

HEDGES AND SAFE HAVENS: AN EXAMINATION OF STOCKS, GOLD AND SILVER IN LATIN AMERICA'S STOCK MARKET

COBERTURAS E REEQUILÍBRIO DE CARTEIRAS: UMA ANÁLISE PARA AS AÇÕES OURO E PRATA NOS MERCADOS BOLSISTAS DA AMÉRICA LATINA

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ABSTRACT

Purpose - This essay aims to analyze whether gold (Gold Bullion: Zurich) and silver (Silver Paris Spot E/KG) will be a safe haven for diversifying portfolios in Latin America's stock markets.

Design/methodology/approach - The analyzed data are the price indexes of the stock markets of Argentina (S&P Merval), Brazil (Ibovespa), Chile (S&P/CLX IGPA), Peru (S&P/BVL General IGBL), Mexico (IPC), USA (Dow Jones), gold (Gold Bullion: Zurich), and silver (Silver Paris Spot E/KG), from December 31, 2019 to September 2, 2020. To answer the research question we used Gregory and Hansen's methodology (1996), and the VAR Granger causality/block exogeneity Wald tests model.

Findings - The results indicate that the markets have very significant integrations and causalities, that is, gold and silver do not function as safe havens for the diversification of portfolios in Latin American stock markets.

Research limitations/implications - While the present investigation used general indices, in future studies sectoral indices can be used, as well as intraday data to have more robust evidence regarding the diversification of portfolios in these regional markets.

Originality/value - This investigation differs from previous studies because it focuses on the rebalancing of portfolios through the estimation of integration models and shocks between gold and silver and the Latin American markets. This differs from the previous ones, which analyzed the average dependencies between gold and financial market movements, and between gold and currency depreciation.

Keywords: Gold; Silver; Safe haven; Risk diversification; Latin America.

RESUMO

Finalidade - Esta pesquisa tem como objetivo analisar se o Ouro (Gold Bullion: Zurich) e a Prata (Silver Paris Spot E/KG), serão um porto seguro para a diversificação de carteiras nos mercados de ações da América Latina.

Desenho / metodologia / abordagem - Os dados analisados são os prices index dos mercados de ações da Argentina (S&P Merval), Brasil (Ibovespa), Chile (S&P/CLX IGPA), Peru (S&P/BVL General IGBL), México (IPC), EUA (Dow Jones), Ouro (Gold Bullion: Zurich), e a Prata (Silver Paris Spot E/KG), no período de 31 de dezembro de 2019 a 02 de setembro de 2020. Para respondermos à questão de investigação utilizamos a metodologia de Gregory and Hansen (1996), e o modelo VAR Granger Causality/Block Exogeneity Wald Tests.

Constatações - Os resultados indicam que os mercados apresentam integrações e causalidades muito significativas, ou seja, o Ouro e a Prata não funcionam como portos seguros à diversificação de carteiras nos mercados de ações da América Latina.

Limitações/ implicações da pesquisa - A presente investigação recorreu a índices gerais, em estudos futuros podemos recorrer a índices setoriais, bem como a dados intradiários para ter evidências mais robustas no que concerne à diversificação de carteiras nestes mercados regionais.

Originalidade/valor - Esta investigação distingue-se dos estudos anteriores, porque incidiu sobre o reequilíbrio de carteiras, através da estimação de modelos de integração e choques entre o Ouro e a Prata, e os mercados da América Latina, o que se diferencia dos anteriores, que analisaram as dependências médias entre o ouro e os movimentos dos mercados financeiros, e entre o ouro e a depreciação da moeda.

Palavras chave: Ouro; Prata; Reequilíbrio; Diversificação do risco; América Latina

1 INTRODUCTION

The COVID-19 pandemic has caused global concern. On January 30, *World Health Organization* (WHO) declared it a global health emergency and the easy spread of this virus has caused uncertainty in the global population. This epidemic has also changed people's lifestyles, millions of people have been placed in isolation in order to reduce the transmission of the virus and companies have to lock down to control the spread of the virus, causing income losses and leading to significant levels of unemployment. Worldwide, flights were canceled, and transportation systems were closed. In general, economic activities were disrupted and stock exchanges declined sharply (Saadat, Rawtani, and Hussain, 2020).

The price of gold has been an asset that has not been affected during some economic changes; that is, historical information shows that the price of gold is not affected in the same way when financial markets crash. In many cases, the price of gold increased when other assets lost value in international markets, which creates confidence in investors that gold can be a safe asset in the rebalancing of portfolios (Mohanasundari, Vidhyapriya, Sundharesalingam, and Kavitha, 2020).

The growing trend of integration and interdependence in international financial markets has increased the likelihood of risk transmission between markets. In periods of turmoil, investors must rebalance their portfolios by closing long positions in markets that present significant levels of risk (Dias, da Silva, and Dionísio, 2019; Mohammadpoor and Rezazadeh, 2019; Morales and Gassie, 2014).

Due the evolution of the Pandemic this research intend to test if the Gold (Bullion: Zurich) and Silver (Paris Spot E/KG), it is safe investment, attending that international investors aims diversify their portfolio in the financial American markets (such as Argentina (S&P Merval), Brazil (Ibovespa), Mexico (IPC), Chile (S&P/CLX IGPA), Peru (S&P/BVL General IGBL) and USA (Dow Jones)) in the period from December 31, 2019 to September 2, 2020. To carry out this analysis different approaches will be undertaken with a view to finding whether the gold and silver market will be a safe haven when the financial markets in Latin America show structural breaks. These results show that the gold and silver market is not a safe haven, and show that they are not an alternative to portfolio



diversification in these regional markets.

This investigation adds two contributions to the literature. The first refers to the study of risk diversification in the Latin American markets, Gold (Bullion: Zurich), Silver (Paris Spot E/KG) markets. Previous studies focused on the average correlations or dependencies between Gold and financial markets changes. And, also between Gold and currencies depreciations. The second contribution is related to the preference for these regional emerging markets. As far as is known, this essay is the first study that analyzes the rebalancing of portfolios in the context of the global pandemic (COVID-19). Additionally, we are aware that the authors Balcilar, Hammoudeh, and Asaba (2015), Siddiqui and Roy (2019), Hussain Shahzad, Bouri, Roubaud, and Kristoufek (2020), Vikneswaran, Purdasy, Rashid, and Basirduddin (2020), analyzed gold as a safe haven for rebalancing of portfolios, but the markets, research questions, and approach were different from those followed in this essay. In terms of structure, this essay is organized in five sections. Section 1 is represented by the current introduction. Section 2 presents a literature review with regard to articles on assets that could be safe ports in the diversification of portfolios. Section 3 describes the data and methodology and section 4 contains the results. Finally, section 5 presents the general conclusions of this research.

