Is Gold a Hedge or a Safe Haven Asset in times of Black Swan Events?

Empirical Evidence from Central Eastern European Equity Markets

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Abstract

The aim of this thesis is to investigate the property of gold to act as a hedge in normal and as a safe haven asset in extreme market conditions[1] in the Central and Eastern European Equity Markets, in the period between 2010 and 2020. The descriptive and econometric analyses indicate that gold serves as a strong hedge in Czech Republic, Germany, Latvia, Serbia, Slovakia, Slovenia and as a weak hedge in Austria, Croatia, Estonia, Greece, Lithuania, Romania, in normal market conditions. Additionally, gold is a strong safe haven in Czech Republic, and weak safe haven in Germany, Latvia, Serbia, Slovakia and Slovenia.
Finally, I use Google Trends Platform to measure the investor's crisis sentiment to further explore the safe haven asset character of gold when a Black Swan event occurs. This ultimate analysis suggests that the price of gold would increase with a rise of the investor's crisis perception.

Keywords:

Black Swan Event

Gold

Hedge

Safe Haven Asset

[1] For the sake of this research, I use the definition of extreme market conditions to identify events that occur unexpectedly, and these can cause major disruptions in financial markets. Such events are so-called Black Swan events and for the purpose of this study, three such Black Swan events are investigated under detail in order to analyse investors' decisions to opt for gold in times of high crisis sentiment, a consequence of such extreme market conditions. These events are EU Sovereign Debt Crisis, Brexit and Covid-19 outbreak. All other market's conditions are defined as normal in this research.

O ouro com um hedge ou um ativo porto seguro em tempos de eventos do Cisne Negro?

(Evidências empíricas dos mercados de ações da Europa Central e Oriental)

Katerina Panayotova Nedyalkova

Abstrato

O objetivo desta tese é investigar a propriedade do ouro para atuar como *proteção* em condições normais e como um ativo porto seguro em condições extremas[2] de Mercados de Ações da Europa Central e de Leste, no período entre 2010 e 2020. As análises descritiva e econométrica indicam que o ouro serve como uma proteção forte na República Tcheca, Alemanha, Letônia, Sérvia, Eslováquia, Eslovênia e como uma proteção fraca na Áustria, Croácia, Estônia, Grécia, Lituânia, Romênia, em condições normais de mercado. O ouro é um porto seguro forte na República Tcheca e um porto seguro fraco na Alemanha, Letônia, Sérvia, Eslováquia e Eslovênia. Por fim, com Google Trends, a percepção da crise do investidor é medida para explorar o caráter do ouro, no evento de Cisne Negro. Esta análise sugere que o preço do ouro aumentaria com o aumento da percepção de crise.

Palabras-chaves:

Evento Cisne Negro

Ouro

Proteção

Ativo porto seguro

[2] Para fins desta pesquisa, utilizo a definição de condições extremas de mercado para identificar eventos que ocorrem inesperadamente e podem causar grandes perturbações nos mercados financeiros. Tais eventos são chamados de eventos Cisne Negro (*Black Swan Events*) e, para os fins deste estudo, três desses eventos Cisne Negro são investigados detalhadamente a fim de analisar as decisões dos investidores de optar pelo ouro em tempos de sentimento de alta crise, uma consequência dessas condições extremas de mercado. Esses eventos são a crise da dívida soberana da União Europeia, o Brexit e o surto de Covid-19. Todas as outras condições do mercado são definidas como normais nessa pesquisa.

1. Introduction

1.1. Background

The performance of gold in the last decade has been noticeable compared to the other commodities' performance, with an increase up to 50% over this period (Fig. 1 and 2). Additionally, in 2020 with the outbreak of Covid-19 the price of gold skyrocketed to reach its peak in early August, standing at 2053,5 US $, an increase of approximately 34% compared to its initial value in the same year (Fig. 3). The ultimate trend suggests that gold is a preferred financial asset in times when financial markets experience high volatility and major price disruptions. Furthermore, in the financial media gold is considered as a "safe haven asset", but such a claim has been rarely investigated. Therefore, the aim of this paper is to test the potential of the precious metal to serve as a protection against losses when financial markets experience major setbacks. Such events could occur unexpectedly, so-called Black Swan[3], and no previous risk management techniques could have been sufficient to incorporate these events with the aim to protect against portfolio's losses. In Baur and McDermott (2010), they find evidence that in such adverse market's conditions, investors would search for an asset as means of wealth protection in a response to these negative market shocks. In their paper there is also a proof that such safe haven effect occurs mostly in the major developed markets (such as in Germany, France, Italy, Switzerland, UK, US), but not in th e emerging markets (Brazil, China, India, Russia). They conclude that even if major losses are suffered in such crisis period, an investor in emerging markets would not opt for gold as a safe haven, but rather prefer to shift his portfolio to the average one (developed markets)[4]. In my research I study whether the Central and Eastern European Equity Markets could be assigned to a developed or emerging countries' investors' attitudes when it comes to using gold as a protection against losses in times of crisis. Finally, with the emerge of Google Trends as a platform to test for investor's crisis perception in times of financial turmoil, I use this platform to further explore the role of uncertainty in inducing the investor's interest to opt for

[3] In finance, Black Swan event is an unpredictable event that could have severe consequences in the financial markets. In this paper, three such events have been investigated with the use of Google Trends, investigating the crisis perception of an investor during such these events, to test for the property of gold as a protection against losses.

[4] In Baur and McDermott (2010) they distinguish between developed and emerging market's portfolio and the developed one is further defined as the average portfolio.

gold as a safe haven asset during the period under study.[5] It should be noted that I adapt the approaches to test for the investor crisis perception, previously introduced by Da et al. (2014) and Weiss et al (2013). The idea is to observe whether in times of high crisis perception, an investor would opt for gold, which would prove the quality of this precious metal as a safe haven asset. The whole procedure used is introduced in the Data Analysis section.

1.2. Motivation and Main Contribution

In this thesis, I aim to test the Hypothesis whether gold can be regarded as a hedge in normal market conditions or as a safe haven asset in times of market turmoil, and especially in periods when so-called Black Swan events occur.[6] The previous academic research focuses mainly on developed and emerging global financial markets, but the potential of gold to serve as a protection in times of financial turmoil has been not studied in the Central and Eastern European Equity Markets. For example, in Baur and McDermott (2010), they test the gold property as a safe haven in the US, Western Europe and some emerging markets, such as Brazil, China, India and Russia. There are several reasons to conduct a research on those equity markets. First of all, there is no previous paper (to my knowledge) that investigates the character of gold as a safe haven in times of crisis in that region. As such, with this investigation I contribute in answering that question. Second, the Central Eastern European economies are often viewed as emerging markets, with prospects of rapid economic growth, especially for those countries that recently joined the European Union. Therefore, such a research would reveal whether in times of crisis[7] investors in these equity markets would opt for gold, which is the case with developed countries Baur and McDermott (2010), or rather prefer to shift their portfolios to the so-called average portfolio, an evidence of emerging markets pattern. In addition, to the previous techniques and econometric models introduced to test for hedge and safe haven quality of gold, I opt for another method, when investigating the crisis perception of the investors in times of uncertainty. This concept is important, since in

[5] If the indexes values are high, this could be interpreted as follows: investors would search for those definitions and it can be suggested that there is high degree of uncertainty, especially in those periods it is interesting to observe whether the price of gold would rise, which ultimate positive relationship would speak for a safe haven property of gold.

[6] In that paper, I focus mainly on three Black Swan events that occurred in the last decade, which caused major disruptions in the European financial markets, namely: European Sovereign Debt Crisis in 2009, Brexit in 2016 and ultimately Covid-19 outbreak in 2020.

[7] The *times of crisis* in this paper defines: (1) the crisis perception of investors that is higher on average – measured with Google Trends; (2) when equity markets experienced their most negative returns.

times of crisis and high uncertainty in the financial markets, investors tend to behave irrationally, so called herd behaviour (Calvo and Mendoza, 2000), and those decisions based on crisis perception affect the preferences for safe haven assets, such as gold. In order to analyse this effect, I develop different crisis sentiment proxies, using Google Trends and study further the investors' decisions to opt for gold in times of Black Swans. This concept stands in line with the herd behaviour and try to conclude whether under high crisis perception in the media, or overall, investors would sell their assets and buy a 'shelter', such as gold. In order to analyse the crisis sentiment of the investors, I use the Google Trends platform and focus on three main events that occurred in the last decade and caused major disruptions in the European financial markets in the CEE region. These three events are the EU sovereign debt crisis, Brexit and finally the outbreak of Covid-19 pandemic. Therefore, to measure the crisis sentiment of the investors, I look for words that reveal the search of these definitions in these certain periods of time. The results suggest that on high crisis perception, measured with Google Trends, investors would opt for gold (See Results section). As a special case, I additionally focus on Covid-19 outbreak and develop two crisis sentiment indexes, to test whether gold price would increase with a rise in the crisis perception in 2020.[8] (See the section data and descriptive analysis for the detailed procedure in respect of building the indexes for the crisis perception analysis.)

