but also higher levels of risk;
- ❖ *stock market investing in palladium* – related to the purchase and sale of the precious metal on the specialized financial markets for trading in raw materials.

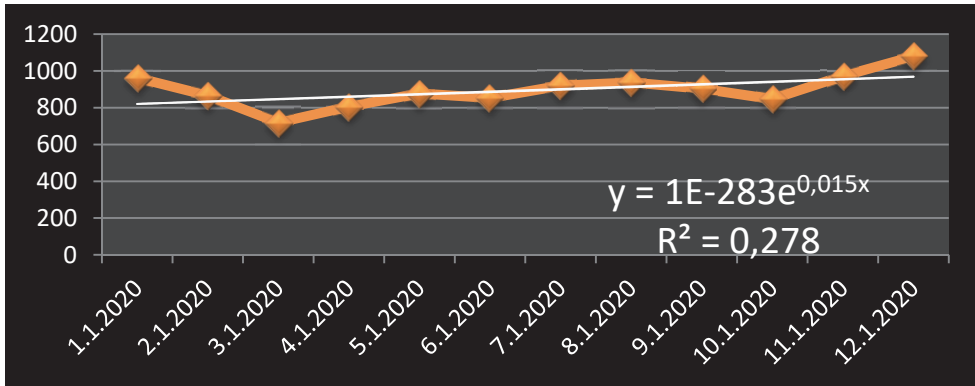
Given the above, if palladium is a member of the platinum group metals, it is relevant for the research to analyze platinum, as a related noble metal. Platinum as a noble metal, in addition to finding widespread application in the jewelry industry, is also used in the automotive industry, similar to palladium, and it is almost as rare as palladium.[4]

The limited quantities of palladium and platinum in the world are one of the reasons for their high price on commodity markets, which makes them preferred for investments.

### **Regression analysis of the price value of platinum and palladium for selected time periods**

The value of precious metals has been preserved through different time periods and continues to be so today.[5] It has been proven over the years that the value of these metals depends on a number of factors, and the focus of this research is the value of platinum and palladium in relation to time. The COVID-19 pandemic that began in late 2019 and has continued to affect all countries to date, has an impact on the financial stability of all countries, changing the way we work and impacting the financial well-being of economic

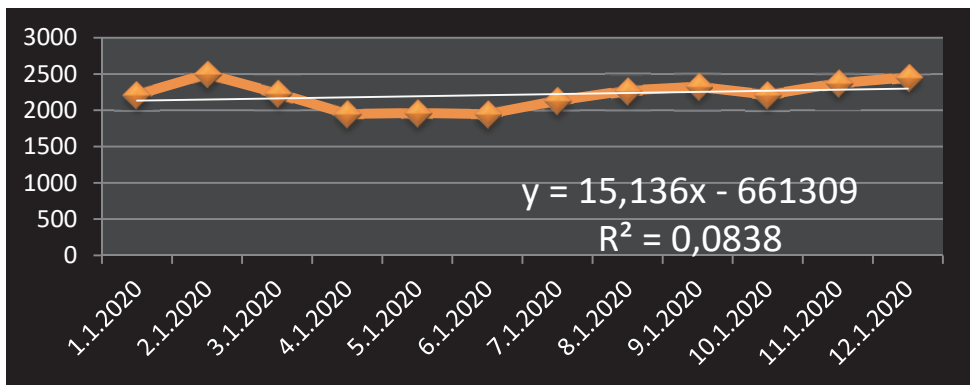
agents and potential investors in commodity markets. This is the basis of the research conducted during this time period, which has left a lasting impact on human history on a global scale.



**Figure 1.** Regression analysis of platinum prices for the first selected period of 01.01.2020 – 31.12.2020

*Source: Author's calculations based on data from investing.com*

As seen from the above, the price of platinum depends on many factors. For the period from January 2020 to December 2020, the price per unit of platinum was at its highest values in December 2020, when the levels for one unit reached values of USD 1079.50. Analyzing the values for the same year in March 2020, platinum was traded at its lowest values for 2020 – USD 718.65. Throughout 2020, the price per unit of the precious metal increased moderately by around 50%. Research on the coefficient of determination ( $R^2$ ) for the period from January 2020 to December 2020 (Fig. 1) shows a value of approximately 28%, which is the basis for the author's assertion that the time factor has a low impact on price increases per unit of the precious metal.