2 LITERATURE REVIEW

The growing uncertainty in the global economy is also transmitted to the global financial market, which makes investors tend to distribute their portfolios from high-risk to low-risk markets. From the perspective of investors and risk managers, gold is regularly seen as a hedge or a safe haven against stock markets, so understanding the relationship between gold and financial markets has significant implications (Ma, Yang, Zou, and Liu, 2020; Yamaka and Maneejuk, 2020).

Balcilar, Hammoudeh, and Asaba (2015), Batten, Ciner, Kosedag, and Lucey (2017), and Laily et al. (2017) examine gold as a safe asset in the adjustment of portfolios by investors. Balcilar, Hammoudeh, and Asaba (2015) show that gold is a less volatile asset when compared to silver and oil, ensuring its use as a “safe haven” asset Batten. Ciner, Kosedag, and Lucey (2017) evidence the non-existence of causal relationships between the price of gold and the stock markets analyzed, suggesting that gold may be a safe asset in the rebalancing of portfolios. Laily et al. (2017) show a positive relationship between the prices of crude oil and the price of gold, and a negative synchronization between the rate of inflation, GDP, interest rates, and exchange rates.

Siddiqui and Roy (2019), D. Huang and Kilic (2019), Balcilar, Demirer, Gupta, and Wohar (2020), Kang, Yoon, Bekiros, and Uddin (2020), Vikneswaran, Purdasy, Rashid, and Basirduddin (2020), and Cheema and Szulczuk (2020) tested various commodities as hedging assets. Siddiqui and Roy (2019) show that gold is a more effective hedging asset than crude oil for institutional investors in India. D. Huang and Kilic (2019) show that gold prices fall in recessions, although to a lesser extent than platinum prices. Balcilar, Demirer, Gupta, and Wohar (2020) show that precious metals cause shocks in the stock markets during periods of high volatility. However, sovereign bonds present an insignificant risk in periods of stock market stress which implies that these assets serve as more effective hedges (or safe havens) for investors in international stock markets. Kang, Yoon, Bekiros, and Uddin (2020) investigated the dynamic relationship between Bitcoin and U.S. stocks (S&P 500), U.S. dollar, Treasury bills and gold futures, showing that Bitcoin can be used as a safe haven for investors. Vikneswaran, Purdasy, Rashid, and Basirduddin (2020) show that gold is a cover and a safe haven for shares in Mauritius. However, when compared to currency, gold is a better protection at the expense of the domestic stock market. Cheema and Szulczuk (2020) show that gold moves together with Bitcoin (BTC), and with the stock markets of the five largest economies in the world, and thus gold has



lost its safe haven status against market losses actions during the COVID-19 global pandemic.

Maghyereh and Abdoh (2020), Bedoui, Guesmi, Kalai, and Porcher (2020), Bouri, Shahzad, Roubaud, Kristoufek, and Lucey (2020), Yamaka and Maneejuk (2020), Naeem, Hasan, Arif, Balli, and Shahzad (2020), Hussain Shahzad, Bouri, Roubaud, and Kristoufek (2020) studied the Gold as a safe investment in international financial market. Maghyereh and Abdoh (2020) show that gold does not act as a diversifier, or a tool for rebalancing the portfolios for Islamic investors. Bedoui, Guesmi, Kalai, and Porcher (2020) show that the assets of precious metals, such as gold, silver, palladium and platinum surpass diamonds when one wants to hedge against the movements of the USD. However, when analyzed from the safe harbor perspective, the evidence shows that precious metals and diamonds serve as a fragile safe harbor. Bouri, Shahzad, Roubaud, Kristoufek, and Lucey (2020) compared the safe haven properties of Bitcoin, gold and the commodities index with the stock markets. The authors show that the benefits of diversification vary in frequency of time, with Bitcoin showing superiority over gold and the commodities index. Yamaka and Maneejuk (2020) show the existence of significant causalities between gold shocks and the volatility of Asian stock markets. The authors highlight the existence of strong correlations between the stock markets of South Korea and India and the gold market during the global financial crisis when compared to the pre- and post-crisis periods. Naeem, Hasan, Arif, Balli, and Shahzad (2020) show that the 2008 global financial crisis accentuated the clashes between the BRIC stock markets with oil and gold. Hussain Shahzad, Bouri, Roubaud, and Kristoufek (2020) evidence that Gold and the virtual coin (Bitcoin) are seemed as secure investments, when international investors aims to rebalance their financial portfolios in G7 financial markets.

In summary, this work aims to contribute to the provision of information to investors and regulators in international stock markets, where individual and institutional investors seek diversification benefits. Therefore, the context of this work is to examine the integration and shocks between Latin American stock markets and the prices of gold and silver in order to understand whether these commodities will be a safe haven during the global pandemic period (COVID-19).

3 EMPIRICAL STUDY

3.1 DATA

The data analyzed are the prices index of the stock markets of Argentina (S&P Merval), Brazil (Ibovespa), Chile (S&P/CLX IGPA), Peru (S&P/BVL General IGBL), Mexico (IPC), USA (Dow Jones), gold (Gold Bullion: Zurich), and silver (Silver Paris Spot E/KG), from December 31, 2019 to September 2, 2020. Prices are daily and were obtained from the DataStream platform using local currency to mitigate exchange rate distortions.



Table 1: The name of countries and their indices

Country	Index
Argentina	S&P Merval
Brazil	Ibovespa
Chile	S&P/CLX IGPA
Peru	S&P/BVL General IGBL
Mexico	IPC
EUA	Dow Jones
Gold	Gold Bullion (Zurich) kg (995) CHF
Silver	Silver Paris Spot E/KG

Source: Own elaboration.