Finally, investigating the equity financial markets in those regions could contribute to the understanding of the preferences and decisions of the investors of those countries in respect of gold in normal and extreme market conditions.

1.3. Literature Review

In the literature there is an ongoing discussion about which financial assets can serve as safe haven assets. For instance, Ranaldo and Söderlind (2007) examine whether some currencies, such as Swiss franc, Japanese yen and US dollar, can be regarded as such refuge assets. In the

[8] This last analysis is not based on the CEE Equities markets for several reasons. Firstly, following the approach of Weiss et al. (2013) and Da et al. (2015) when building such indexes, with Google Trends, the language used is English. Therefore, due to the diverse languages spoken in those countries such an analysis is not feasible. Secondly, an important factor to consider is the internet availability of a particular country. As such, it is more appropriate to investigate a crisis sentiment with Google Trends on global level, assuming that such internet availability is given. Finally, the motivation of conducting such a study is due to the significant jump in the price of gold in this ultimate 2020 year, as a possible consequence of the Covid-19 outbreak. Thus, analysing the global crisis perception as a driver of buying gold would be more relevant for better interpretation purposes, rather than using only one particular region.

timeframe of 1993 to 2008, they find evidence that in periods of extreme market shocks, Swiss franc and Japanese yen would appreciate, which speaks for the safe haven property of these currencies. In the paper of Upper (2000) the authors examine the German government securities, as means of low risk and highly liquid assets, and following the period of Russian devaluation in 1998, they conclude that these financial assets have the property of a safe haven.

There are several academic papers which intend to prove the quality of gold as a protection in times of financial turmoil. For example, Baur and McDermott (2010) show evidence that gold is a safe haven asset in Germany, UK and US, when the equity markets undergo financial shocks and there are extreme negative returns observable. Furthermore, in McCown and Zimmerman (2006), the authors investigate the performance of some precious metals, such silver and gold, and conclude that gold has the property of a zero-beta asset and therefore bears no systematic risk to an investor's portfolio. In this research, they show that returns on gold are moderately higher than those of Treasury Bills in the time period between 1970 and 2003. Additionally, there is a proof of the inflation-hedging feature of gold, which again suggests that this precious metal commodity can serve as a protection against value losses. Next, in the paper Capie et al. (2005) the authors examine the character of gold as a hedge against currency's fluctuations, such as the US dollar, and conclude that gold can serve as a hedge against exchange-rate movements. Moreover, Sherman (1982) provides an evidence that gold lowers volatility and improves portfolio returns in periods of high inflation and uncertainty environment and stagnant economic growth.

When examining the investor decisions under extreme market conditions, an important concept should be mentioned: a financial contagion effect. In Forbes and Rigobon (2002) they define the contagion effect as a significant increase in market co-movement after a financial shock. In times of financial turmoil investors would opt for diversification with the aim to reduce their financial portfolios' losses, but because such an effect might occur, the international diversification options would be limited, Ibragimov and Walden, (2007). Therefore, a safe haven asset gains importance as an asset which offers negative correlation and protection against losses. Furthermore, when investigating the consequences of the contagion effect, another theory should be mentioned: domino effect. This latest concept suggests that local crises can reach a regional or even a global scale, indicating that such domino effect gives even more incentive for the investors to diversify their portfolios, Markwat (2009) and Calvo and Mendoza, (2000).

Finally, the concept of opting for a safe haven asset in times of Black Swan stands in line with the theory of investor behaviour literature. This theory suggests that in times of market turmoil and especially in periods of high crisis sentiment perception, the investors would take decisions that are irrational, meaning decisions that are unrelated to the fundamentals of an asset, and these actions would lead to noise trading, greater mispricing and excess volatility, DSSW, (1990). Yet, the concept of behavioural finance theory and crisis sentiment perception is from particular interest for the question whether gold is a safe haven, since in times of market turmoil, it is believed also that investors would opt for such safe haven assets in order to mitigate the negative effects of losses on their portfolios. For example, in the Irresberger (2015), the authors conclude that in times of high crisis sentiment, stock performance of the US banking industry would be significantly and negatively affected. Investors would behave irrationally[9], irrespective of idiosyncratic or macroeconomic factors, when such a crisis sentiment occurs. The question arises on how to measure such sentiment. In the literature there are several methods that can be applied to measure crisis sentiment. In this research, I construct two indexes to measure such crisis perception, using Google Trends. The first index is called FEARS, introduced by Da et al. (2014) and the second index is called General Crisis Sentiment Index, developed by Weiss et al (2013).

The paper proceeds as follows: Section (2) introduces the main characterises of gold as a financial asset and in Section (3) a clear distinction between a weak and strong hedge and safe haven asset is defined. In following Section (4), I present the data, descriptive and econometric analyses. And finally, in Section (5), I discuss the main results and conclusions obtained on that research.

2. Gold as a financial asset

The beauty of gold is that it loves bad news.[10] (The Economist)

Gold has the cachet and reputation as a vehicle of preserving value through time due to its precious metal characteristics. Moreover, in 1944 a Bretton Woods Agreement was

[9] This theory suggests that in times of market turmoil and especially in periods of high crisis sentiment perception, the investors would take decisions that are irrational, meaning decisions that are unrelated to the fundamentals of an asset, and these actions would lead to noise trading, greater mispricing and excess volatility, DSSW, (1990).

[10] The Economist, 26th February 2009 Edition

introduced, such that world's most developed countries pegged their currencies to this precious metal, including the US$. Although the gold standard was removed in 1971, today this precious metal is still used as global currency benchmark by some countries. Additionally, central banks all over the globe continue to keep gold reserves as means of guarding their own currency's values. Yet, there is a contradiction regarding the gold's property as a safe asset. For instance, some claim that investors use this commodity out of speculative purposes, and other advocate that gold is still an attractive way of protection against uncertainty, inflation and financial losses (The Economist, 2005, 2009).

2.1. Characteristics of gold as a financial asset

One main feature of gold is that it serves as a hedge against inflation or when US $ losses in value. This phenomenon occurs because gold is quoted in US$ dollars, and as such if that currency's value is falling, the nominal price of the precious metal will rise, therefore keeping its real value. Furthermore, gold can be regarded as a hedge against exchange-rate fluctuations for portfolios with dollar holdings. There is an evidence of that particular feature of gold in Capie et el. (2005). Another distinctive property of this precious metal is its market relative simplicity, meaning that its value determinants are simpler to evaluate compared to other financial assets. For example, gold as a physical asset, possesses an intrinsic value. Also, gold's value is not dependent on future earnings forecasts or credit ratings and opting for such an asset bears no default risk. Consequently, in times of high uncertainty, especially when Black Swan events occur, the other assets' values may drop significantly, but in contrast the gold's value may increase for the reasons explained above. Finally, recent events suggest that gold price tends to increase as an investor's response to financial turmoil, an evidence of gold as a preferred alternative asset.

2.2. Recent movements in price of gold

The price of gold has fluctuated wildly in the last decade. At the beginning of the period it was on rise, after dropping with more 200 index points in 2013. Since then, the price has increased steadily compared to the Goldman Sachs commodities index, which value experienced major losses since 2014. The Figure 1 shows the period of the current Covid -19 pandemic and there is a clear evidence that compared to the commodity index, the price of

gold surged throughout this timeframe. This observation is an indicator of the fact that gold price responds positively to negative market's setting. Additionally, the performance of gold's price during the last decade suggests that its price steadily increased, reaching its peak in 2020. In Figure 2 the focus is on year 2020 and the outburst of the pandemic. There is clear evidence that commodity markets experienced major setback, whereas gold price skyrocketed, another suggestion for the gold property as a safe haven in period of a financial turmoil. Looking at the most recent events, there is an evidence that the price of gold experienced a dramatic rise due to the increased investor's demand to possess the commodity in order to minimise the negative impact of the recent pandemic on their portfolios.

