



The performance of metal-related funds before and during covid-19: Evidence from Brazil

El desempeño de los fondos relacionados con los metales antes y durante el covid-19: evidencia de Brasil

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Abstract

The main purpose of this paper is to analyze the risk-adjusted performance of Brazilian commodity metal-related funds considering the Covid-19 pandemic. The database is comprised of Brazilian investment funds during the period from January, 2005 to June, 2021. Using daily returns, each quarter, we employed the Return Based Style Analysis to identify metal-related funds. The study hypothesis was tested through panel data regressions. On one hand, the main results suggest that, during Covid-19 pandemic, metal-related funds performed better in comparison to the other investment funds. This result was also persistent considering different measures for fund performance. On the other hand, the performance of metal-related funds was equivalent to the performance of the other funds during the Global Financial Crisis. The quantitative analysis also considers the effects of number of confirmed cases for Covid-19 and total vaccination on fund's daily returns.

JEL Code: G10, G11, G12

Keywords: commodity markets; global crisis; covid-19; investment funds

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Resumen

El objetivo principal de este estudio es analizar el desempeño ajustado al riesgo de los fondos relacionados con los commodities metálicos considerando la pandemia de Covid-19. La base de datos está compuesta por fondos de inversión brasileños durante el período de enero de 2005 a junio de 2021. Utilizando rendimientos diarios, cada trimestre, empleamos el Análisis de estilo basado en rendimiento para identificar fondos relacionados con metales. La hipótesis del estudio se probó mediante regresiones de datos de panel. Por un lado, los principales resultados sugieren que, durante la pandemia de Covid-19, los fondos relacionados con los metales tuvieron un mejor desempeño en comparación con los otros fondos de inversión. Este resultado también fue persistente considerando diferentes medidas para el desempeño del fondo. Por otro lado, el desempeño de los fondos relacionados con los metales fue equivalente al desempeño de los otros fondos durante la Crisis Financiera Global. El análisis cuantitativo también considera los efectos del número de casos confirmados de Covid-19 y la vacunación total en los rendimientos diarios del fondo.

Código JEL: G10, G11, G12

Palabras clave: mercados de commodities; crisis global; covid-19; fondos de inversión

Introduction

In March 2020, The World Health Organization (WHO) declared the Covid-19 virus as a pandemic, causing, in addition to the effects directly related to human health, impacts on different economies and financial markets due to the abrupt interruption in the daily activities of the nations, as well as the perception of uncertainty related to this scenario (Kuckertz et al. 2020; Zhang et al. 2020; Shaikh 2021; Chen and Yeh 2021; Umar et al. 2021a; Yousaf 2021). As the months have passed, the uncertainty in the markets caused by the Covid-19 pandemic has aligned with the different cycles / waves of the coronavirus, marked by the increase in infections and human deaths (Zhang et al. 2020; Chen and Yeh 2021; Shaikh 2021; Yousaf 2021). Political decisions to mitigate contagion, provide social assistance and/or stimulate the economy have been varied in different countries; however, such interventions also introduced uncertainties in global financial markets (Zhang et al. 2020; Adewopo et al. 2021; Li et al. 2021a; Yousaf 2021).

The commodities markets, in general, have also been affected by the events and measures adopted in different economies to face the Covid-19 pandemic. The lower demand for final products and semi-fabricators' operation have affected energy and metal commodities, consequently leading to changes in the prices of these commodities. Commodities have gained relevance in the financial market due to the introduction of a variety of financial products available to different types of investors. These assets connect nations (Kirikkaleli and Güngör 2021) and can provide the possibility of increasing benefits from

portfolio diversification (Babalos and Stavroyiannis 2015; Chen 2015; Shalini and Prasanna 2016; Junttila et al. 2018; Ait-Youcef 2019; Ordu-Akkaya and Soytaş 2020; Adekoya and Oliyide 2021; Adekoya et al. 2021; Al Janabi 2021; Borgards et al. 2021; Ezeaku et al. 2021; Rehman and Vinh 2021; Sun et al. 2021; Zhang and Pan 2021).

Previous research has deepened the effects produced by Covid-19, showing the attraction of investment fund managers for portfolios related to sustainable or environmental investments - explained by an increase in green investments in the period (Guérin and Suntheim 2021) - or European social entrepreneurship funds (Mirza et al. 2020). Real estate investments have also been attractive due to the regular income generated by this type of investment; however, they are also exposed to other kinds of risks, such as their dependence on macroeconomic factors (Sumer and Ozorhon 2020). Within this context, asset allocation in commodities markets has been widely documented and explored (Hernandez et al. 2020; Sumer and Ozorhon 2020; Al Janabi 2021).

Different investors evaluate the commodities sector as an option when searching for alternatives for asset allocation (Junttila et al. 2018; Li et al. 2021b; Adekoya et al. 2021; Yousaf 2021), being necessary to select among different groups of commodities: agricultural, metallic and energy, or considering different financial aspects (Ezeaku et al. 2021; Rehman and Vinh 2021; Yousaf 2021) because each of them have shown different levels of volatility or profitability in times of crisis (Babalos and Stavroyiannis 2015; Shalini and Prasanna 2016). Previous research observed a positive relationship between the profitability of raw material prices and the advance of the pandemic (Salisu et al. 2020), while other studies have documented a negative relationship between metal commodities and volatility of the markets (Junttila et al. 2018; Ezeaku et al. 2021; Li et al. 2021a; Yousaf 2021), and in some energy commodities (Yousaf 2021) or agricultural commodities (Adewopo et al. 2021). Therefore, some fund managers can seek protection through investments in commodities, but these investments can also be affected by the variables related to the Covid-19 due to the financial contagion effect.

Financial crises provide an environment to analyze the adherence of the contagion theory (Rigobon 2002; Prorokowski 2013). During the Covid-19 Pandemic, institutional investors may allocate more resources in the commodities markets, seeking for protection against lower levels of risk. Considering that the Covid-19 Pandemic is a situation with no precedents in the financial market, a research question arises: what was the risk-adjusted performance of commodity metal-related funds considering the Covid-19 pandemic? In line with the research question, the main purpose of this paper is to analyze the risk-adjusted performance of commodity metal-related funds considering the Covid-19 pandemic. This purpose was divided into three specific objectives: i) identify commodity metal-related funds in the Brazilian market; ii) test the performance of these funds, considering the Covid-19 pandemic; and iii) test the effect of Covid-19 variables on the daily returns of metal-related funds.