METHODOLOGY

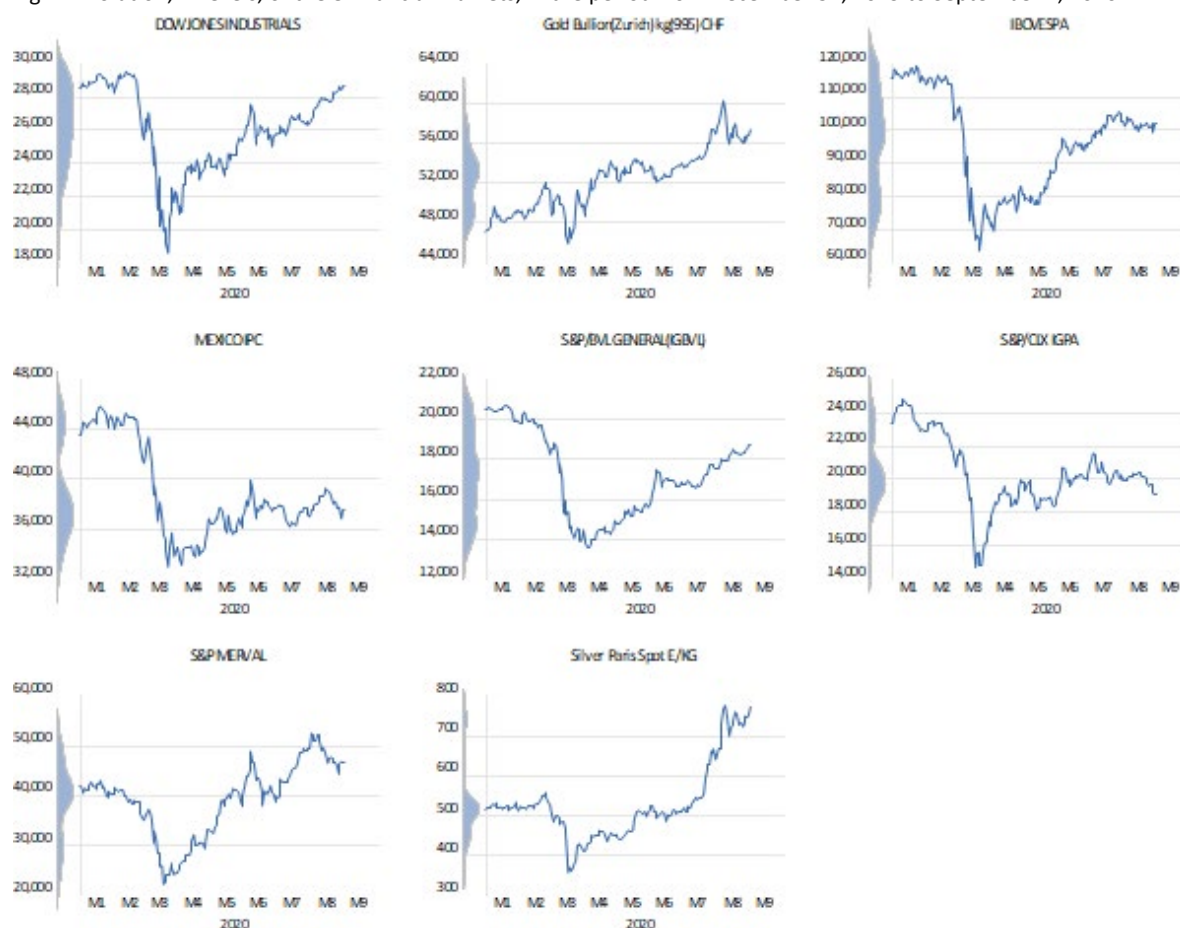
The research took place over several stages. The characterization of the sample used was carried out through descriptive statistics, using the Jarque and Bera (1980) adherence test. With the purpose of assessing the stationarity of the time series, this research use the Levin, Lin, and Chu (2002), ADF (Dickey and Fuller, 1981), and PP (Pierre Perron and Phillips, 1988) tests that postulate the same null hypotheses, while the Hadri test (2000), postulates contrary hypotheses. In order to determine the structure breaks, the study make graphs of stability to the residues. To determine the date of the structure breaks were applied the test proposed by Clemente et al. (1998). To verify the integration between the financial markets, the methodology of Gregory and Hansen (1996) is used, aligned with similar studies that examined a very troubled period in the financial markets. Additionally, the reason why standard cointegration tests such as Engle and Granger (1987) and Johansen (1988) are not suitable for testing regime change cointegration is that such tests assume that the cointegration vector is invariant over time. To examine shocks between markets the study applied VAR Granger causality/block exogeneity Wald tests model, which uses Wald's statistics and tests whether the null hypothesis that the lagged endogenous coefficients of the "cause" variable is null or not "causes" the dependent variable in the Grangerian sense. However, it should be noted that the result of this test is highly sensitive to the number of lags considered in the model, so the first concern is to properly estimate this value in order to arrive at robust evidence (Gujarati, 2004). To determine the number of lags to include in the causality tests, we will use the FPE (Final prediction error), and AIC (Akaike information criterion) criteria, and to validate the robustness of the model, we will estimate the VAR residual serial correlation.

4 RESULTS

Figure 1 shows the evolution of financial markets, in levels, in the period from December 2019 to September 2020. This is a period of considerable complexity, due to understanding the outbreak of the global pandemic (COVID-19). Most markets show structure breaks in February and March 2020.