3. Definitions

The following section provides with a definition for a hedge and a safe haven asset in order to differentiate between the two terms. I use the definitions represented by Baur and McDermott (2010) and distinguish between a weak and a strong hedge, and between a weak safe haven and a strong safe haven. In a normal market condition, gold can serve as a hedge[11] and in extreme market conditions, it can be used as a safe haven[12]. For this investigation, a strong negative correlation between gold and equity portfolio would indicate a safe haven property of gold in a period of financial turmoil.

Overall, the length of the effect is the main distinction between the two items. For example, a hedge asset can be used on average, when the market does not experience major setback, whereas, a safe haven is only essential in some certain times, such as the Black Swan Covid-19 outbreak in 2020. Also, assets that act as a hedge against equity tend to co-move with those stocks in periods of market turmoil, because investors would sell those assets simultaneously. Such a pattern stands in line with the contagion effect or herd behaviour (Calvo and Mendoza, (2000). In opposite, in such uncertain periods, there are some assets that do not co-move with the other assets but are negatively correlated. In this occasion, such assets work as a safe haven and protection against value losses in times of crisis. One

[11] A strong (weak) hedge is a financial asset that is negatively correlated (uncorrelated) with another financial asset in normal market conditions.

[12] A strong (weak) safe haven is a financial asset that is negatively correlated (uncorrelated) with another financial asset, but only in extreme market conditions, for example in times of Black Swan events.

important aspect should be mentioned that those safe haven assets would in general co-move with the other assets in normal market conditions.

Finally, a distinction between a strong and a weak hedge or safe haven is important from an investor's perspective. For instance, if there is a negative correlation between two assets, investors would benefit from the positive returns generated in case that one of those assets suffer negative returns. This would be not the case for assets that are uncorrelated or co-move. As a consequence, such positive returns can contribute to the stability of the financial system in times of market turmoil by mitigating the negative effects, such as losses and value destruction.

4. Descriptive and econometric analysis

The following part of the paper contains the description of the data set, descriptive statistics section, econometric analysis and main results.

4.1. Data and Descriptive Statistics

As a benchmark of the Central and Eastern European countries' equity markets, I use the main stock indices of those countries and further sort these into four main groups, according to their market capitalisation in US$. These are *Central and Eastern European Global Index*, which contains all the countries under study; *Baltics Index*, composed by Lithuania, Latvia and Estonia; *Balkans Index*, formed by Bulgaria, Croatia, Romania, Serbia and Slovenia, and finally *Central Europe Index* with Austria, Czech Republic, Hungary, Poland and Slovakia. I do not consider Germany and Switzerland into Central Europe index and into Central and Eastern European Global Index for interpretation purposes, due to the fact that those two countries have much higher market capitalisation and economic scale, compared to the other economies in the region. I extract daily data from the Thomson Reuters database, using the main stock indices of all the countries in the CEE region, expect Bosna and Herzegovina, Kosovo, Montenegro and North Macedonia, since there is no data available, or simply because those countries do not have a stock exchange. I follow the procedure used in Baur and McDermott (2010) and use the market capitalisation criteria to allocate the weight of the local indexes when building the regional indexes. It should be noticed that when constructing the indices, the data used is in US$ dollars and the market capitalisation is adapted in this

currency. For the separate country analysis, the local currency is used[13]. As a proxy of the price of gold I use the US$ price of gold bullion per one Troy ounce, which is equivalent to 31 grams of the precious metal. I extract this data from Thomson Reuters, using the COMEX Future Contract, which is the most liquid and equivalent to 100 Gold Troy ounces, for the purposes of this analysis I consider the gold price for 1 Troy ounce (33 = 0.031). The dataset covers ten years, starting from January 4th, 2010 to October 30th, 2020.

For the crisis sentiment analysis, I use Google Trends Platform to extract daily search items for three particular events for the time period under study. For the investigation based on Central and Eastern European Equity Markets I focus on three events and look into the search levels for some with those events related definitions. Those events occurred in the last decade and had significant negative impact on the European financial markets: EU Sovereign debt crisis, Brexit and most recent Black Swan: the outbreak of corona virus. The reason that such observation might be from interest is that in periods of extreme market conditions the investors tend to opt for a safe haven asset, Calvo and Mendoza, (2000). The idea is to look for a proxy of the investor crisis sentiment and analyse the consequences of changes in the equity markets under study with gold. For this research, I extract data for the most searched definitions in those three periods at daily frequency from Google Trends. For example, for the EU sovereign debt crisis, I retrieved daily data for the definition: *sovereign debt*. Next, to measure the investor crisis sentiment in 2016 on the Brexit event, I download data with the search definition *Brexit*. And finally, for the most recent pandemic, the definition *corona virus* is used to test for the impact of crisis sentiment on gold. The periods of those events are adapted as follows: the day when those events occurred is used as the first day of the observations and the timeframe which is analysed is set to be one year. There is an assumption that throughout this period, investors would adapt their portfolios towards changes caused by those unexpected market disruptions. For EU Sovereign crisis, the initial data is December, the 1st 2009, as the crisis started in the late of the same year; for Brexit, start date is June the 23th, 2016 and for Covid-19 pandemic, the January 1st, 2020 is

[13] All indexes are composed in US$, as in these particular countries there are various currencies in circulation, an approach as in Baur and McDermott (2010). However, such a generalisation could produce bias results due to the fact that if the US-dollar currency losses in value, this would cause a rise in the nominal dollar price of gold and ultimately these changes would drive the co-movements of the non-US stocks and the gold price. Therefore, in order to eliminate the distorting bias of the US-dollar currency, I use the approach in Baur and McDermott (2010) and repeat the analysis for all country's equity indices in the sample, using their own local currency.

considered.[14] The exact procedure of implementing the crisis sentiment proxy is described in the following section.

Finally, I build two crisis sentiment indexes to investigate the relationship of gold with the crisis perception of an investor only in year 2020, with the outbreak of Covid-19.[15] When building the two crisis sentiment indexes, I extract the data, using again Google Trends Platform, and follow the approach represented by Da et al. (2015) to construct the Financial and Economic Attitudes Revealed by Search index (FEARS) and the approach of Weiss et al. (2013) to build GCSI[16]. In the first case, they use thirty definitions to construct the FEARS index (see table in Appendix). The idea is to search for negative definitions, which an investor would look for in times of negative economic setting, such as a financial crisis, for example. The list of those definitions is in the Appendix. I extract the daily data for the time period, starting from January 1st, 2020 to October 30th, 2020. For the second index, I follow the instructions represented by Weiss et al (2013), which intends to measure the broad market crisis perception in the given period of time. But, instead of using the same definitions, I choose other adapted words for the corona outbreak in 2020, which are the following: Covid-19, bear market, wuhan, corona, corona virus. I extract the daily observations of each of these words for the whole year 2020, starting with the 1st of January. The exact procedure of implementing these indexes into the regression analysis is described in the following section.

Table 1 summarises the statistics results of daily returns data for all the indices and countries in the CEE region. The table shows the number of observations, the average, the standard deviation and the minimum and maximum values of the daily returns for each market, respectively. The mean of the daily returns of the CEE equity portfolio is lower than the gold daily average return, and also the standard deviation of that equity index is higher than the

[14] Although, corona pandemic cases started to emerge mostly in end of February 2020 in Europe, the event occurred in late 2019 already, with the most affected economy being China, and also due to the scale of this Black Swan the crisis quickly reached a global scale.

[15] This last analysis is not based on the CEE Equities markets for several reasons. Firstly, following the approach of Weiss et al. (2013) and Da et al. (2015) when building such indexes, using Google Trends, the language used is English. Therefore, due to the diverse languages spoken in those countries such an analysis is not feasible. Secondly, an important factor to consider is the internet availability of a particular country. As such, it is more appropriate to investigate a crisis sentiment with Google Trends on global level, assuming that such internet availability is given. Finally, the motivation of conducting such a study is due to the significant jump of 34% in the price of gold in this ultimate 2020 year, as one possible consequence of the Covid-19 outbreak. Thus, analysing the global crisis perception as a driver of buying gold would be more relevant for better interpretation purposes, rather than using only one particular region.