The analysis was developed using data of investment funds from Brazil, since it is an emerging economy with a sophisticated capital market (Chamon and Garcia 2016), being “the largest equity and debt market in Latin America, and a large component of most emerging market indices against which portfolio investors are benchmarked” (Forbes et al. 2016, p. 86). Brazil also presents higher country risk and a relatively weak investor protection (Lopes and Alencar 2010; Brugni et al. 2021), which are factors that can introduce more complexity for portfolio allocation. During the Pandemic, Brazil experienced currency depreciation and an increase in commodity prices, which impacted inflation expectations (IMF, 2021). Consequently, an analysis in the context of Brazilian institutional investors can generate numerous insights for other developing economies. Due to the global climate of high uncertainty during the Pandemic, it is also desirable to evaluate the potential diversification that can be offered by economies of emerging markets. This analysis has implications for society, since “commodity prices are linked to the health of the local economy because commodities affect the cost of living through inflation” (Kanuri et al. 2016, p. 90).

There are relatively few studies addressing commodity markets and metal-related funds (Kanuri et al. 2016; French and Li 2021; Rehman and Vinh 2021), but investments in precious metal funds are gaining attention from investors who want to diversify and seek exposure to variations in precious metals (Otero and Reboredo 2018; Tsolas 2020). The low number of studies reinforces the relevance of a research taking into account investors decisions related to an eventual selection of refuge in the face of various economic, business or social factors, especially considering that these factors can affect the profitability or returns during the health crisis. Additionally, when studying this industry, evidence is provided to policy managers of countries whose income is closely related to the exports of metals or other commodities, as is the case of some Latin American emerging countries mentioned by Babalos and Stavroyiannis (2015) and even developed countries that demand these products (Ordu-Akkaya and Soytaş 2020). Therefore, this study can contribute to the formulation of economic recovery or reactivation plans by having access to information on the current effects on commodities markets and / or risk assessment related to global factors (Hernandez, et al. 2020; Ordu-Akkaya and Soytaş 2020).

This study contributes to the literature related to commodities markets and to the measurement of the effects of financial markets caused by Covid-19, providing: i) an analysis related to the daily variables of advances in infections, as used in different studies; and ii) an innovative vision by integrating as a variable progress in vaccination against the virus. In this context, the WHO (2021) declared that the first collective vaccination program was launched at the beginning of 2021, the year in which the inclusion in the Emergency Use Listing (EUL) was given the green light of Pfizer's Covid-19 vaccine (BNT162b2). The paper also expands the literature on commodities and commodity volatility that has been recently published (Mukherjee and Goswami 2017; Kirikkaleli and Güngör 2021; Maghyereh and Abdoh 2022;

Gupta and Pierdzioch 2023). The results of the study contribute to policy managers, academic researchers, individual and institutional investors in the measurement of macroeconomic effects caused by the pandemic. Additionally, it provides a study for future analysis about financial performance of investment funds in times of financial crisis, reinforcing also some possible effects on the markets according to the Financial Contagion Theory, mentioned by different studies (Shalini and Prasanna 2016; Hernandez, et al. 2020; Ordu-Akkaya and Soytaş 2020; Salisu et al. 2020).

Literature review

Constant changes have occurred in the commodities markets since the first case of Covid-19 was detected. These changes include, for example, reduced demand and alteration of supply chains, which individually or in combination have caused disturbances in the world markets (Ezeaku et al. 2021).

Investors' motivations to allocate resources in the commodities market are mixed; investors may also consider the potential returns that commodities can provide during financial crises, or in proximity to these periods (Ordu-Akkaya and Soytaş 2020; Adekoya et al. 2021; Zhang and Pan 2021). However, there have also been numerous studies that explore these markets considering different types of commodities (Ezeaku et al. 2021; Yousaf 2021) or pose questions about the effectiveness of risk hedging of these commodities (Xu et al. 2013).

Different studies suggest gold as a refuge for investors in times of uncertainty, providing risk mitigation (Junttila et al. 2018; Sumer and Ozorhon 2020; Adekoya et al. 2021; Kinatader et al. 2021; Karamti and Belhassine 2021; Li et al. 2021a; Li et al. 2021b; Shaikh 2021; Yousaf 2021). An equivalent situation is documented by Yousaf (2021) regarding palladium and Brent oil, or for Kamdem, Essomba and Berinyuy (2020) in relation to silver. Even cryptocurrencies are suggested and considered in these analyses (Karamti and Belhassine 2021; Melki and Nefzi 2021). The evidence is mixed regarding the effectiveness of the aforementioned metallic commodities. Studies such as those by Adekoya, Oliyide and Oduyemi (2021), empirically argue that the potential of gold to hedge against the risks of the energy commodity market and equity markets in the world stock markets prior to Covid-19 was not sufficient for the first case; however, the situation changed after the uncertainties that arose during the pandemic, suggesting an effective coverage for both, in line with the changes in correlations documented in the 2008 crisis by Junttila et al. (2018). This evidence is in line with the classification of Multiple Equilibriums related to Investor Behavior in the Financial Contagion Theory, as defined in Rigobon (2002), where investors seeking for a refuge can represent a sign for propagation in other economies.

Regarding the influence of energy commodities in different industries or in the prices of other commodities, evidence is also mixed in times of pandemic. Moreover, in line with the Financial Contagion

Theory, variations in oil prices, driven by reduced demand for crude oil due to abrupt disruptions in operations, can affect the prices or returns associated with this commodity, generating contagion to other industries that use this raw material as an input for production (Amar et al. 2021; Borgards et al. 2021; Ezeaku et al. 2021; Shruthi and Ramani 2021). Sun, Mirza, Qadeer and Hsueh (2021) observed also the presence of bidirectional causality and showed that oil prices are affected by agricultural commodity prices, and vice versa.

Changes in market returns volatility during periods of the financial crisis, such as the 2008 crisis, increased the volatility in the returns of the commodity market during the period, increasing also the risk of investing in commodity market futures (Shalini and Prasanna 2016). Since the commodity market is closely linked to industrial production and macroeconomic activity in the countries, its level of risk also has implications for other sectors and industries (Shalini and Prasanna 2016). In relation to the behavior of commodity futures during the pandemic, previous research highlights that soft and metal commodities exhibited fewer overreactions when compared to precious metals and energy commodities (Borgards et al. 2021).

Considering the perspective of investments funds, commodities markets have become an important alternative for diversification, offering a potentially high expected rate of return and attractive advantages for risk management (Babalos and Stavroyiannis 2015; Al Janabi 2021). The foreign capital produced by institutional investors through investment funds has a vital importance in emerging countries and even in developed countries, a factor that contributes to the contagion effects (Ordu-Akkaya and Soytaş 2020). However, the diversification through commodities can also expose the fund portfolio to other factors of the market, affecting the volatility and behavior of its returns.