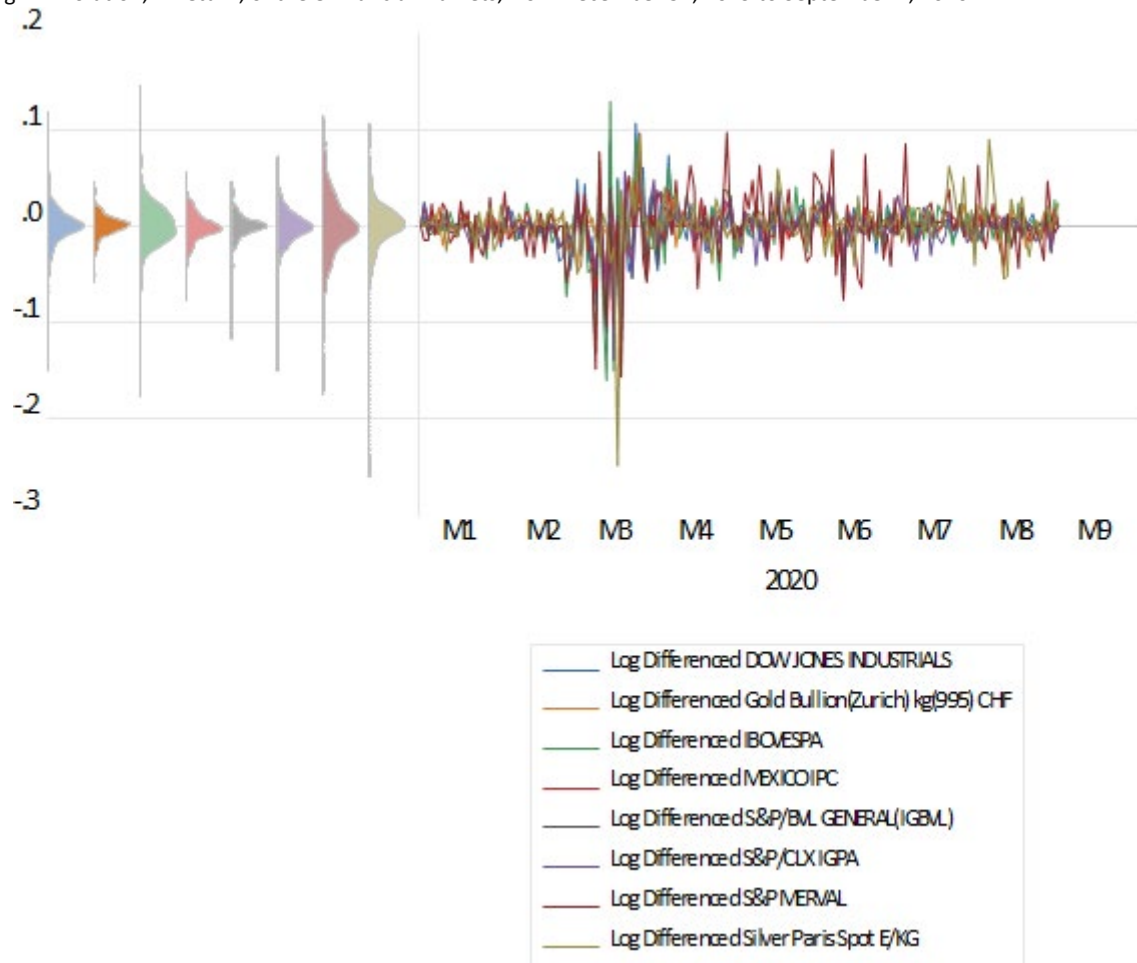
Fig. 1: Evolution, in levels, of the 8 financial markets, in the period from December 31, 2019 to September 2, 2020.



Source: Own elaboration.

Figure 2 shows the evolution, in profitability, of the eight financial markets; graphical analysis of the indices shows that they reveal very similar patterns of behavior during the sample period and suggest that this occurrence could be linked with the global pandemic (COVID-19). The values of the indices underwent wide variations over the months studied. However, in spite of the wide variations, the return show characteristics of average stationarity, giving a first indication that the series may be stationary. On the other hand, the graphic analysis also allows to verify a drop down in the market due the crash in stock market motivated by the effects of the Pandemic (between February and April 2020). Additionally, kernel density, suggest that Argentine market (S&P Merval) has the highest volatility. (-3 to 1), while the gold market (Gold Bullion (Zurich) kg (995) CHF) shows the lowest volatility when compared to the other markets.

Fig. 2: Evolution, in return, of the 8 financial markets, from December 31, 2019 to September 2, 2020.



Source: Own elaboration.

Table 2 shows the main descriptive statistics of the financial markets under analysis, and allows us to assess that the profitability of the stock market indices of the USA (Dow Jones), Argentina (S&P Merval), gold (Gold Bullion (Zurich) kg (995) CHF), and silver (Silver Paris Spot E/KG) have positive daily averages. The markets in Brazil (Ibovespa), Mexico (IPC), Peru (S&P BVL), and Chile (S&P IGPA) show negative returns. The Argentine market (S&P Merval) presents the most marked standard deviation (0.035860). In addition, it is possible to verify that all markets have negative asymmetries ($\neq 0$), while in short-circuits they have values above 3, which contradicts the hypothesis that the data follow a normal distribution (asymmetry = 0, kurtosis = 3). In order to validate the Jarque-Bera adherence test, it rejects the null hypothesis with a significance of 1%, showing that the data do not have a normal distribution.

Table 2: Descriptive statistics of returns of the financial markets under analysis, from December 31, 2019 to September 2, 2020.

	D J	IBOVESPA	IPC	BVL	IGPA	MERVAL	GOLD	SILVER
Mean	2.12E-05	-0.000700	-0.000846	-0.000534	-0.001150	0.000625	0.001111	0.002308
Std. Dev.	0.026801	0.032571	0.016769	0.017032	0.022374	0.035860	0.012377	0.028953
Skewness	-0.743286	-1.265302	-0.498868	-1.908674	-2.031019	-0.716756	-0.538273	-3.335562
Kurtosis	9.875197	10.80981	4.923765	13.28376	14.62033	6.609023	6.344188	34.08683
Jarque-Bera	364.9***	497.0***	34.6***	887.4***	1117.5***	111.2***	91.0***	7455.3***
Observations	177	177	177	177	177	177	177	177

Source: Own elaboration.

Notes: ***, **, and * represent significance at 1%, 5% and 10%, respectively.

The estimation of the time series allows to examine the stationary nature of the data series from the eight market markets. The Levin, Lin, and Chu (2002), ADF (Dickey and Fuller, 1981), PP (Pierre Perron and Phillips, 1988) tests postulate the same null hypotheses, while the Hadri (2000) test postulates the contrary hypotheses. The intersection of the unit root tests shows the stationarity, in returns, of the time series. However, the results highlight the test lags, and suggest that the time series may not be stable. This results justify the appliance of the test Clemente et al. (1998) that analyzes stationarity with structure breaks.

Table 3: Stationary test by Levin, Lin, and Chu (2002), applied to the 8 financial markets, in the period from December 31, 2019 to September 2, 2020.

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-39.2286	0.0000	8	1406
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-36.0913	0.0000	8	1406
ADF - Fisher Chi-square	682.296	0.0000	8	1406
PP - Fisher Chi-square	797.078	0.0000	8	1408
Source: Own elaboration Note: ** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.				

Table 4: Hadri (2000) stationarity test, applied to the 8 financial markets, in the period from December 31, 2019 to September 2, 2020.