[16] It should be noted that the definitions that I choose are adapted to the Black Swan in 2020 in order to adjust the index to the current Covid-19 pandemic search definitions and to be more precise when measuring the crisis sentiment of an investor in this particular period.

gold's standard deviation. These results are consistent with the minimum and maximum values for the daily returns for the two financial assets. The CEE equity portfolio index exhibits higher negative returns (-0.1285) compared to gold minimum return values (-0.0982), but it has also higher positive returns (0.0865) compared to gold maximum return values (0.0578). The data reveals that the most extreme negative returns are observable in the Central European equity index (-0.1542), whereas the most extreme positive returns are represented in the Balkans equity markets (0.0905). In general, Balkans equity markets generate higher average returns compared to the other regions, but with highest standard deviation compared to the other sub-regional equity indexes: Central Europe and Baltics.

	Daily frequency				
	Observations	*Mean*	*Minimum*	*Maximum*	*Standard Deviation*
Gold	2696	0.0002	- 0.0982	0.0578	0.0104
Indices (in US$)					
Balcans	2696	0.0132	- 0.1422	0.0905	0.0126
Baltics	2696	0.0003	- 0.1103	0.0525	0.0091
Central Europe	2696	- 0.0002	- 0.1542	0.0881	0.0151
CEE International	2696	- 0.0001	- 0.1285	0.0865	0.0134
Markets (in local currency)					
Austria	2696	- 0.0001	- 0.1467	0.1021	0.0139
Bulgaria	2696	0.0000	- 0.1081	0.0564	0.0084
Chech Republic	2696	- 0.0001	- 0.0816	0.0737	-0.0001
Croatia	2696	- 0.0001	- 0.1073	0.0856	0.0075
Estonia	2696	0.0004	- 0.1060	0.0570	0.0090
Germany	2696	0.0002	- 0.1305	0.1041	0.0130
Greece	2696	- 0.0005	- 0.1771	0.1343	0.0213
Latvia	2696	0.0005	- 0.1634	0.0578	0.0112
Lithuania	2696	0.0004	- 0.1194	0.0634	0.0076
Poland	2696	- 0.0002	- 0.1425	0.0634	0.0126
Romania	2696	0.0002	- 0.1189	0.1056	0.0117
Russia	2696	- 0.0001	- 0.1395	0.1325	0.0181
Serbia	2696	0.0001	- 0.1242	0.0460	0.0088
Slovakia	2696	0.0001	- 0.1481	0.0912	0.0113
Slovenia	2696	- 0.0001	- 0.0938	0.0596	0.0090
Switzerland	2696	0.0002	- 0.1067	0.0807	0.0107
Turkey	2696	- 0.0014	- 4.6021	0.0690	0.0898

Table 1 *The table exhibits the descriptive statistics of daily returns of the all indexes in the CEE region and gold in US$ dollar, and the daily returns of all the countries in their local currency.*

4.2. Descriptive Analysis

The following section contains a descriptive analysis of the gold-equity market relation in the CEE region. The Figure 3 shows the CEE equity index movements towards the price of gold movements and there are several trends which can be further analysed. At the beginning of the period, the CEE equity index strongly co-moved with gold. After that the index suffered major losses in late 2011 and 2012, whereas gold value increased steadily, showing opposite direction move, which speaks for the hedge property of gold in this period. One possible explanation could be the EU Sovereign Debt crisis in late 2009, which brought European financial markets into calamity, and investors relied on gold as a hedge and possible as a safe haven throughout this timeframe. Next, the index recovered slightly, whereas gold lost in value. Thus, suggesting that in bull markets gold losses in value, whereas in bear markets gold gains in value. In 2016, the equity index dropped again, a consequence of Brexit that occurred in the same year. In the past three years, the CEE global stock index recovered on its value, standing at 1800 index points in the middle of 2018, whereas gold price moved in the opposite direction, below the index value. Finally, with the Covid-19 outbreak in 2020, the CEE equity index, as the major global stock indexes, suffered major losses, dropping approximately 800 index points, but the price of gold increased dramatically, again indicating the gold property as a safe haven in times of financial turmoil. In conclusion, there is an evidence that the relation of gold and CEE equity index is not constant and varies over time.

When gold and equity portfolio move in opposite directions, for example if the index drops but in the same time the price of gold increases and vice versa, there is again an evidence of the hedge or safe haven property of this precious commodity. In the timeframe under study, these periods occurred in 2011 to 2012, 2016 and 2020. All these periods are characterised by high uncertainty as a consequence of several unexpected events, Black Swans that caused major value destruction among European financial markets. In contrast, in times where gold and CEE equity portfolio strongly co-moved, for instance in 2010, 2015 and 2019, there is no evidence of the hedge property of the precious metal. Probably, in these periods, along with the economic recovery in these regions, investors anticipated a crash and that could be a reason why they opted for gold in these time intervals or simply they had more capital disposable to allocate into financial assets, since the index gained on value, except in 2015.

In order to further investigate the time-varying pattern of gold with the CEE equity index, I use the approach introduced by Baur and McDermott (2010). I observe a beta factor between the two financial assets, after running a rolling window regression of gold daily returns on the stock index daily returns. The time window is 250 daily observations, which is equal to one financial calendar year. Figure 4 shows the evaluation of the beta coefficient estimate, which is positive on average. This observation confirms that the gold and equity index relationship is not constant, as such gold is not a hedge or safe haven asset in the whole-time interval under study, but rather than only in some specific periods. Furthermore, a positive beta suggests that the index is primarily correlated with gold price on average. Yet, a negative relationship speaks for the fact that gold served as a hedge or safe haven throughout the period. Such negative beta coefficients can be observed in 2011, 2015, 2016 to 2017 and 2020. Again, this negative relationship stands in line with the previous findings that in those years investors possibly opted for gold as means of hedge or safe haven due to the major financial disruptions, caused by unexpected events, such as EU Sovereign Debt crisis, Brexit and Covid-19 outbreak. In conclusion, the graph indicates that the correlation of gold and stock index is not persistent but varies over time and as such gold is not a hedge or safe haven asset in the whole timeframe under study, rather than only in some specific periods. There are times in which the correlation is positive and times in which is negative. Therefore, this pattern shows that a positive beta on average does not eliminate times in which gold appears to be used as a hedge or a safe haven. And the opposite is true, such that negative beta on average does not eliminate times in which gold co-moves with the equity index. When repeating the analysis for the other indexes, and results show a similar evidence. For instance, all the regressions' estimates indicate that beta is not constant but varies over time. For purposes of clarity I present only the results of the CEE equity index and gold. All other indexes results are represented in Appendix.

4.3. Econometric Analysis

In the following chapter, I present the econometric methods that are used when examining gold's property as a hedge in normal market circumstances or as a safe haven asset in extreme market conditions. I use an econometric approach, previously developed by Baur and McDermott (2010), to answer the hypothesis whether gold is indeed an asset that could protect investors in extreme financial shocks.

The dependent variable is gold daily return, with the assumption that gold is dependent on variations in the equity markets. There is another assumption that the relationship between these two variables varies over time, which means that such a relation is not constant and is affected by extreme circumstances, such as Black Swan events, for example.

$$R_{Gold,\,t} = \alpha + b_t R_{equity,\,t} + e_t \quad (1a)$$

$$bt = s_0 + s_1 D(R_{equity}\, q_{10}) + s_2 D(R_{equity}\, q_5) + s_3 D(R_{equity}\, q_1) \quad (1b)$$

In the first equation, I use a rolling window regression to estimate beta factor, or the correlation between the two financial assets over time, with a window length 250 days. Next, in order to analyse the safe haven property of gold, the econometric approach, represented in Equation (1b) is used. This equation represents a dynamic process, where s_0, s_1, s_2, s_3 are parameters aimed to reveal the gold property of hedge in normal market conditions, or of a safe haven in extreme market conditions. I use the following procedure when applying the Eq. (1b). Firstly, I calculate the beta between daily returns of gold and daily equity indexes' returns (Eq. 1a). Secondly, I calculate three thresholds (1%, 5%, 10%) of the worst daily returns, for both gold and equity, correspondingly. The reason to use this approach is to analyse the most extreme negative market returns and analyse further whether in those circumstances, investors would opt for gold as a protection. These three thresholds are incorporated in a regression analysis as dummies (D). If a daily return is lower than a threshold, a dummy of 1 is considered or a dummy of 0, in the opposite case. Finally, after running the regression, the results can be interpreted in the following way: if one of the parameters s_1, s_2, or s_3 is statistically significant, there is a proof of a non-linear relation between the equity market in the countries investigated and the gold. Next, if the coefficients

in Eq. (1b) are negative (plus s_0), gold serves as a weak safe haven asset. Additionally, if the coefficients in Eq. (1b) are negative and significantly different from zero, gold can be considered as a strong safe haven asset in the equity markets considered. In respect of the gold property as a hedge, parameter s_0 should be considered. For example, gold is a weak hedge if s_0 is non-positive or zero and a strong hedge if s_0 is negative and the sum of the rest coefficients do not mutually exceed the s_0 value. Finally, the main focus of this model is on most significant negative returns in order to analyse possible non-linear relationship between gold and stock indexes, suggesting that if there is such relationship, investors would behave differently in extreme market circumstances in comparison to normal market conditions.