French and Li (2021) documented a strong relationship between US equity flows to Brazil and both risk and return measures in the Brazilian equity market. According to the authors, a commodity price shock can positively predict US institutional investment in Brazil (French and Li 2021), a result that is aligned with the financialization of these markets exposed by Ordu-Akkaya and Soytaş (2020). Investment funds, during the Covid-19 pandemic, may seek refuge in the commodities markets. The main arguments for the refuge denomination are based on: i) the observed capacity of the commodity markets to provide a hedge against inflation and fluctuations in the value of the US dollar (Junttila et al. 2018; Sumer and Ozorhon 2020; Shaikh 2021); ii) the conservation of value in periods political or economic uncertainty (Junttila et al. 2018; Shaikh 2021; Yousef 2021); iii) the high intrinsic value and stability experienced over time as a store of value (Adekoya et al. 2021); and iv) high liquidity and better risk-adjusted returns (Shaikh 2021). These benefits can contribute to a better fund performance during the Pandemic, and the main hypothesis of this paper is that: H_1 – Commodity metal-related funds achieved better risk-adjusted performance during the Covid-19 pandemic when compared to other funds.

Different indicators of the Covid-19 pandemic have evolved. They involve number of confirmed cases, human deaths, new variants of the virus, approvals of different vaccines and/or numbers of people inoculated. These indicators related to the Covid-19 crisis have also affected the financial markets and different economies, motivating many actors to enhance recovery plans from the recession or to plan an adequate diversification of the portfolio in international financial markets (Adekoya et al. 2021; Li et al. 2021b; Rehman and Vinh 2021).

The studies that have been developed using as parameters to measure the effects of the health crisis are varied, among which we can mention: i) the use of cumulative daily Covid-19 cases or cumulative deaths worldwide from the John Hopkins Coronavirus Resource Center (Kamdem et al. 2020; Zhang et al. 2020; Adekoya and Oliyide 2021; Amar et al. 2021; Karamti and Belhassine 2021; Li et al. 2021a; Li et al. 2021b; Salisu et al. 2020; Yousaf 2021; Zarembo, et al. 2021); ii) using either a full or partial time series based on the period between the first identified case of Covid-19 and the elapsed time of the health crisis (Adekoya et al. 2021; Borgards et al. 2021; Chen and Yeh 2021; Ezeaku et al. 2021; Kinatered et al. 2021); iii) industrial indicators obtained from databases whose analyzes cover part of the beginning of the pandemic (Sumer and Ozorhon 2020; Wiczorek-Kosmala 2021; Melki and Nefzi 2021; Sun et al. 2021; Umar et al. 2021b); iv) including the development of automated models in the verification and cleaning of commodity price data presented in real time in the elapsed period of covid-19 (Adewopo et al. 2021); or v) other daily indicators that have emerged during the pandemic such as the St. Louis Fed Financial Stress Index or daily data of the Coronavirus Worldwide Panic Index (Chen and Yeh 2021; Umar et al. 2021a).

Data and methods

The quantitative analysis of this study involves four major stages: i) identifying risk factors to conduct the style analysis and identifying Brazilian investment funds that are linked to the commodity metal market (item 3.1); ii) calculating the risk-adjusted performance of investment funds in the sample (item 3.2); iii) testing the effect of Covid-19 period and the Global Financial Crisis on the risk-adjusted performance of the funds (item 3.3); and iv) testing the effect of Covid-19 related factors (vaccination and number of confirmed cases) on daily returns of investment funds (item 3.4). Therefore, this section is divided into four sub-sections, explaining each one of these stages.

Return based style analysis

In this study, commodity-related funds identification considers a return based style analysis (Sharpe 1992). This methodology was chosen considering its popularity and its relative ease to implement and to evaluate, since it only requires fund's returns and the returns of the risk/market factors. Therefore, it is necessary to select a set of risk factors to include in the quantitative model and analyze the exposure that each fund has to these factors. Considering that the main purpose of this research is related to funds linked to the commodity metal market, we selected three different metals to conduct the analysis: gold, silver and copper. Information related to the price of these commodities was extracted from Cochilco (2021). We also collected information on other variables related to the Brazilian capital market, including: stock market indexes, investments in fixed income, and currency. Table 1 describes these variables.

Table 1
 Variables considered for the return based style analysis

Variable	Description	Market	Source
Cooper (Comex)	Returns of the commodity Cooper (daily)	Commodity	Cochilco (2021)
Cooper (LME)	Returns of the commodity Cooper (daily)	Commodity	Cochilco (2021)
Gold (Comex)	Returns of the commodity Gold (daily)	Commodity	Cochilco (2021)
Gold (H&H)	Returns of the commodity Gold (daily)	Commodity	Cochilco (2021)
Gold (LBM)	Returns of the commodity Gold (daily)	Commodity	Cochilco (2021)
Silver (Comex)	Returns of the commodity Silver (daily)	Commodity	Cochilco (2021)
Silver (H&H)	Returns of the commodity Silver (daily)	Commodity	Cochilco (2021)
Silver (London)	Returns of the commodity Silver (daily)	Commodity	Cochilco (2021)
Ibovespa	Returns of the main stock index in Brazil, the Ibovespa (daily)	Stocks	Economática (2021)
IEEX	Returns of the Electrical Energy Index, Brazil (daily)	Stocks	Economática (2021)
IBRx-50	Returns of a theoretical portfolio comprised of the 50 most liquidity stocks (daily)	Stocks	Economática (2021)
Dollar	Currency returns, based on the US-Dollar/BR-Real price (daily)	Currency	Economática (2021)
Euro	Currency returns, based on the Euro/BR-Real price (daily)	Currency	Economática (2021)
Savings	Remuneration for basic savings in Brazil (Poupança), monthly	Fixed Income	Economática (2021)
SELIC	The Basic Interest Rate of Brazil, that can represent returns related to fixed income investments (daily)	Fixed Income	IPEA/CBB (2021)

The variables selected to represent the risk factors may present some degree of correlation. Therefore, we developed an Exploratory Factor Analysis (based on Principal Component Analysis) to reduce the number of factors and address potential concerns related to multicollinearity. To do so, all the variables presented in Table 1 were included in a factor analysis and the results are presented in Table 2. It is important to note that the sample period starts in January/2005 and ends in June/2021. To avoid concerns related to extreme outliers, we used the winsorization procedure in the variable daily returns, at 2% (1% in each tail).