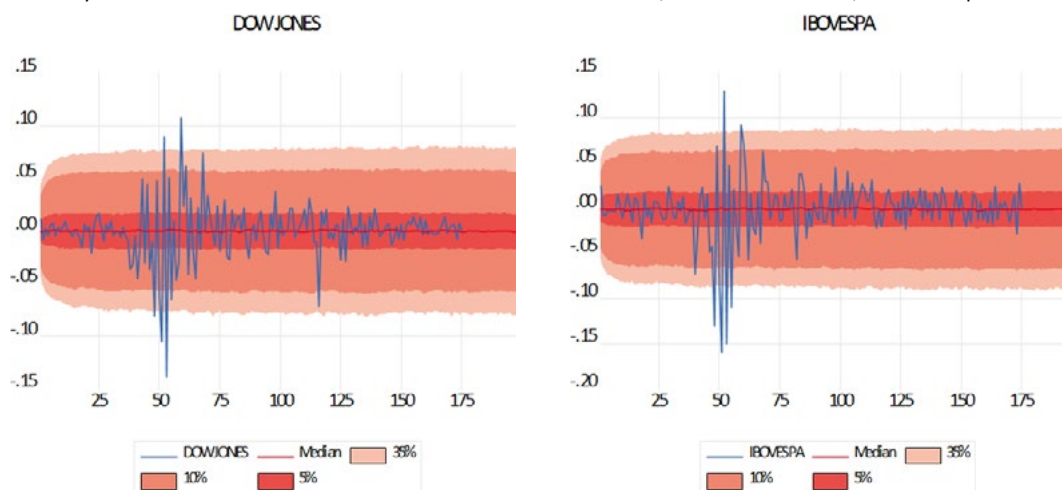
Method		Statistic	Prob.**	
Hadri Z-stat		1.49430	0.0675	
Heteroscedastic Consistent Z-stat		1.20548	0.1140	
Intermediate results on UNTITLED				
		Variance		
Series	LM	HAC	Bandwidth	Obs
DOW JONES	0.2010	0.000556	5.0	177
IBOVESPA	0.2983	0.000821	3.0	177
MEXICO IPC	0.1670	0.000261	2.0	177
S&P BVL	0.4850	0.000381	7.0	177
S&P IGPA	0.0833	0.000795	7.0	177
S&P Merval	0.2208	0.001394	5.0	177
GOLD	0.0359	0.000105	9.0	177
SILVER	0.3503	0.000912	6.0	177

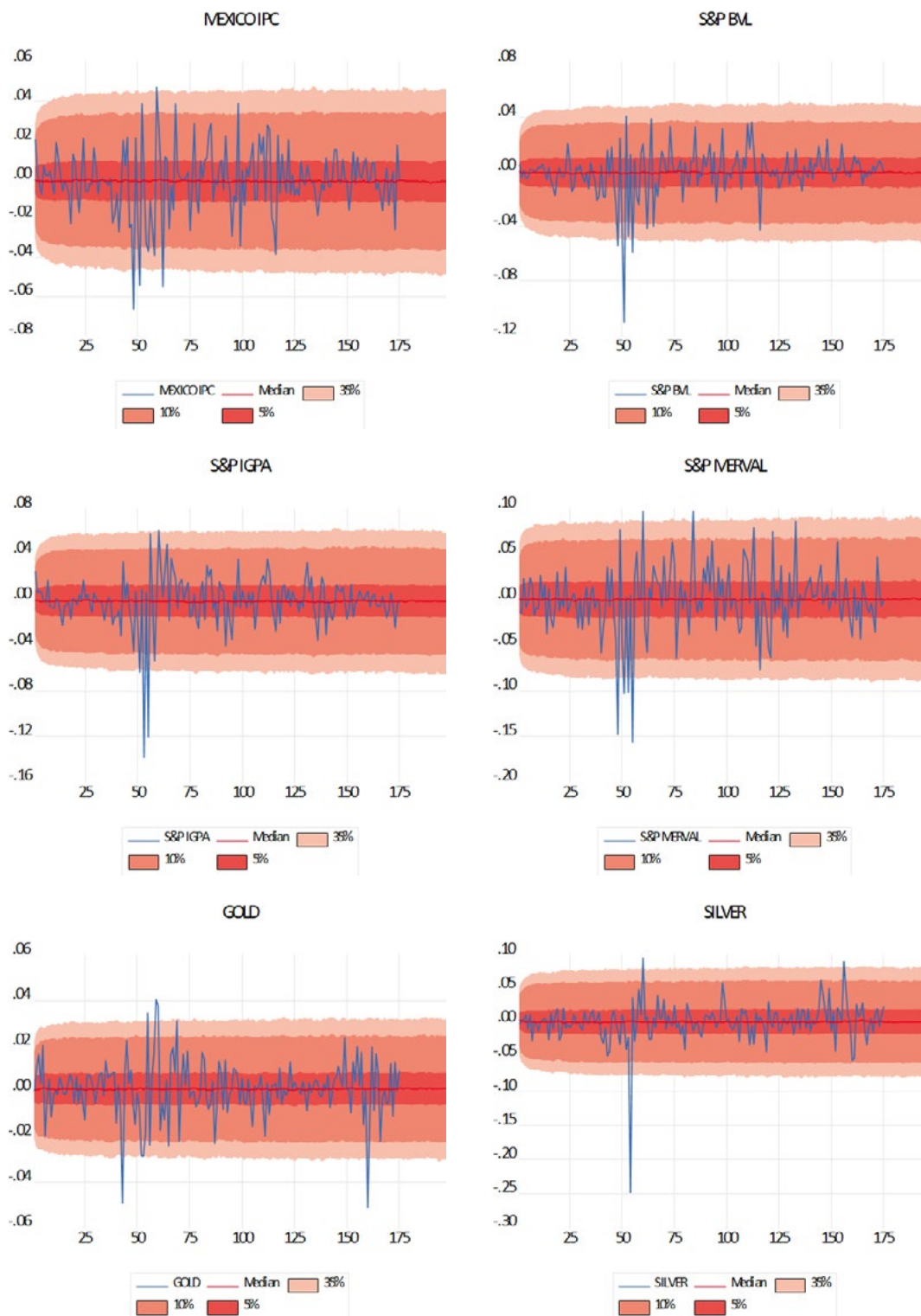
Source: Own elaboration.

Note: *High autocorrelation leads to severe size distortion in Hadri test leading to over-rejection of the null. ** Probabilities are computed assuming asymptotic normality.