	Daily frequency			
	Hedge	*0.1*	*0.05*	*0.01*
Indices (in US$)				
Balcans	0.1178 ***	0.1041	0.0995	0.1321
Baltics	0.2706 ***	0.2416 ***	0.1907 ***	0.1809 ***
Central Europe	0.0783 ***	0.0905	0.0971	0.0955
CEE International	0.1011 ***	0.1126	0.1127	0.1215
Markets (in local currency)				
Austria	- 0.0154 ***	0.0234 ***	0.0279	0.0169
Bulgaria	0.0136 ***	0.0197	0.0477 *	0.0551
Chech Republic	- 0.0431 ***	- 0.0138 ***	- 0.0035	- 0.01763
Croatia	- 0.0201 ***	0.0136 ***	0.0285	0.0086
Estonia	- 0.0239 ***	0.0107 ***	0.0233	0.0347
Germany	- 0.0381 ***	- 0.0201	- 0.0061	- 0.0096
Greece	- 0.0151 ***	0.0019 ***	0.0036	- 0.0059
Latvia	- 0.0203 ***	- 0.0283	0.0014 ***	- 0.0014
Lithuania	- 0.0101 ***	0.0215 ***	0.0458	0.0261
Poland	0.0566 ***	0.0596	0.0658	0.0465
Romania	- 0.0172 ***	0.0169 ***	0.0081	0.0516
Russia	0.0741 ***	0.0621	0.0635	0.0599
Serbia	- 0.2356 **	- 0.2355	- 0.2171	- 0.2171
Slovakia	- 0.0376 ***	- 0.0449	- 0.0467	- 0.0098 *
Slovenia	- 0.0116 ***	- 0.0092	- 0.0033	0.0089
Switzerland	0.1129 ***	0.1359	0.1542	0.1327
Turkey	0.0552 ***	0.0562	0.0539	0.0374

Table 2 *The table depicts the estimation results for the property of gold to act as a hedge and a safe haven asset for daily returns. Negative coefficients show that gold acts as a hedge against equity (hedge column). Additionally, zero or negative coefficients reveal that gold is a weak or strong safe haven asset under extreme market conditions, respectively (0.10, 0.05 and 0.01 percentile column). The results can be interpreted as follows: gold serves as a strong hedge in Czech Republic, Germany, Latvia, Serbia, Slovakia, Slovenia and as a weak hedge in Austria, Croatia, Estonia, Greece, Lithuania, Romania, in normal market conditions. In all other countries, gold co-moves with the stock indices in normal market circumstances.*

To analyse the crisis sentiment of the investors on the safe haven property of gold, I conduct an additional analysis, using the Google Trends Platform. For this analysis, three Black Swan events are considered. These events occurred in the last decade and had significant negative impact on the European financial markets: EU Sovereign debt crisis, Brexit and most recent Black Swan: the outbreak of corona virus. The crisis sentiment proxy is implemented into the regression analysis as a dummy variable. In these three periods, I conduct the regression previously used, but extended with the additional dummy accounting for the investor crisis perception (Eq. 1c). In order to incorporate such a dummy into the regression, I first calculate a threshold, which is the average value of all the daily observations for the given period of time, and further assign a dummy variable of 1 to those values that exceed the threshold, and a dummy variable of 0 to those that do not exceed the average. One important specification should be made at this point that when investigating the crisis perception in a timeframe of one year and using the first day of Black Swan event as a starting day for the analysis, the property of hedge can be generally interpreted as a safe haven asset, due to the short-term period, approximately 250 trading days or one calendar year.

$$bt = s_0 + s_1 D(R_{equity}\, q_{10}) + s_2 D(R_{equity}\, q_5) + s_3 D(R_{equity}\, q_1) + s_4 D(_{Crisis\ Sentiment}) \quad (1c)$$

$$PRICE_{GOLD} = \alpha + b_1 GCSI + b_2 FEARS + e_r \quad (1d)$$

Finally, the last econometric analysis that I use for this study is focused on year 2020 and on the Covid-19 outbreak (Eq. 1d). The analysis does not focus on CEE region but aims to investigate the relation of crisis sentiment perception of the investors worldwide on the price of gold[17]. In other words, if the gold price increases with the rise in crisis perception, it can be suggested that gold is a safe haven in that period. Such an observation is in line with the herd behaviour theory Calvo and Mendoza, (2000)**.** In order to incorporate the indexes into the regression analysis, for each day I calculate the average and the final result is implemented into the regression analysis. Further, I use the price of gold as a dependent variable and regress it on the two crisis sentiment indexes (Eq.1d). The results of all the econometric models are represented in the Section Results.

[17] Reason of conducting that analysis is to measure the crisis sentiment of the investors globally, since in the last year gold price experienced major jump due to the corona outbreak and it is from further interest to observe such a relationship. For better interpretation purposes, I conduct this analysis on global scale. In contrast, testing for these specific crisis sentiment indexes on CEE region is not feasible, due to the language differences and possible limited internet accessibility in these countries.

4.4. Estimation Results

This part of the report represents the estimation results obtained on the econometric analyses. Table 2 reveals the outcomes of the regression analysis, Eq. (1a) and (1b), for daily data and shows the relation of the equity indices under study with gold in normal and extreme market circumstances. The table shows the estimates of s0 (normal conditions) and all other coefficients (s1, s2, s3), which account for the whole effect of extreme market circumstances, that is the sum of s0 and s1 for 10% quantile, the sum of s0, s1 and s2 for the 5% quantile and the sum of s0, s1, s2 and s3 for the 1% quantile. The top section of the table represents the results of the equity indices, which are denominated in US$ (Balkans, Baltics, Central Europe and Central and Eastern Europe Global Index). In the down section the results contain all countries equity market indices of that region in the local currency. When examining the equity indices, the results suggest that gold tends to strongly co-move in normal market conditions and is not a safe haven asset in extreme market conditions.

These outcomes are not surprising, since the indices are composed in US$ and one important remark should be made: if the US-dollar currency losses in value, this would cause a rise in the nominal dollar price of gold and ultimately these changes would drive the co-movements of the non-US stocks and the gold price. For more precise interpretation purposes and in order to eliminate the distorting bias of the US-dollar currency, I use the approach in Baur and McDermott (2010) and repeat the analysis for all country's equity indices in the sample, using their own local currency.

The results can be interpreted as follows: gold serves as a strong hedge in Czech Republic, Germany, Latvia, Serbia, Slovakia, Slovenia and as a weak hedge in Austria, Croatia, Estonia, Greece, Lithuania, Romania, in normal market conditions. In all other countries, gold co-moves with the stock indices in normal market circumstances. Additionally, gold is a strong safe haven in Czech Republic, at the 10% quantile, and weak safe haven in Germany, Latvia, Serbia, Slovakia and Slovenia. In all other countries, gold and equity portfolios tend to co-move under extreme conditions.

In general, following the first econometric analysis, incorporating the most extreme market returns, it can be concluded that in almost all countries selected, gold is a hedge, either weak

or strong and a safe haven asset under extreme market conditions. The exception of these results are the countries, including Bulgaria, Poland, Russia, Switzerland and Turkey, where gold tends to co-move with the stock markets indices. The results can be interpreted in the following way: when a shock occurs in the market, and when the investors are faced with high degree of uncertainty and would suffer significant losses as a consequence, they would opt for selling equity and purchase gold, in general. Such investor's behaviour does not occur in some countries, where those financial assets tend to co-move. Therefore, investors would behave differently when market disturbances appear, in those specific markets. For instance, in those countries, with a positive correlation between gold and equity markets, investors might also seek for a safe haven asset, but other than gold. This is an interesting observation, given the economic scale of that particular region. Looking at the countries, where gold co-moves strongly, except Bulgaria, it should be noticed that all these economies are considered as emerging markets, which comes in line with the results obtained in the paper of Baur and McDermott (2010). They find evidence that in such economies and in times of financial turmoil, the investors might also sell their equity holdings, but rather than seeking the shelter of gold, for example, they would opt to shift their investments towards developed countries' portfolios. They might opt for investing in developed markets' portfolios, for example or for another safe haven asset. Furthermore, in case of Russia and Poland, this country is one of the major exporters of gold, as such there is a significant portion of the gold mining companies in the equity index, therefore the explanation of the strong co-move.
In conclusion, gold is a hedge in almost all countries in the selection, expect Bulgaria, Poland, Russia, Switzerland and Turkey and a safe haven in Czech Republic, Germany, Latvia, Serbia, Slovakia and Slovenia.