Table 2
 Results for the Exploratory Factor Analysis

This analysis was developed in order to select the variables to be included in the return based style analysis

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Silver (Comex)	0.546	0.007	-0.075	0.001	-0.010	0.055
Gold (Comex)	0.542	-0.006	0.004	-0.001	0.014	-0.078
Silver (H&H)	0.497	-0.006	0.023	-0.001	-0.016	0.064
Ibovespa	-0.004	0.596	-0.007	-0.004	0.013	0.041
IBRx-50	0.002	0.586	-0.008	-0.004	0.023	0.057
IEEX	-0.007	0.546	0.022	0.009	-0.039	-0.104
Gold (LBM)	-0.026	0.005	0.660	0.001	0.008	-0.042
Silver (London)	-0.017	0.007	0.606	0.000	-0.012	0.085
Gold (H&H)	0.340	-0.006	0.325	0.001	0.010	-0.103
SELIC	-0.001	-0.002	-0.002	0.707	-0.001	0.006
Savings	0.001	0.003	0.002	0.707	0.002	-0.004
Euro	0.051	0.026	0.015	-0.005	0.737	0.039
Dollar	-0.056	-0.028	-0.014	0.005	0.674	-0.039
Cooper (LME)	-0.133	-0.026	0.217	-0.002	-0.008	0.689
Cooper (Comex)	0.148	0.020	-0.196	0.003	0.004	0.688

Notes: the sample period starts in January/2005 and ends in June/2021; we used the winsorization procedure in the daily returns, at 2% (1% in each tail), in order to avoid concerns with extreme outliers; the table displays rotated components (rotation: orthogonal varimax, Kaiser normalization); loadings higher than 0.4 were highlighted in bold

The results from Table 3 suggest a weak or low degree of correlation among the variables. Therefore, the return based style analysis was conducted considering Equation 1. It is important to note that the coefficients of Equation 1 were estimated each quarter during the sample period, since the investment funds can alter their allocation strategy over time. Therefore, for each fund and each quarter, we have the RBSA results.

$$Ret_t = \beta_1 Gold_t + \beta_2 Ibovespa_t + \beta_3 Silver_t + \beta_4 SELIC_t + \beta_5 Dollar_t + \beta_6 Cooper_t + \varepsilon_t \quad (1)$$

In which:

Ret_t = represents the return of the fund in day “t”;

Gold_t = represents the return of the commodity Gold (Comex) in day “t”;

Ibovespa_t = represents the return of Ibovespa in day “t”;

Silver_t = represents the return of the commodity Silver (London) in day “t”;

SELIC_t = represents the return of SELIC rate in day “t”;

Dollar_t = represents the currency return, based on the Dollar/BR Real price in day “t”;

Cooper_t = represents the return of the commodity Cooper (Comex) in day “t”;

β_1 ; β_2 ; β_3 ; β_4 ; β_5 ; β_6 ; ε = represent the proxies for each fund allocation in each factor.

The coefficients of Equation 1 were estimated through an optimization process that aims to identify the optimal allocation percentage for each variable, resulting in the fund's return (Sharpe 1992). The sum of the coefficients from β_1 to β_6 ranges from 0 to 1 (i.e., from 0% to 100%), and each coefficient (β_1 ; β_2 ; β_3 ; β_4 ; β_5 ; β_6) can assume a value restricted from 0 to 1 (i.e., from 0% to 100%). Therefore, Equation 1 represents a quantitative equation in which its parameters are estimated under constraints. For example, suppose that for a given fund, the result obtained was: $\beta_1=0.25$; $\beta_2=0.10$; $\beta_3=0.35$; $\beta_4=0.15$; $\beta_5=0.02$; $\beta_6=0.13$; this result suggests that this investment fund probably has allocations related to the commodities market, particularly in Silver (β_3) and Gold (β_1), but low exposure to currency (β_5).

The study sample comprises Brazilian Multimarket Funds, a type of investment fund in Brazil that can invest in different types of assets. Multimarket Funds represent the largest category of investment funds in Brazil in terms of the number of funds and the volume of Total Net Assets when compared, for example, to the category of Stock Funds. Unlike some countries, in Brazil, currently, there is no a specific category of funds named “commodity funds”, which makes the identification of commodity related funds a relatively intricate task. To perform such identification, we employed the RBSA. The period of analysis starts in January/2005, considering that the Brazilian rules about investment funds formation, management, operation and disclosure of information were standardized in 2004 (Brazilian Securities and Exchange Commission - CVM, 2004). Throughout the period from January/2005 to June/2021, we identified 23,594 Multimarket Funds to conduct the style analysis. The database contains 393,099 observations at the fund/quarter level (23,594 funds during 66 quarters); it means that we run 393,099 regressions and recorded the respective parameters of Equation 1. Funds that closed during the period and funds that started during the sample period were also considered, so our sample is not affected by survivorship bias. Table 4 contains summary statistics about the quarterly coefficients obtained through the RBSA

Table 4

Summary Statistics Related to the Return Based Style Analysis

This table reports the results for the “Return Based Style Analysis”. During the period from January/2005 to June/2021, each quarter, we estimated the coefficients of Equation 1. To be included in the analysis, the fund must present at least 45 daily returns in the respective quarter. The table reports the results based on percentiles.

Variables		p10	p25	p50	p75	p90
Gold	(β_1)	0.000%	0.000%	0.098%	0.916%	3.601%
Ibovespa	(β_2)	0.000%	0.113%	2.633%	10.264%	19.918%
Silver	(β_3)	0.000%	0.000%	0.034%	0.488%	1.682%
SELIC	(β_4)	69.474%	82.442%	92.766%	97.913%	99.481%
Dollar	(β_5)	0.000%	0.000%	0.113%	1.538%	7.440%
Cooper	(β_6)	0.000%	0.000%	0.107%	0.652%	2.325%
Commod.	($\beta_1+\beta_3+\beta_6$)	0.007%	0.252%	0.991%	3.043%	6.714%

In order to identify the Brazilian investment funds that are related to the commodity metal market (the first specific purpose of this paper), we are particularly interested in the sum of the coefficients of Equation 1 that are related to metals. In other words, the sum of the coefficients β_1 ; β_3 ; and β_6 (Gold, Silver, and Cooper) is employed to determine commodity metal-related funds. Following this rationale, each quarter, funds that demonstrated at least 10% of their portfolio associated with Gold, Silver or Cooper were considered as a commodity metal-related fund for that specific quarter.

The risk-adjusted performance of investment funds in the sample

We used the Sharpe ratio (Sharpe 1966) as a measure for the risk-adjusted performance of the investment funds, on a quarterly basis. Assessing the funds in the sample each quarter offers some advantages, as it does not assume that performance is constant over the entire sample period and it allows the use of a panel data to test the study hypothesis. The proxy chosen for the risk-free ratio is the SELIC return. Therefore, each quarter, using daily returns, we calculate the Sharpe ratio for each fund. The Sharpe ratio captures the average risk-premium achieved by the fund during the quarter, adjusted by its volatility during the same period. We also included other two measures of fund performance in additional analyzes, that are: i) the average risk-premium achieved by the fund, each quarter; ii) the Adjusted Sharpe ratio, as proposed by Israelsen (2005), which is calculated each quarter. Regarding the Adjusted Sharpe ratio, it considers an additional adjustment for the traditional Sharpe ratio, specifically for those funds with a negative risk-premium.