**Figure 2.** Regression analysis of palladium for the studied period

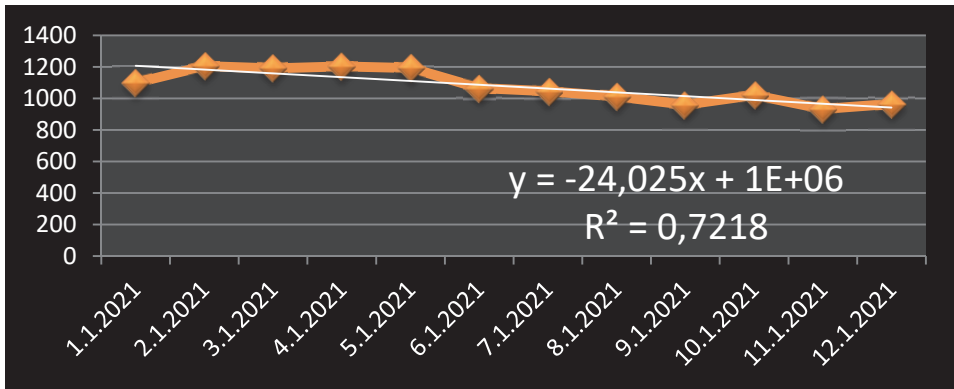
*Source: Author's calculations*

In line with the study of platinum prices, the author also examines the price of palladium for the same time period (Fig. 2) in order to determine if there is a dependence in the formation of prices and whether the factor of time has an equal effect on both noble metals. Upon analysis of the results obtained, it is observed that the price of palladium has the highest levels in January 2020, when one unit of palladium is sold on commodity markets for USD 2500, and the lowest values in June 2020 – USD 1948.90. In fact, the price of palladium at the end of the year, December 2020, continues to maintain values close to the upper limit for the year, specifically USD 2455.50 per troy ounce. The price of palladium has increased by an average of around 28% per year, with the increase being realized at moderate rates as seen from the trend line. Examining in a similar way as in Fig. 1 the coefficient of determination ( $R^2$ ), from Fig. 2 it can be seen that the time factor has a value of 9% and the author cannot assert that it has an effect on the price values of palladium.

Systematizing the results of fig. 1 and fig. 2 the author can summarize that it is possible that the time factor does not have a key impact on the price per unit of the two precious metals. Chronological research of the period January 2020 – December 2020 gives rise to hypotheses in the author that it is possible that the crisis that entered and deepened during the COVID period led to these increases in the prices of the studied precious metals. The restrictive measures during the COVID pandemic imposed at the national and supranational level had an impact on the standard of living of many of the economic agents, including loss of financial well-being, jobs, savings, etc., which further motivates investors to look for new investment opportunities and „financial havens”. The increased demand for precious metals as a means of investment, preservation and the increase of the financial well-being of individuals can increase the demand for the studied precious metals (platinum and palladium), which are also in naturally limited quantities, which similarly increases their prices on commodity exchanges, where they are offered.

A literature review shows that according to data from the United States Geological Survey (USGS), platinum production in South Africa decreased by about 10% in 2020 compared to 2019, reaching a level of 120,000 kg. in 2020.[6] Among the reasons are the global COVID crisis that began at the end of 2019 and the consequences of its spread - restrictions in the work process, „lockdown”, the increased costs for the implementation of activities related to the extraction of precious metals, which are also a natural resource.

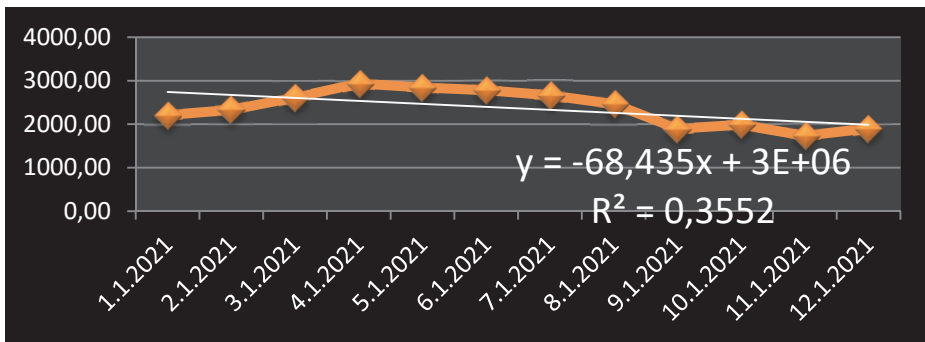
By analyzing similar data for the precious metal palladium, from available information and data from the United States Geological Survey (USGS), production in the largest producing country, Russia, decreased by 7% in 2020 compared to the previous year 2019, when it produced 98,000 kg of palladium. In 2020, it reached a level of 91 000 kg. The research shows that the trend of a 9% decrease in palladium production is also observed in other producing countries.[7] Globally, the COVID crisis and the restrictions put in place have reduced palladium production by 17,000 kg. Palladium, which can be defined as financial losses. The reduced production of palladium and platinum and the increased costs are grounds for assuming by the author that this has led to an increase in the price values of the two studied precious metals.