	Daily frequency				
	Crisis Sentiment Proxy	*Hedge*	*0.1*	*0.05*	*0.01*
CEE Index (in US$)					
EU Sovereign Crisis	- 0.0847 ***	0.2182***	0.0000	0.0000	0.0000
Brexit	- 0.0129 ***	- 0.1198***	- 0.0784***	- 0.0596	- 0.0301
Covid 19 Pandemic	0.0978 ***	0.0722 ***	0.0802	0.0074	0.0504

Table 3 *The table covers the results of the Equation 1c and implementing the concept of crisis sentiment as an explanatory variable for the property of gold to act as a safe haven asset.*

The results of the extended regression model are represented in Table 3, when incorporating the crisis sentiment, to test the property of gold as a safe haven under Black Swan events. In 2009 and following one-year time period, considering the EU Sovereign Debt Crisis, gold tends to co-move with the equity markets, suggesting neither hedge property, nor safe haven.

Nevertheless, at 5% percentile, when the stock market experienced its worst daily returns, the coefficient is negative, but statistically significant not different from zero, as such gold served as a weak safe haven. The crisis sentiment has a negative coefficient, statistically different from zero, which reveals that on this specific Black Swan event, if the investor crisis sentiment increases, the beta factor would increase and vice versa. This observation is logical, since in that particular period gold does not serve as hedge nor as safe haven asset in the market under study. The results of the analysis on Brexit event, suggest that gold is a strong hedge (safe haven) asset, with coefficient of -0.11 that is significantly different from zero. The crisis sentiment proxy also has a statistically significant negative coefficient, suggesting that in times of that Black Swan, the investors opted for safe haven asset, when the crisis perception increased. This observation shows a linear relation between the beta and crisis sentiment, which again is logical due to the fact that in that period gold serves as a safe haven asset in the markets under investigation. Finally, looking at the results of the most recent Black Swan, there is an evidence that gold was not a hedge, nor a safe haven, in fact the two assets co-move. Also, looking at the crisis sentiment proxy, there is proof of a linear relation, suggesting that if there is an increase of that perception, there will be an increase of the co-movements in the two asset classes, which also stands in line with the idea that during that period the investors did not rely on gold as a meaning of protection. Both coefficients are statistically significant.

In conclusion, although during this particular period on general there was a high perception of uncertainty, measured by the Google Trends as proxy of crisis sentiment, not all investors in those equity markets did opt for gold as meaning of a safe haven asset.

Daily frequency - 2020					
	Coefficient	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Gold Price (in US$)	1243.82 ***	1543.72	90.12	1328.94	1727.59
General Crisis Sentiment Index	1.4151 ***	41.50	23.04	0.67	87.60
FEARS	3.8575 ***	62.52	6.04	46.20	76.10

Table 4 *The table covers the results of the Equation 1d, incorporating two crisis sentiment indexes when investigating the property of gold to act as a safe haven in extreme market conditions.*

The table 4 shows the results on the last econometric analysis conducted, using the two crisis sentiment proxies in order to investigate the relationship between the investor crisis perception and the price of gold on the Covid-19 outbreak in 2020.

It is noticeable that when using the two crisis sentiment indexes to verify the gold quality as a safe haven asset, there is an evidence that an increase of crisis sentiment would lead to the increase of the price of gold. The results suggest that in times of extreme market disruption, caused by the occurrence of Black Swan event such as Covid-19, the crisis sentiment perception is positive correlated with the price of gold. This particular outcome can be interpreted as follows: in times of high crisis investor perception, the price of gold would rise, which speaks for the gold feature as a 'refuge', or as a safe haven asset in that particular crisis. Both indexes coefficients are statistically significant. Finally, such results indicate that incorporating a crisis sentiment into an analysis when testing the gold's property as a safe haven asset is important in terms of understanding the investor's preferences in times of financial turmoil.

5. Conclusion

The aim of this study is to analyse the role of gold as a hedge or a safe haven asset in the CEE stock market, in the normal and in the extreme market conditions in a period between 2010 and 2020. I test the hypothesis whether gold serves as a hedge under normal market conditions on average or as a safe haven asset under extreme market conditions, such as Black Swan events. In that analysis I distinguish between a weak and a strong hedge and safe haven asset. Such distinction is important, since a weak safe haven will shield a potential investor only to some degree, meaning that it does not co-move with other financial assets in extreme market setting. In opposite, a strong haven asset is negatively correlated, or in other words will move in opposite directions with the other financial assets in extreme periods, thus mitigating the negative effects and possibly reducing the overall portfolio's losses suffered in such periods.

Additionally, to further investigate the property of gold to act as a protection, I incorporate the investor's crisis perception into the analysis, using Google Trends. Finally, I build two indexes, which are used as proxies for crisis sentiment in year 2020, to study the effect of such a negative investor's perception on global scale on the price of this precious metal in this particular year given the unprecedented Covid-19 outbreak and record rise in gold price.

I find evidence that gold serves as a strong hedge against equity portfolios in Czech Republic, Germany, Latvia, Serbia, Slovakia, Slovenia and as a weak hedge in Austria, Croatia, Estonia, Greece, Lithuania and Romania. In all other countries, gold co-moves with those stock indices in normal market conditions. Furthermore, gold is a strong safe haven asset in Czech Republic and weak safe haven in Germany, Latvia, Serbia, Slovakia and Slovenia. In all other countries, gold and those equity portfolios tend to co-move under extreme conditions. When incorporating the investor's crisis sentiment and analysing its effect on the three specific Black Swan events, there is an evidence that the investors reacted differently to those shocks in respect of buying gold. For instance, in 2009 due the European Union Sovereign Debt Crisis, although there was a high crisis perception, measured by the Google Trends, investors in the countries under study did not opt for gold as meaning as a safe haven asset. In contract, with Brexit in 2016, there is a proof that gold possible served as a safe haven asset for the investors for that particular period. Nonetheless, in 2020 with the outbreak of Covid-19 pandemic, although the equity markets suffered major setbacks in these regions and the price of gold increased dramatically, investors did not opt for gold as means of safe haven asset in the countries under investigation.

Finally, when investigating the crisis perception of an investor on global scale on the price of gold in 2020, there is an evidence that gold would gain in value with the increase of such a crisis perception. This ultimate observation suggests that an investor would prefer the gold as a means of protection or safe haven against losses in times of extreme market conditions.
In conclusion, in this research I find evidence that gold has the property to act as a hedge and a safe haven asset in normal and extreme market conditions, in the Central and Eastern European region in the timeframe of 2010 and 2020. Furthermore, compared to the outcomes in Baur and McDermott (2010), my findings speak for the fact that investors from Central and Eastern European countries would opt for gold as a vehicle of protection in times of extreme market conditions, a pattern observable in the developed countries under their study. Moreover, when accounting for the crisis sentiment factor in this region, the results suggest that the investors have different preferences on gold to act as a safe haven asset. Nonetheless, the results indicate that they would opt for this precious commodity as an instrument of protection against portfolio's losses in some extreme market events, such as Brexit. Finally, when investigating the effect of crisis sentiment on global scale in the last 2020 using the two crisis sentiment indexes, there is an evidence that the price of gold would increase with the rise in the crisis perception, an evidence of the gold as a preferred safe haven asset in times of

high crisis sentiment. In conclusion, gold has the prospect to act as a stabilising force, mitigating the negative effects and reducing the portfolio's losses, when a financial shock appears.

APPENDIX

FEARS Index – Financial and Economic Attitudes Revealed by Search Terms

The table shows the thirty search definitions used to construct the crisis sentiment index - Financial and Economic Attitudes Revealed by Search (FEARS) introduced by Da, Z., Engelberg, J., Gao, P. (2015).