The quantitative model applied to analyze the effect of Covid-19 on fund performance is presented in Equation 2. This equation also incorporates five control variables related to fund characteristics: performance fees, funds’ age, funds’ size, leverage and funds exclusively designed to only

one investor (exclusive funds, a specific category of investment fund that exists in Brazil). All these control variables were chosen based on previous research (Ackermann et al. 1999; Chevalier and Ellison 1997; Mamede and Malaquias 2017; Chen and Malaquias 2018). Data was extracted from *Economica* (2021).

$$SHP_{iq} = \beta_1 Commod_{iq} + \beta_2 Perf.Fee_{iq} + \beta_3 Age_{iq} + \beta_4 Size_{iq} + \beta_5 Leverage_{iq} + \beta_6 Excl_{iq} + \varepsilon_{iq} \quad (2)$$

In which:

SHP_{iq} = represents the risk-adjusted return of the fund “i” in the quarter “q”;

$Commod_{iq}$ = represent the proxy used to identify commodity metal-related funds. It is a dummy variable that, each quarter, receives 1 for investment funds that presented at least 10% of their portfolio linked to Gold, Cooper or Silver, and 0 for the other cases;

$Perf.Fee_{iq}$ = it is a dummy variable that receives 1 for funds that have performance fees;

Age_{iq} = represents fund’s age (in years) at the beginning of each year;

$Size_{iq}$ = represents the natural logarithmic of funds Total Net Assets at the beginning of each quarter;

$Leverage_{iq}$ = represents a dummy variable that receives 1 for funds that can use leverage strategies to develop their activities;

$Excl_{iq}$ = it is a dummy variable that receives 1 for funds designed to receive investment exclusively from one investor;

$\beta_1; \beta_2; \beta_3; \beta_4; \beta_5; \beta_6; \varepsilon$ = represent the parameters of the model.

The quantitative model available in Equation 2 was also estimated using the risk-premium of each quarter ($RskPr$) and the adjusted Sharpe ratio of each quarter ($SHP-a$) as dependent variables in additional analyzes. To examine the study hypotheses, we used regression analysis with panel data. Considering that the results for some dummy variables were naturally dropped through the fixed effects model, we applied the Lagrange Multiplier / Breusch & Pagan test to determine which model would be more appropriate: the random effects or pooled data. In all cases, the results indicated that the random effects model was the most appropriate choice.

To examine the effect of Covid-19 scenario on fund performance (observing the second specific purpose of this paper), we contrasted the coefficients of Equation 2 across two different periods: from January/2005 to December/2019; and from January/2020 to June/2021.

The analysis considering the global financial crisis

The sample period of this study includes observations from the Global Financial Crisis of 2008. Therefore, we conducted additional rounds of tests in order to analyze the Crisis effect on fund performance. Following previous research (Babalos & Stavroyiannis 2015; Ordu-Akkaya and Soytas 2020; Al Janabi 2021), our binary variable for the global financial crisis takes 1 in the four quarters of 2008 and in the 1st and 2nd quarters of 2009, and takes the value 0 in the other periods. By utilizing interactions among the variables, Equation 3 was used to explore the effect of both Covid-19 and Global Financial Crisis on the performance of metal-related funds.

$$SHP_{iq} = \beta_1 Commod_{iq} + \beta_2 Covid_q + \beta_3 Covid_q * Commod_{iq} + \beta_4 Crisis_q + \beta_5 Crisis_q * Commod_{iq} + \beta_6 Perf.Fee_{iq} + \beta_7 Age_{iq} + \beta_8 Size_{iq} + \beta_9 Leverage_{iq} + \beta_{10} Excl_{iq} + \varepsilon_{iq} \quad (3)$$

In which:

SHP_{iq} = represents the risk-adjusted return of the fund “i” in the quarter “q”;

$Commod_{iq}$ = represent the proxy used to identify commodity metal-related funds. It is a dummy variable that, each quarter, receives 1 for investment funds that presented at least 10% of their portfolio linked to Gold, Cooper or Silver, and 0 for the other cases;

$Covid_q$ = represents a dummy variable that receives 1 in the quarters from January/2020 to June/2021, and 0 for the other periods;

$Crisis_q$ = represents a dummy variable that receives 1 in the quarters from January/2008 to June/2009, and 0 for the other periods;

$Perf.Fee_{iq}$ = it is a dummy variable that receives 1 for funds that have performance fees;

Age_{iq} = represents fund’s age (in years) at the beginning of each year;

$Size_{iq}$ = represents the natural logarithmic of funds Total Net Assets at the beginning of each quarter;

$Leverage_{iq}$ = represents a dummy variable that receives 1 for funds that can use leverage strategies to develop their activities;

$Excl_{iq}$ = it is a dummy variable that receives 1 for funds designed to receive investment exclusively from one investor;

$\beta_1; \beta_2; \beta_3; \beta_4; \beta_5; \beta_6; \beta_7; \beta_8; \beta_9; \beta_{10}; \varepsilon$ = represent the parameters of the model.

The effect of covid-19 related variables on funds returns

The dataset of this study contains two variables related to Covid-19: number of confirmed cases in the world and total vaccinations in the world. The data were extracted from Our World in Data (2021). To assess the effect of number of confirmed cases (NumCases) and the effect of total vaccinations (Vaccinat) on daily returns, we applied the natural logarithm of these variables in each day. In other words, NumCases represents the natural logarithm of the number of confirmed cases on that specific day (not the cumulated number of confirmed cases) and Vaccinat indicates the natural logarithm of the total vaccinations worldwide on that day (not the cumulated number of total vaccinations). Equations 4 and 5 outline the autoregressive models employed in this analysis; the coefficients of these equations were individually estimated for each fund of the sample. The control variables considered in these equations are the same variables used in the RBSA.

$$\text{Ret}_t = \beta_1 \text{Ret}_{t-1} + \beta_2 \text{NumCases}_t + \beta_3 \text{Gold}_t + \beta_4 \text{Ibovespa}_t + \beta_5 \text{Silver}_t + \beta_6 \text{SELIC}_t + \beta_7 \text{Dollar}_t + \beta_8 \text{Cooper}_t + \varepsilon_t \quad (4)$$

$$\text{Ret}_t = \beta_1 \text{Ret}_{t-1} + \beta_2 \text{Vaccinat}_t + \beta_3 \text{Gold}_t + \beta_4 \text{Ibovespa}_t + \beta_5 \text{Silver}_t + \beta_6 \text{SELIC}_t + \beta_7 \text{Dollar}_t + \beta_8 \text{Cooper}_t + \varepsilon_t \quad (5)$$

In which:

Ret_t = represents the return of the fund in the day “t”;

Ret_{t-1} = represents the return of the fund in the previous day, “t-1”;

NumCases_t = represents the natural logarithmic of number of confirmed cases of that day (not the cumulated number of confirmed cases);

Vaccinat_t = represents the total vaccinations of that day (not the cumulated number of total vaccinations);

Gold_t , Ibovespa_t , Silver_t , SELIC_t , Dollar_t , and Cooper_t = are control variables;

β_1 ; β_2 ; β_3 ; β_4 ; β_5 ; β_6 ; β_7 ; β_8 ; ε = represent the parameters of the model.