Figure 3 shows the stability tests carried out on residue from stock markets in order to corroborate the presence of structural breaks. The graphical analysis suggest the existence of disturbances in the variance. Additionally, when examining the graphs and the 95% probability limits, indicate the existence of a violation of the probability limits, and thus the time series show unstable behavior.

Fig. 3: Stability tests carried out on the residues of the 8 financial markets, from December 31, 2019 to September 2, 2020.





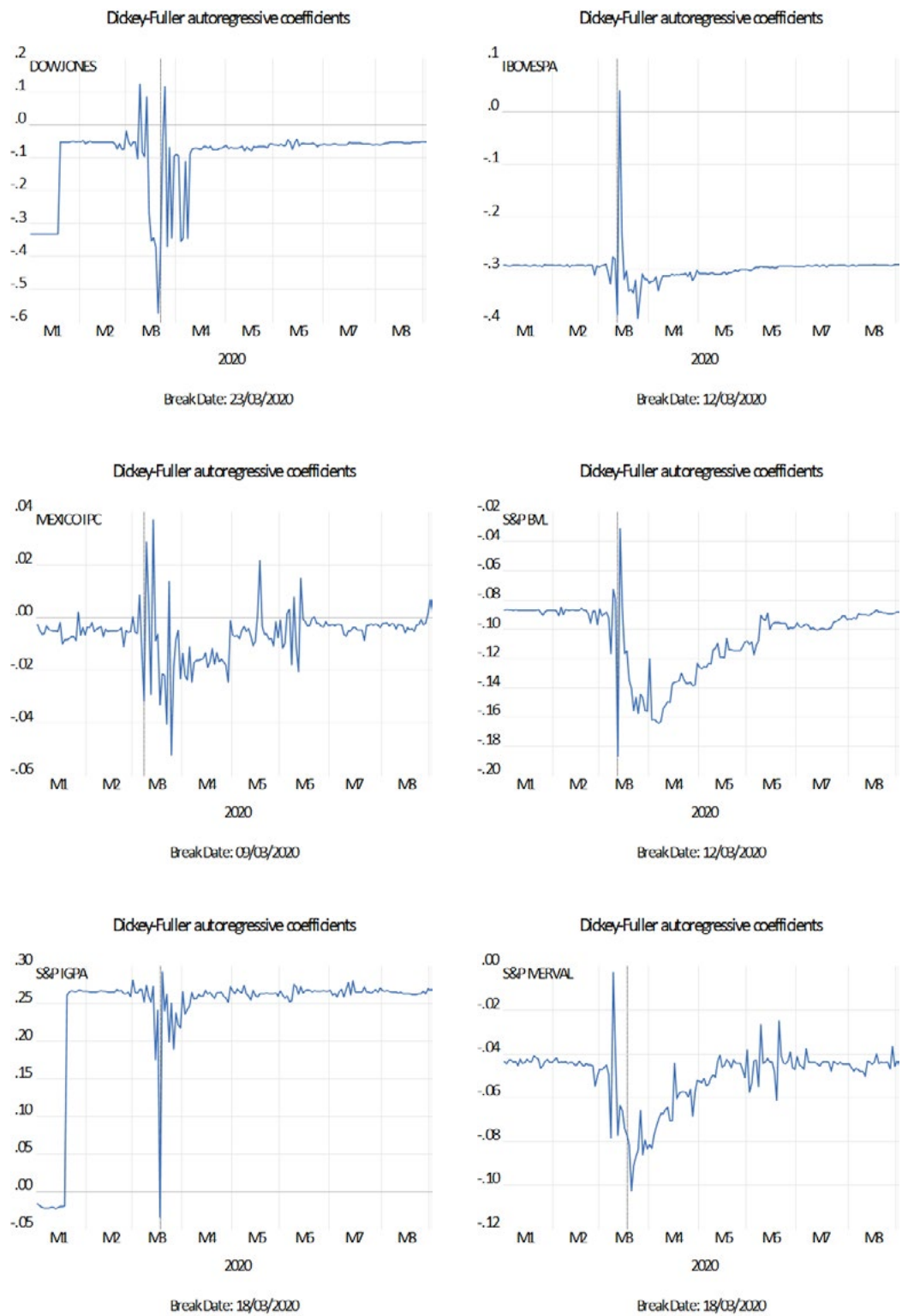
Source: Own elaboration.

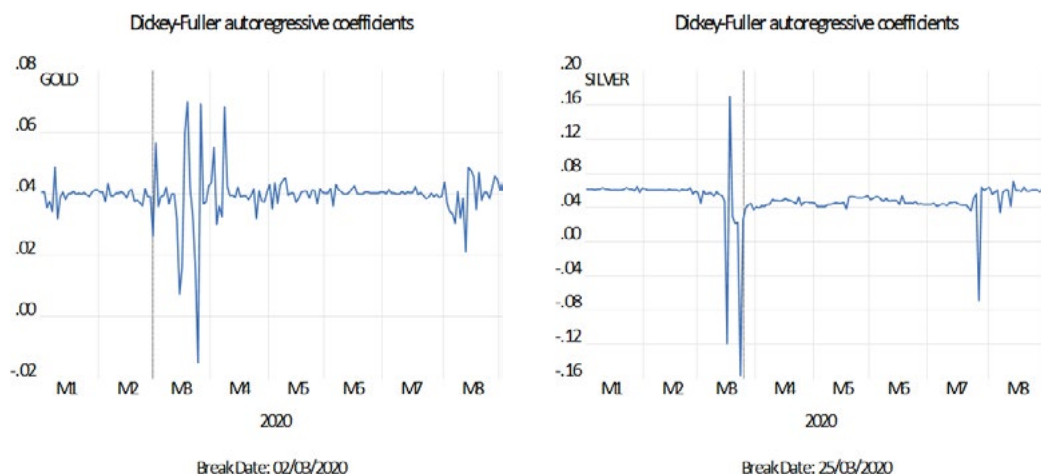
Figure 4 shows the results of the unit root tests, with structure breaks, by Clemente et al. (1998), suggesting sharp structure breaks in March 2020, which was expected due to the evolution of the global pandemic (COVID-19). The results are in line with the findings of the authors Lahmiri and Bekiros (2020), Sansa (2020), He, Liu, Wang, and Yu (2020), which show sharp falls in the finan-



cial markets, resulting from the global pandemic (COVID-19).