GOLD PRICES	FRUGAL	EXPENSE
RECESSION	GDP	DONATION
GOLD PRICE	CHARITY	SAVINGS
DEPRESSION	BANKRUPCY	SOCIAL SECURITY CARD
GREAT DEPRESSION	UNEMPLOYMENT	THE CRISIS
GOLD	INFLATION RATE	DEFAULT
ECONOMY	BANKRUPT	BENEFITS
PRICE OF GOLD	THE GREAT DEPRESSION	UNEMPLOYED
THE DEPRESSION	CAR DONATE	POVERTY
CRISIS	CAPITALIZATION	SOCIAL SECURITY OFFICE

GSCI Index - General Crisis Sentiment Search Terms

The table shows the five search definitions used to construct the General Crisis sentiment index (adapted version), the original GCSI index is introduced by Weiß, G., Irresberger, F., König, F.E. (2013).

BEAR MARKET	CORONA	CORONA VIRUS	COVID-19	WUHAN

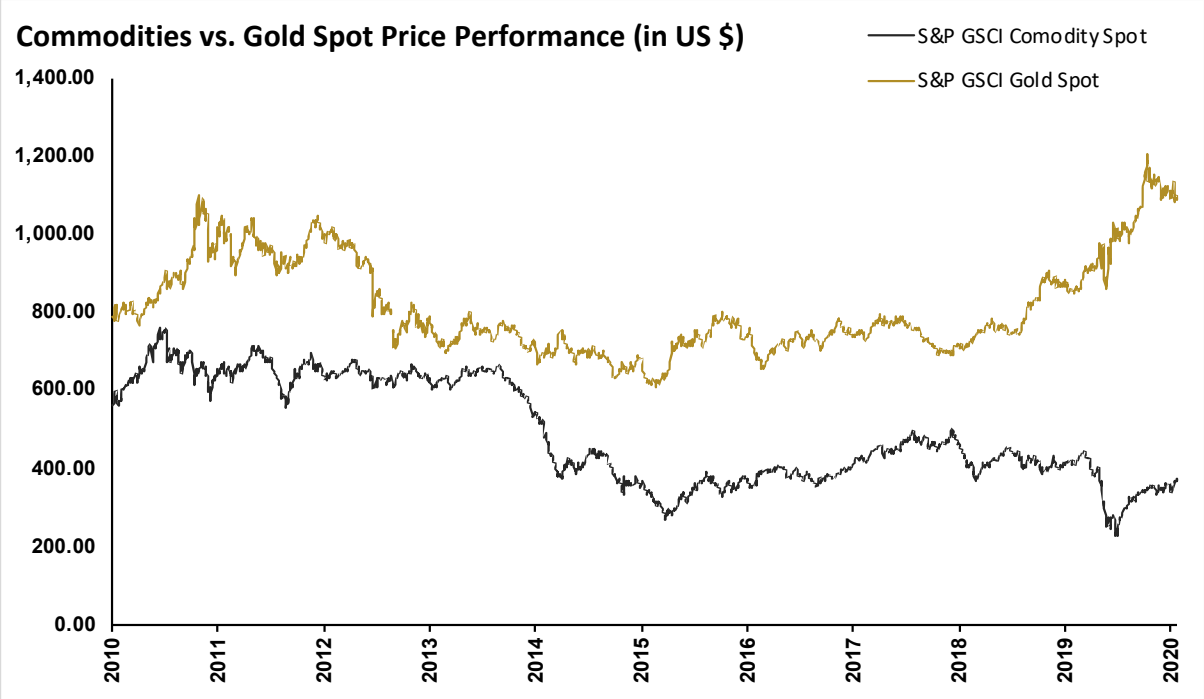

Figure 1 *The figure shows the development of the S&P GCSI gold and commodity spot indices over the last decade, from 2010 and 2020, using daily data.*

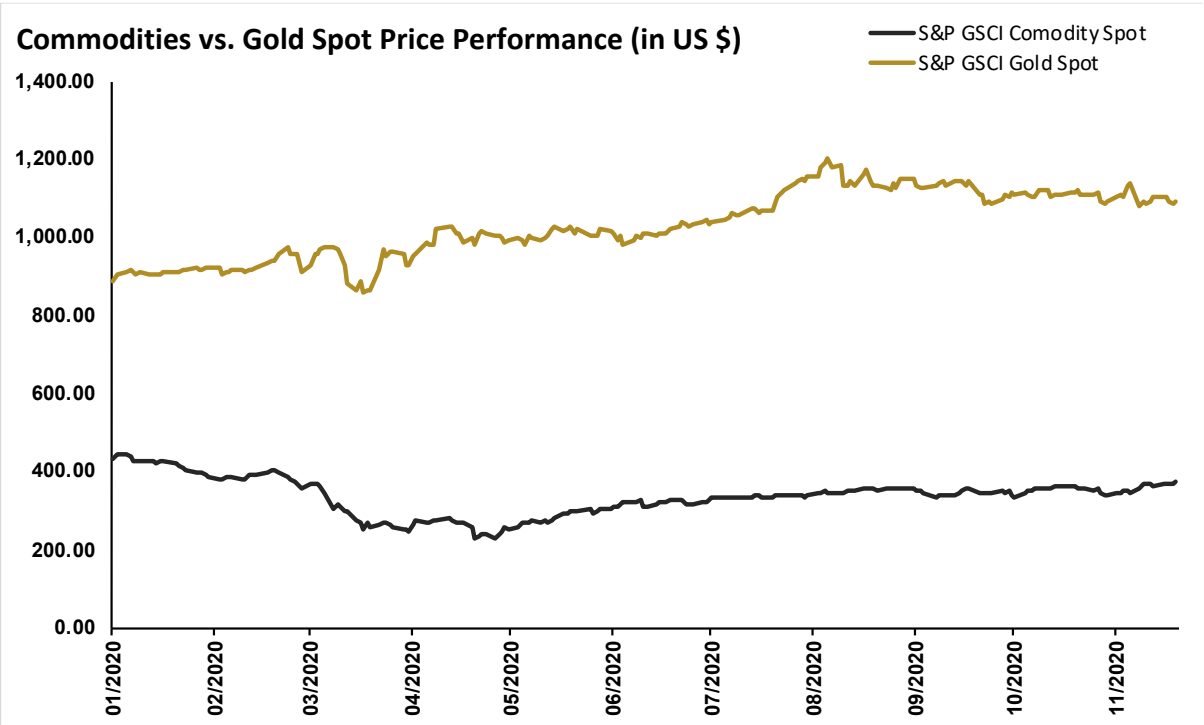

Figure 2 *The Figure shows the development of the S&P GCSI gold and commodity spot indices over the year 2020, using daily data.*