**Figure 3.** Regression analysis of platinum prices for the second selected period of 01.01.2021 – 31.12.2021

*Source: Author's calculations based on data from investing.com*

Looking at the time period January 2021 – 2021 and based on the author's graphic analysis, it is evident that the value of platinum has changed relatively at a stable pace, marking the highest price values in February at USD 1205.25 per troy ounce and the most - low values in November 2021 – USD 932.75. Analyzing the data on the graph (Fig. 3), high values of the coefficient of determinant ( $R^2$ ) are observed, the value of which in percentage is 72% and shows a relatively high interrelationship between the studied factors period and time. In the previous researched period  $R^2$  (Fig. 1) the value 28% and the influence in this case the influence of the time factor on the price per unit is weak. In this case, the author's hypothesis that the time factor has a constant influence on the price of the precious metal cannot be supported.



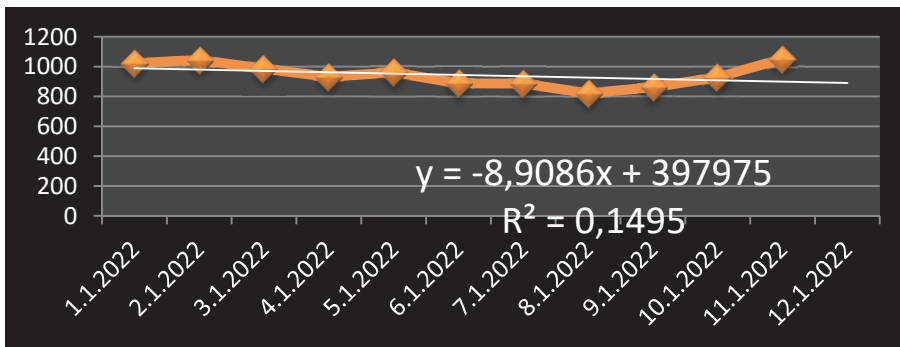
**Figure 4.** Regression analysis of palladium for the studied period

*Source: Author's calculations*

Examining palladium price values (Fig. 4) over a calendar year period (2021) shows a continuation of the trend from 2020 (Fig. 2) of increased value per troy ounce of the precious metal. From the attached graph it is clear that in April 2021 the highest value of palladium was traded on the international markets for USD 2935, and the lowest in November 2021 – USD 1735.50. Comparing the average values for a troy ounce of palladium in 2020 was around USD 2,216.42 and in 2021 around USD 2,364.29, indicating

that on average its value will have increased by nearly 7%. Analyzing the researched time factor, we observe that the coefficient of determinant ( $R^2$ ) maintains levels of approximately 36% and, according to the author's interpretation, may have little impact on the price per troy ounce of palladium. Looking chronologically at the previous period January 2020 – December 2020, we see that  $R^2$  has a significantly lower value (Fig. 2), expressed as a percentage it is about 76% lower than the coefficient of determinant in 2021 and there is no direct relationship that can explain the increase in palladium unit price.

Researching platinum and palladium production in 2021 and based on US Geological Survey research, South Africa has increased its platinum production to 130,000 kg, which is 10,000 kg. more, compared to 2020. On the other hand, the Russian Federation in 2021 has reduced palladium production, with the studied (2021) being 74,000 kg. and is significantly less compared to the previous calendar year. Expected military action in Ukraine is likely to have affected precious metals production. [8]