Fig. 4: Stationarity tests with structure breaks by Clemente et al. (1998), in returns, referring to the 8 financial markets, in the period from December 31, 2019 to September 2, 2020.





Source: Own elaboration.

Table 5 presents the results of Gregory-Hansen integration, with structure breakdown, and highlight 34 pairs of integrated markets (out of 49 possible). This results show that the structure breaks mostly occur in March 2020 (15 out of 34 possible). The US market (Dow Jones) has six integrations (out of seven possible), while the Mexico (IPC), Gold (Gold Bullion (Zurich) kg (995) CHF) and Silver (Silver Paris Spot E/KG) markets) show five integrations. The S&P/CLX IGPA, Ibovespa, S&P/BVL General IGBL stock indexes reveal four, and three integrations, respectively. The Argentine market (S&P Merval) presents a single integration. These findings show that the diversification of portfolios may be brought into question due to the marked level of integration between the gold and silver stock markets.

Table 5: Gregory-Hansen tests, in the period from January 31, 2019 to September 2, 2020.

Markets	t-statistic	Method	Lags	Break Date	Results
IBOVESPA/S&P Merval	-4.82*	Trend	0	09/03/2020	Integration
IBOVESPA/S&P IGPA	-5.14**	Trend	4	09/03/2020	Integration
IBOVESPA/DOW JONES	-5.00**	Trend	0	12/06/2020	Integration
IBOVESPA/GOLD	-4.91*	Trend	0	09/03/2020	Integration
IPC/S&P Merval	-5.11**	Trend	0	09/03/2020	Integration
IPC/S&P IGBVL	-5.15**	Trend	0	24/04/2020	Integration
IPC/S&P IGPA	-4.79*	Trend	0	09/03/2020	Integration
IPC/GOLD	-4.99**	Regime	0	12/03/2020	Integration
IPC/SILVER	-5.04**	Regime	0	09/03/2020	Integration
S&P Merval/SILVER	-4.78*	Regime	0	04/05/2020	Integration
S&P IGBVL/IPC	-5.04**	Trend	0	24/04/2020	Integration
S&P IGBVL/DOW JONES	-5.51***	Trend	2	30/03/2020	Integration
S&P IGBVL/GOLD	-4.91*	Trend	0	09/03/2020	Integration
S&P IGPA/IBOVESPA	-4.89*	Regime	4	09/04/2020	Integration
S&P IGPA/IPC	-4.95**	Regime	0	30/03/2020	Integration
S&P IGPA/S&P Merval	-4.87*	Regime	5	03/03/2020	Integration
S&P IGPA/S&P IGBVL	-5.02**	Regime	1	31/03/2020	Integration
DOW JONES/IBOVESPA	-4.95*	Trend	0	15/06/2020	Integration
DOW JONES/S&P Merval	-4.99**	Trend	3	04/03/2020	Integration
DOW JONES/S&P IGBVL	-5.14**	Trend	2	30/03/2020	Integration
DOW JONES/S&P IGPA	-5.08**	Trend	0	28/02/2020	Integration
DOW JONES/GOLD	-5.44**	Trend	3	04/03/2020	Integration
DOW JONES/SILVER	-5.25**	Trend	3	23/07/2020	Integration
GOLD/IBOVESPA	-5.00	Trend	0	29/05/2020	Integration
GOLD/S&P Merval	-5.13**	Trend	0	27/05/2020	Integration
GOLD/S&P IGPA	-5.26**	Trend	0	01/06/2020	Integration
GOLD/DOW JONES	-4.74*	Trend	0	27/05/2020	Integration
GOLD/SILVER	-4.78*	Trend	0	07/04/2020	Integration
SILVER/IBOVESPA	-5.85***	Trend	2	24/07/2020	Integration
SILVER/IPC	-5.70***	Trend	2	24/07/2020	Integration
SILVER/S&P Merval	-5.37**	Regime	0	24/07/2020	Integration
SILVER/S&P IGBVL	-5.25**	Regime	0	05/06/2020	Integration
SILVER/S&P IGPA	-5.12**	Trend	0	24/07/2020	Integration
SILVER/DOW JONES	-6.58***	Trend	4	24/07/2020	Integration

Source: Own elaboration.

Notes: ***, **, * represent significance at 1%, 5% and 10%, respectively.

To analyze the significance of the causal relationships between the financial markets under analysis, the VAR Granger causality/block exogeneity Wald tests model was applied. To determine the number of lags to include in the causality tests, this research applied the criteria FPE (final prediction error), and AIC (Akaike information criterion) that suggest four lags. A smaller number of lags



increases the degrees of freedom, while a larger number of lags decreases the problems of autocorrelation (see Table 6).

Table 6: VAR Lag Order Selection Criteria, in the period from January 31, 2019 to September 2, 2020

Lag	LogL	LR	FPE	AIC	SC	HQ
0	3540.150	NA	9.69e-29	-41.80060	-41.65244*	-41.74047
1	3663.266	233.1185	4.82e-29	-42.50019	-41.16674	-41.95905*
2	3726.481	113.7119	4.89e-29	-42.49090	-39.97216	-41.46875
3	3790.398	108.9239	4.95e-29	-42.48992	-38.78590	-40.98676
4	3859.025	110.4525	4.80e-29*	-42.54467*	-37.65536	-40.56050
5	3913.671	82.77696	5.57e-29	-42.43397	-36.35937	-39.96879
6	3969.419	79.16971	6.51e-29	-42.33632	-35.07644	-39.39012
7	4040.034	93.59537*	6.54e-29	-42.41460	-33.96943	-38.98739
8	4104.243	79.02749	7.30e-29	-42.41708	-32.78662	-38.50886

Source: Own elaboration.

Note: * indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Table 7 presents the results of the VAR residual serial correlation LM tests; we (????) estimate a VAR with four lags, and the existence of autocorrelation can be seen in the residues (five lags). To eliminate correlation in the series, we estimated a VAR with five lags and then performed the autocorrelation test with six lags. The null hypothesis was not rejected, which corroborates that the model presents a robust estimation.

Table 7: VAR Residual Serial Correlation LM Tests, in the period from January 31, 2019 to September 2, 2020.