The autoregressive models available in Equations 4 and 5 were estimated using ordinary least squares for each fund, constrained to the period from January/2020 to June/2021 (daily data). In this context, Equations 4 and 5 were applied to each fund during the period, and the coefficients related to NumCases and Vaccinat were compared using percentile measures, considering metal-related funds in comparison to the other funds within the sample. Since the sample, for this specific analysis, comprises 9,455 funds, we conducted 9,455 regressions (one for each fund) and obtained 9,455 coefficients for the

effect of NumCases on fund daily returns (Equation 4) and 9,455 coefficients for the effect of Vaccinat on fund daily returns (Equation 5).

Results

Table 5 presents the summary statistics of funds in the sample, with the observations arranged by fund / quarter. On average, the Sharpe ratio exhibited a positive (mean = 0.016) and the average risk-premium was close to zero (mean = 0.005).

Table 5

Summary Statistics of the Data

This table represent the summary statistics of the study database considering a panel data comprised of quarterly observations from 23,594 funds during the period from January/2005 to June/2021. To be included in this database, the fund must present at least 45 daily returns in the respective quarter

Variable	Obs	Mean	Std. Dev.	Min	Max
Sharpe	393,099	0.016	0.227	-0.826	0.558
SharpeISR	393,099	0.086	0.130	-0.051	0.558
Risk-Premium	393,099	0.005	0.037	-0.094	0.118
Commod.	393,099	0.050	0.218	0.000	1.000
Perf.Fee	393,099	0.217	0.412	0.000	1.000
Funds Age	393,099	4.877	4.237	0.000	28.000
Funds Size	393,099	17.269	1.500	14.204	20.970
Leverage	393,099	0.817	0.387	0.000	1.000
Exclusive	393,099	0.166	0.372	0.000	1.000

Notes: Sharpe = represents the risk-adjusted return for each fund, each quarter; SharpeISR = represents the adjusted Sharpe ratio, according to Israelsen (2005); Risk-Premium = represents the average difference of the returns of the fund “i” and the risk-free ratio during the quarter “q”; Commod = it is a dummy variable that, each quarter, receives 1 for investment funds that presented at least 10% of their portfolio linked to Gold, Cooper or Silver, and 0 for the other cases; Perf.Fee = it is a dummy variable that receives 1 for funds that have performance fees; Age = represents fund’s age (in years) at the beginning of each year; Size = represents the natural logarithmic of funds Total Net Assets at the beginning of each quarter; Leverage = represents a dummy variable that receives 1 for funds that can use leverage strategies to develop their activities; Excl = it is a dummy variable that receives 1 for funds designed to receive investment exclusively from one investor.

Approximately 21% of the observations originate from funds that have performance fees, while 16.6% of the observations are from Exclusive funds. On average, the funds have been active for 4.8 years. Regarding the second specific objective of this paper, Table 6 displays the results for the performance of commodity-related funds across the entire sample period, while Table 7 presents the results segregated by the quarters affected by Covid-19 pandemic.

Table 6

Performance of Commodity Metal-Related Funds compared to the Other Funds, considering the entire period of the sample

Variables	Coef.	Std. Err.	z	P>z
Commod.	0.029	0.002	18.350	0.000
Perf.Fee	0.006	0.002	2.500	0.013
Funds Age	-0.001	0.000	-7.720	0.000
Funds Size	0.025	0.000	60.100	0.000
Leverage	0.041	0.003	15.650	0.000
Exclusive	-0.006	0.003	-2.040	0.042
Constant	-0.448	0.008	-59.470	0.000
Num. Obs.=	393,099		R-sq: within =	0.0068
Num. Funds=	23,594		between =	0.0692
VIF max. =	1.08		overall =	0.0264

Table 7

Performance of Commodity Metal-Related Funds compared to the Other Funds

Variables	Jan/2005 - Dec/2019				Jan/2020 - June/2021			
	Coef.	Std. Err.	z	P>z	Coef.	Std. Err.	Z	P>z
Commod	0.014	0.002	7.480	0.000	0.066	0.003	22.970	0.000
Perf.Fee	0.005	0.003	1.850	0.065	-0.003	0.003	-0.960	0.335
Funds Age	-0.003	0.000	-19.670	0.000	-0.003	0.000	-11.650	0.000
Funds Size	0.024	0.000	53.350	0.000	0.012	0.001	14.680	0.000
Leverage	0.043	0.003	14.950	0.000	0.023	0.004	6.500	0.000
Exclusive	-0.003	0.003	-0.920	0.360	0.003	0.004	0.900	0.367
Constant	-0.453	0.008	-53.770	0.000	-0.150	0.015	-9.950	0.000
Num. Obs.=	331,214		R-sq: within=	0.0059	Num. Obs.=	61,885	R-sq: within=	0.0114
Num. Funds=	20,468		between =	0.0667	Num. Funds=	12,052	between =	0.0262
			overall =	0.0243			overall =	0.0187

Notes: Dependent variable: Sharpe Ratio for each fund, each quarter; Commod = it is a dummy variable that, each quarter, receives 1 for investment funds that presented at least 10% of their portfolio linked to Gold, Cooper or Silver, and 0 for the other cases; Perf.Fee = it is a dummy variable that receives 1 for funds that have performance fees; Age = represents fund's age (in years) at the beginning of each year; Size = represents the natural logarithmic of funds Total Net Assets at the beginning of each quarter; Leverage = represents a dummy variable that receives 1 for funds that can use leverage strategies to develop their activities; Excl = it is a dummy variable that receives 1 for funds designed to receive investment exclusively from one investor. The coefficients were estimated using panel data analysis with random effects

As per the findings presented in Tables 6 and 7, on average, commodity metal-related funds achieved superior indexes for risk-adjusted performance in comparison to the other funds of the sample.