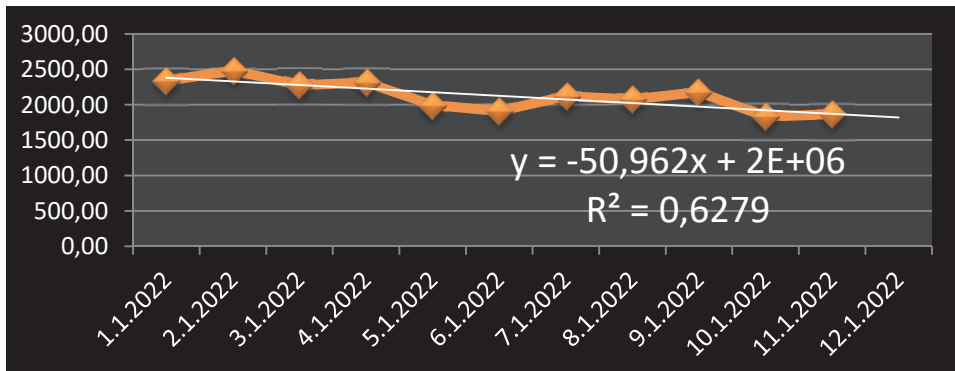


**Figure 5.** Regression price analysis of platinum for the third selected period of 01.01.2022 – 30.11.2022 and prediction for December 2022.

*Source:* Author's calculations based on data from investing.com

In search of the possible interrelationship between the factors time and price (in USD), the study of the price values of the precious metal platinum for the period from January 2022 to the present moment (November 2022) is quite similar. From the regression analysis presented in Fig. 5 it is evident that the value per troy ounce in 2022 is highest in November 2022. – USD 1051.50 and lowest in August 2022, when it reached levels of 822.10 per unit. As can be seen from the provided graphic analysis, from May 2022, a drop in the price of platinum was observed, which led to reaching its lowest levels for the period recorded in August, and after this period it increased its values. However, based on the trend line, the author allows for the possibility of further declines in the price per troy ounce of the precious metal. Analyzing the coefficient of determinant ( $R^2$ ) for the period it can be seen that it keeps its tendency to be variable as in this period it is around 15% and it can be argued that in this period the time factor has little impact on the price of platinum

Investigating the possible reasons in an international aspect for the new increase in the price of a troy ounce of platinum after August 2022, the author assumes that it is the decrease in production related to the closure of mines involved in the activity that has decreased and the amount of extracted production, which has led to to increase the price per unit.[9]



**Figure 6.** Regression analysis of palladium for the studied period and prediction for December 2022

*Source: Author's calculations*

Analogous summarization of the data for the precious metal palladium for the period from January 2022 to November 2022 (Fig. 6) reveals that the highest value of palladium per troy ounce was in February 2022, when it was traded on financial markets for raw materials at USD 2487.52, and its lowest levels were in October 2022 - USD 1831.70. It can be seen from the set training line that a drop in its price can be predicted for the month of December 2022. Examining the coefficient of the determinant, which is 63%, it can be argued that it can have a moderate impact on the price of a troy ounce of palladium. Comparing  $R^2$  to the previous periods studied where it was 9% in 2020, 2021 – 36% and 2022 – 63% cannot be said to have a long-term impact on the value of the precious metal, rather it has instant effect.

In 2022, not only was platinum production down after mine closures in South Africa pushed up its price marginally, but it also limited the amount of palladium in the country due to depleted reserves. In the period of the military operation initiated by Russia, there are also restrictions on sales of palladium from Russia, which is also the main producer on a global scale.[10] This, in turn, is creating a shortage of palladium, and another rise in palladium troy ounce values is expected.

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In the world of market economy, innovations and technological progress, the subject of discussion and analysis have been and will continue to be financial and commodity markets, through which economic agents aim to protect themselves from inflation and increase their financial well-being. Humanity has valued the qualities of precious metals since ancient times and has successfully applied some of them in many industries, thereby preserving and increasing their value, making them an irreplaceable resource. To date, the subject of discussion and analysis among researchers is the idea of how to predict and forecast the value of the precious metal, examining various factors that could potentially affect the price per unit of the studied precious metal.

This research aims to track the price dynamics of precious metals - platinum and palladium - during selected time periods of the COVID pandemic and to examine the extent to which the factor of time is related to the values of the metals. According to the author's interpretation of the data presented in the research, the time factor cannot be the main determinant of value, but may have secondary importance depending on the geopolitical and economic situation at the national and international level. Additionally, the author

provides recommendations for future research on precious metals and their interaction with other financial and economic factors, including the global economic crisis during and after the COVID pandemic, inflation, financial well-being of economic entities for the studied period, and more.

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