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	67.87471	64	0.3466	1.064314	(64, 675.6)	0.3481
2	103.8889	64	0.0012	1.671950	(64, 675.6)	0.0012
3	100.5019	64	0.0024	1.613476	(64, 675.6)	0.0025
4	91.34477	64	0.0140	1.456780	(64, 675.6)	0.0142
5	100.0005	64	0.0027	1.604843	(64, 675.6)	0.0027
6	72.07396	64	0.2284	1.133580	(64, 675.6)	0.2297

Source: Own elaboration.

Note: *Edgeworth expansion corrected likelihood ratio statistic.

The results of Granger's causality tests are shown in Table 8, referring to the financial markets under analysis. The causality tests show 35 causal relationships (out of 49 possible). Silver (Silver Paris Spot E/KG) is the market that causes the most shocks in the remaining markets (five out of seven possible).. Gold (Gold Bullion (Zurich) kg (995) CHF) causes its peers five times and is caused in all markets in the Grangerian sense, except for the Mexico (IPC) market. The US (DJ) and Brazil markets cause five markets, while the Argentine (S&P Merval), Chile (S&P IGBVL) and Peru (S&P IGBVL) markets cause four markets. The Mexican market causes two markets (out of seven possible). The markets caused, in the Grangerian sense, are the stock market indexes S&P IGPA (5) Dow Jones



(4), S&P IGBVL (4), Ibovespa (3), IPC (3), and S&P Merval (3). These results show that the gold and silver markets are not a safe haven, and show that they are not an alternative to portfolio diversification in these stock markets. These findings are in line with the evidence presented by the authors Balcilar, Demirer, Gupta, and Wohar (2020), who show that precious metals cause shocks in the stock markets during periods of high volatility.

Table 8: Test Granger/Block Exogeneity Wald, from January 31, 2019 to September 2, 2020.

	GOLD	SILVER	DJ	IBOVESPA	IPC	MERVAL	IGBVL	IGPA
GOLD	***** *	4.22(5)** *	2.97(5)**	3.80(5)***	0.57(5)	3.09(5)**	2.13(5) *	2.71(5)**
SILVER	11.19(5)** *	***** *	10.73(5)* **	10.07(6)***	2.78(5)* *	5.58(5)***	11.32(5) ***	7.92(5)** *
DJ	2.33(5)**	3.43(5)** *	*****	1.88(5)	1.33(5)	2.52(5)**	1.80(5)	1.99(5)*
IBOVESPA	2.21(5)*	2.07(5)*	1.42(5)	*****	1.87(5)	3.58(5)***	0.58(5)	1.45(5)
IPC	1.94(5)*	2.10(5)*	1.13(5)	0.88(5)	***** *	1.18(5)	1.02(5)	1.34(5)
S&P Merval	1.43(5)	1.71(5)	2.31(5)**	2.49(5)**	1.40(5)	*****	1.92(5) *	1.56(5)
S&P IGBVL	1.44(5)	1.83(5)	1.79(5)	1.97(5)*	2.88(5)* *	1.83(5)	***** **	0.95(5)
S&P IGPA	3.11(5)**	5.67(5)** *	5.34(5)** *	4.78(5)***	0.59(5)	0.83(5)	2.74(5) **	*****

Source: Own elaboration.

Notes: Column markets "cause" online markets. The lateral values in parentheses refer to lags. ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

5 FINAL REMARKS

This research aimed to analyze whether gold (Gold Bullion: Zurich) and silver (Silver Paris Spot E/KG) are a safe haven for the diversification of portfolios in the financial markets of Argentina (S&P Merval), Brazil (Ibovespa), Mexico (IPC), Chile (S&P/CLX IGPA), Peru (S&P/BVL General IGBL), and the USA (Dow Jones), from December 31, 2019 to September 2, 2020. To perform this analysis, different approaches were undertaken to find out whether the gold and silver markets are a safe haven when the financial markets in Latin America present structural breakdowns.

We carried out two statistical tests for this purpose. The first test estimates whether the markets have significant levels of financial integration. The second assesses whether the price indices exhibit movements, showing whether the hypothesis of arbitrage and anomalous returns is feasible.

In the first test we estimated the Gregory-Hansen model (1996), and 34 pairs of integrated markets were found (out of 49 possible). We also found that most structure breaks occurred in March 2020 (15 out of 34 possible). The US market (Dow Jones) has six integrations (out of seven possible), while the Mexico (IPC), gold (Gold Bullion (Zurich) kg (995) CHF) and silver (Silver Paris Spot E/KG) markets) show five integrations. The S&P/CLX IGPA, Ibovespa, and S&P/BVL General IGBL stock indexes have four and three integrations, respectively and the Argentine market (S&P Merval) presents a single integration. These findings show that the diversification of portfolios may be brought into question due to the marked level of integration between the gold and silver stock markets.

The second test shows 35 causal relationships (out of 49 possible). Silver (Silver Paris Spot E/KG) is the market that causes the most shocks in the remaining markets (five out of seven possi-



ble), and is caused by all markets (7). Gold (Gold Bullion (Zurich) kg (995) CHF) causes its peers five times and is caused in all markets in the Grangerian sense, except for the Mexico (IPC) market. The US (DJ) and Brazil markets cause five markets, while the Argentine (S&P MERVAL), Chile (S&P IGBVL), and Peru (S&P IGBVL) markets cause four markets. The Mexican market causes two markets (out of seven possible). The markets caused, in the Grangerian sense, are the stock market indexes S&P IGPA (5), Dow Jones (4), S&P IGBVL (4), Ibovespa (3), IPC (3), and S&P MERVAL (3). These results show that the gold and silver market is not a safe haven, and show that they are not an alternative to portfolio diversification in these stock markets.

The general conclusion retained and supported by the results obtained, through tests carried out with econometric and mathematical models, demonstrates that the global pandemic has a significant impact on the memory properties of the analyzed markets. The results indicate that the markets have very significant integrations and causalities, that is, gold and silver do not function as safe ports for the diversification of portfolios in the Latin American stock markets. These conclusions also open space for market regulators to take measures to ensure better information among international financial markets. In conclusion, we believe that investors should diversify their portfolios and invest in less risky markets in order to mitigate risk and improve the efficiency of their portfolios.

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2. Development of hypotheses or research questions (empirical studies)	√	√
3. Development of theoretical propositions (theoretical work)		
4. Theoretical foundation / Literature review	√	
5. Definition of methodological procedures		√
6. Data collection		
7. Statistical analysis	√	
8. Analysis and interpretation of data		√
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