Furthermore, the risk-adjusted performance of metal-related funds during the quarters affected by the Covid-19 pandemic (Jan/2020 to June/2021) displayed a higher strength in comparison to the other funds (the coefficient was 0.066), when contrasted with the performance of the other period (Jan/2005 to Dec/2019, in which the coefficient was 0.014). Therefore, these results validate H1 and imply that commodity metal-related funds achieved better risk-adjusted performance during the Covid-19 pandemic when compared to the other funds.

In order to analyze whether these results were related to the proxy for risk-adjusted performance, we replicated the analysis using the Adjusted Sharpe ratio and the Risk-Premium of each quarter as the dependent variables. The results can be found in Table 8.

Table 8
 Performance of Commodity Metal-Related Funds compared to the Other Funds, considering other measures for fund performance

Variables	Dependent Var.: Adj. Sharpe Ratio				Dependent Var.: Risk Premium			
	Jan/2005 - Dec/2019		Jan/2020 - June/2021		Jan/2005 - Dec/2019		Jan/2020 - June/2021	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
Commod.	-0.005	0.000	0.045	0.000	0.005	0.000	0.035	0.000
Perf.Fee	-0.003	0.009	-0.002	0.281	-0.001	0.036	-0.005	0.000
Funds Age	-0.001	0.000	-0.002	0.000	0.0004	0.000	-0.0004	0.000
Funds Size	0.005	0.000	0.003	0.000	0.001	0.000	0.001	0.000
Leverage	-0.014	0.000	-0.024	0.000	0.005	0.000	0.011	0.000
Exclusive	0.002	0.162	0.000	0.999	0.001	0.071	0.001	0.044
Constant	0.003	0.530	0.081	0.000	-0.023	0.000	-0.012	0.000
Num. Obs.=	331,214		61,885		331,214		61,885	
Num. Funds=	20,468		12,052		20,468		12,052	

Notes: Dependent variable: Adjusted Sharpe Ratio for each fund, each quarter or Average Risk-Premium of each quarter; Commod = it is a dummy variable that, each quarter, receives 1 for investment funds that presented at least 10% of their portfolio linked to Gold, Cooper or Silver, and 0 for the other cases; Perf.Fee = it is a dummy variable that receives 1 for funds that have performance fees; Age = represents fund's age (in years) at the beginning of each year; Size = represents the natural logarithmic of funds Total Net Assets at the beginning of each quarter; Leverage = represents a dummy variable that receives 1 for funds that can use leverage strategies to develop their activities; Excl = it is a dummy variable that receives 1 for funds designed to receive investment exclusively from one investor. The coefficients were estimated using panel data analysis with random effects.

The effect of the variable Commod. on fund performance remained strong during the Covid-19 even when using different measures for performance, as illustrated in Table 8. These results emphasize that commodity metal-related funds presented, on average, better performance than their counterparts throughout the Covid-19 pandemic. The analysis was also carried out considering other perspective, involving interactions among variables and a measure for the Global Financial Crisis, as shown in Table 9.

Table 9

Performance of Commodity Metal-Related Funds compared to the Other Funds, considering interactions among variables and the Global Financial Crisis

Variables	Coef.	Std. Err.	z	P>z
Commod.	0.015	0.002	8.400	0.000
Covid	0.041	0.001	38.590	0.000
Covid*Commod.	0.047	0.003	13.660	0.000
Crisis	-0.042	0.001	-30.210	0.000
Crisis*Commod.	-0.003	0.014	-0.240	0.808
Perf.Fee	0.004	0.002	1.740	0.081
Funds Age	-0.003	0.000	-27.700	0.000
Funds Size	0.023	0.000	57.630	0.000
Leverage	0.038	0.003	14.970	0.000
Exclusive	-0.004	0.003	-1.330	0.184
Constant	-0.422	0.007	-56.810	0.000
Num. Obs.=	393,099		R-sq: within =	0.0117
Num. Funds=	23,594		between =	0.1162
VIF max. =	1.44		overall =	0.0368

Notes: Dependent variable: Sharpe Ratio for each fund, each quarter; Commod = it is a dummy variable that, each quarter, receives 1 for investment funds that presented at least 10% of their portfolio linked to Gold, Cooper or Silver, and 0 for the other cases; Covid = it is a dummy variable that receives 1 for the quarters from Jan/2020 to June/2021; Crisis = it is a dummy variable that receives 1 for the quarters from Jan/2008 to June/2009; Perf.Fee = it is a dummy variable that receives 1 for funds that have performance fees; Age = represents fund's age (in years) at the beginning of each year; Size = represents the natural logarithmic of funds Total Net Assets at the beginning of each quarter; Leverage = represents a dummy variable that receives 1 for funds that can use leverage strategies to develop their activities; Excl = it is a dummy variable that receives 1 for funds designed to receive investment exclusively from one investor. The coefficients were estimated using panel data analysis with random effects

According to the results in Table 9, consistent with the previous results from Tables 7 and 8, the risk-adjusted performance of metal-related funds was better than the performance of the other funds ($\beta = 0.015$), especially during the Covid-19 period ($\beta = 0.047$). The result for the performance of metal-related funds during the Pandemic was equivalent when using the Adjusted Sharpe ratio and the risk-premium of the quarter as dependent variables.

However, according to the results in Table 9, the performance of metal-related funds during the Global Financial Crisis did not exhibit statistically significant differences compared to the performance achieved by the other funds. The effect of the Global Financial Crisis was negative and statistically significant for the funds within the sample.

Aligned with the third specific objective of this paper, the final round of analyzes examines the effect of Covid-19 variables (number of confirmed cases and total vaccinations). Table 10 contains the results and the analysis; for this particular evaluation, the analysis is restricted to the period from Jan/2020 to June/2021.

Table 10

The Effect of Number of Confirmed Cases and Total Vaccinations on Daily Fund Returns

This table reports cross-sectional statistics related to the analysis of Covid-19 variables (NumCases and Vaccinat.) on daily returns of the funds of the sample. For each fund, during the period from Jan/2020 to June/2021, we estimated a regression model available in Equations 4 and 5. Considering that the sample, in this specific analysis, is comprised of 9.455 funds, we estimated the regression for each one of these 9.455 funds and obtained 9.455 coefficients for the effect of NumCases on fund daily returns (following Equation 4) and 9.455 coefficients for the effect of Vaccinat on fund daily returns (following Equation 5). The table reports percentile statistics (and the mean) of these 9.455 coefficients.

Panel A: Statistics for the Coefficients of the variable NumCases							
Funds:	Freq.	p10	p25	p50	p75	p90	Mean
Other Funds	9,171	-0.0042	0.0016	0.0086	0.0141	0.0206	0.0080
Metal-Related Funds	284	-0.0294	-0.0031	0.0174	0.0308	0.0430	0.0102
Panel B: Statistics for the Coefficients of the variable Vaccinat							
Funds:	Freq.	p10	p25	p50	p75	p90	Mean
Other Funds	9,171	-0.0038	-0.0009	0.0008	0.0029	0.0056	0.0008
Metal-Related Funds	284	-0.0099	-0.0022	0.0041	0.0085	0.0210	0.0049

Notes: NumCases = represents the natural logarithmic of number of confirmed cases of that day (not the cumulated number of confirmed cases); Vaccinat = represents the total vaccinations of that day (not the cumulated number of total vaccinations); Metal-Related Funds: funds that received the value 1 for the variable Commod. during, at least, 50% of the quarters.

Based on the findings in Table 10 (Panel A), the effect of the variable NumCases on the daily returns of metal-related funds was positive and greater than in the other funds within the sample. This analysis suggests a positive relationship between the daily number of confirmed cases of Covid-19 and the daily returns of metal-related funds within the sample. In this scenario, on average, the returns of metal-related funds increased with the increase in the number of confirmed cases. Regarding the effect of the variable Vaccinat on daily returns, Panel B of Table 10 suggests that this effect was also positive among metal-related funds. A chi-square test conducted using the medians of each groups in Panels A and B indicated that the difference is statistically significant at 1% in both (Panel A and Panel B).

Based on the literature review conducted in this paper (Adekoya et al. 2021; Li et al. 2021b; Rehman and Vinh 2021), it is possible to observe that the numbers related to the Covid-19 (NumCases and Vaccinat.) have affected the financial market. In this case, many investors can realize an environment of uncertainty to perform their operations in the capital market, while other investors may find good opportunities during these times to negotiate and generate extraordinary gains. Institutional investors, such as the investment funds, on average, may found assets to invest during these times and obtain positive returns, as the results suggest. However, the funds in the category “other funds” of the sample also presented a lower but positive coefficient for this analysis during the period. It indicates that many funds in the category of “other funds” also found opportunities in the financial market to achieve better returns during the period of analysis.

In general, the results of higher returns on commodity-related investment funds reinforce previous studies measuring the effects of Covid-19 in financial markets that document a potential refuge in commodities markets (Adekoya and Oliyide 2021; Adekoya et al. 2021; Li et al. 2021b; Yousaf 2021). Regarding the results obtained when using the variable NumCases on the daily returns of metal-related funds, they align with previous studies, such as: Salisu et al. (2020), who consider the Covid-19 global fear index and document a positive relationship with the profitability of raw material prices; Kamdem et al. (2020), who found effects on commodity prices using different measurement tools in relation to this study; and Adekoya and Oliyide (2021), who demonstrated strong volatility in the markets using this variable, where gold acted as a net receiver of shocks and other served as net transmitters.

Overall, these results also align with the Financial Contagion Theory (Rigobon 2002), and the number of confirmed cases published periodically may serve as a channel through which shocks are transmitted. The results of Panel B (Table 10), related to the increase in the number of vaccinations, can be interpreted as announcements of quantitative easing explored by Chen and Yeh (2021) and Zhang et al. (2020).

Conclusions

The empirical evidence of this study aligns with investigations related to the effects caused by Covid-19 on financial markets, particularly regarding the use of commodities as a refuge by investors in times of financial crisis. Overall, the main results suggest a higher risk-adjusted returns on metal-related funds during the quarters affected by the Covid-19 pandemic. Therefore, this paper brings together two kinds of assets available in the financial market (commodities and investment funds) and shows the potential benefits that can be achieved through diversification. This type of analysis allows for a deeper understanding of how investment funds work and respond to health crises.

Investment funds exposed to the variations of metal commodities showed better risk-adjusted performance when compared to the other funds during the Covid-19 Pandemic, probably due the benefits of the commodities for diversification and for reducing the risk exposition to the other asset classes in the financial market. The channel for such effect, in this study, seems to be linked to the indexes related to the advancement of Covid-19. In relation to previous research, this study introduces novel contributions related to a contemporary topic in the financial market (Covid-19), that also represents a sanitary crisis with no precedents. It makes the study contributions timely. Moreover, understanding the behavior of investment funds during Covid-19 contributes to the decision-making process in situations characterized by increase in commodity prices and significant inflation.

As an innovative analysis, our findings indicate that variables related to the Covid-19 Pandemic presented a positive effect on the daily returns of the funds, particularly for the metal-related funds identified in the study. In this way, both the number of confirmed cases and total vaccinations may serve as indicators of the pandemic's progression or containment, thereby influencing the daily return indexes achieved by fund managers. Therefore, results of this research can contribute to the academic literature related to commodities markets and investment funds (French and Li 2021; Rehman and Vinh 2021), using a contemporary approach based on the Covid-19 effects. Moreover, the results reinforce the application of contagion theory within the context of health crisis (Shalini and Prasanna 2016; Hernandez et al. 2020; Ordu-Akkaya and Soytaş 2020; Salisu et al. 2020), addressing a possible channel through which shocks has been transmitted in the financial market. The methodological procedures used to identify investment funds related to the commodity market, through the RBSA, have the potential to stimulate further research in the field of Finance.

In relation to the practical implications, fund managers can observe that commodity-related assets can provide benefits for diversification and, properly used, can also contribute to a better risk-adjusted performance. On the one hand, comparing data from November 2020 to July 2021, Brazil faced a raise in inflation (IMF, 2021). On the other hand, some Brazilian funds, particularly metal-related funds, achieved better indexes of return during the Pandemic. Therefore, some types of Brazilian investment funds can represent an alternative to face some challenges related to economic difficulties in Brazil, or even to hedge against them. Governments can also consider the information provided by this research in the planning for reactivation during different phases of the pandemic, particularly in countries that are commodity dependents (Babalos and Stavroyiannis 2015; Ordu-Akkaya and Soytaş 2020). Both individual and institutional investors can leverage the results of this research to assess the potential macroeconomic effects brought by the pandemic on the investment fund industry.

This study has two main limitations. The first limitation is related to the procedure used to identify metal-related funds. Using the RBSA and daily returns, we identified Brazilian investment funds linked to the commodity metal markets. This approach relies on regressions and, consequently, serves a proxy for fund classification. Future research in the field can analyze the portfolio allocation and financial investments periodically conducted by this particular kind of fund. The second limitation is related to the sample composition, since it only involves Brazilian investment funds within the Multimarket category. Therefore, considering that the effects of the health crisis can be different according to each country characteristics (Zaremba et al. 2021), funds exposed to the commodity metal markets, but located in other countries, may present a different behavior in comparison to the investment funds considered in this paper. As a possibility for future research, we recommend additional analysis including other categories of investment funds and other commodities classes. Moreover, further research can consider fund's

regulations and the portfolio composition in order to improve the criteria to identify funds related to metal commodities.

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