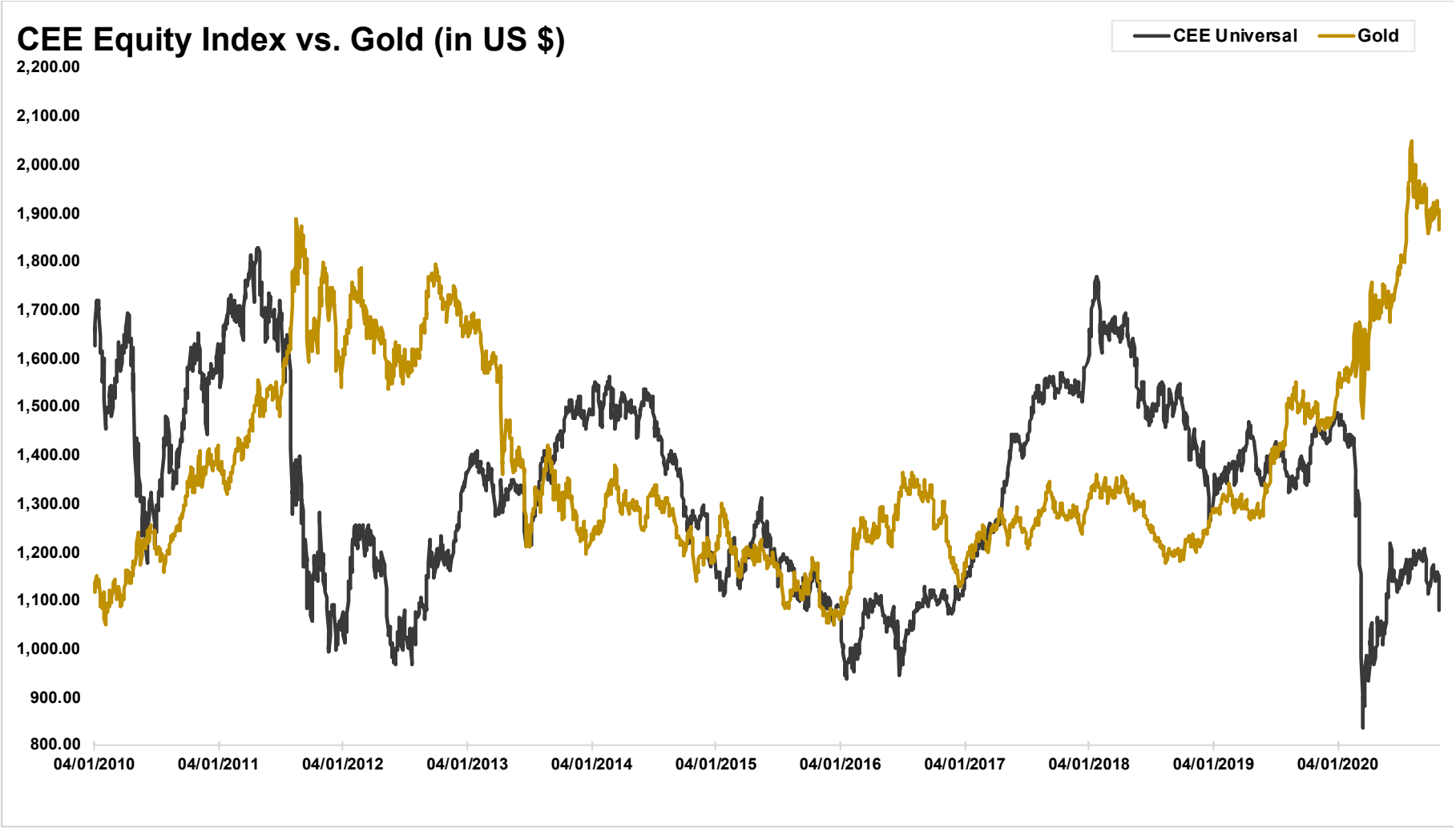

Figure 3 *The figure exhibits the development of the CEE equity index and the price of gold in US$ for over a 10-year timeframe under study, starting from 2010 until 2020 for daily data.*

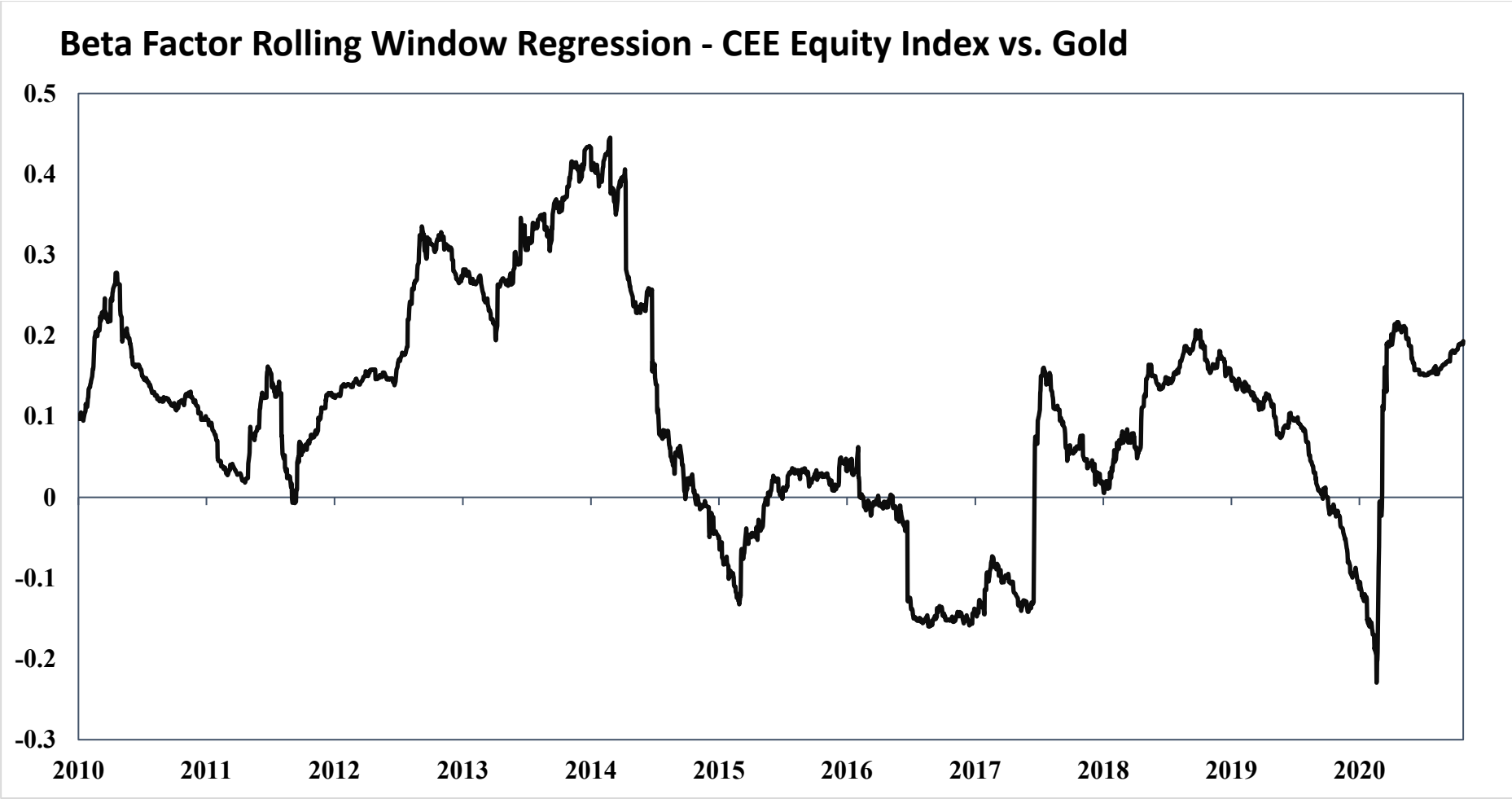

Figure 4 *The figure shows the development of the correlation between the CEE equity index and the price of gold on daily data. A window length of 250 observations on daily data is used to estimate the rolling correlation between the two assets. The graph indicates that such a relationship is changing and varies heavily throughout the time period under study, from 2010 to 2020. All indices are represented in US$.*

Figure 5 *The figure exhibits the development of the Central Europe equity index and the price of gold in US$ for over a 10-year timeframe under study, starting from 2010 until 2020 for daily data.*

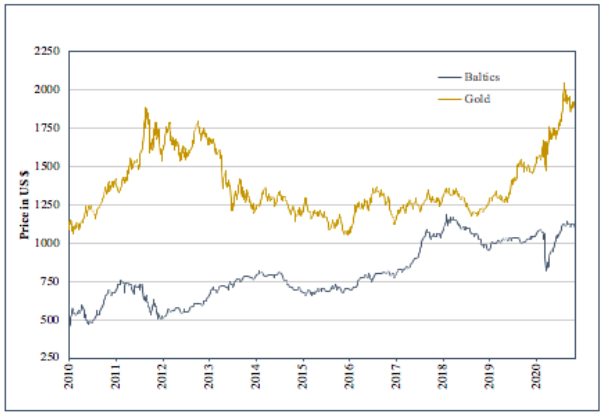

Figure 6 *The figure exhibits the development of the Baltics equity index and the price of gold in US$ for over a 10-year timeframe under study, starting from 2010 until 2020 for daily data.*

Figure 7 *The figure exhibits the development of the Balkans equity index and the price of gold in US$ for over a 10-year timeframe under study, starting from 2010 until 2020 for daily*

Figure 8 *The figure shows the development of the correlation between the Central Europe equity index and the price of gold on daily data. A window length of 250 observations on daily data is used to estimate the rolling correlation between the two assets. The graph indicates that such a relationship is changing and varies heavily throughout the time period under study, from 2010 to 2020. All indices are represented in US$.*

Figure 9 *The figure shows the development of the correlation between the Baltics equity index and the price of gold on daily data. A window length of 250 observations on daily data is used to estimate the rolling correlation between the two assets. The graph indicates that such a relationship is changing and varies heavily throughout the time period under study, from 2010 to 2020. All indices are represented in US$.*

Figure 10 *The figure shows the development of the correlation between the Balkans equity index and the price of gold on daily data. A window length of 250 observations on daily data is used to estimate the rolling correlation between the two assets. The graph indicates that such a relationship is changing and varies heavily throughout the time period under study, from 2010 to 2020. All indices are represented in US$.*

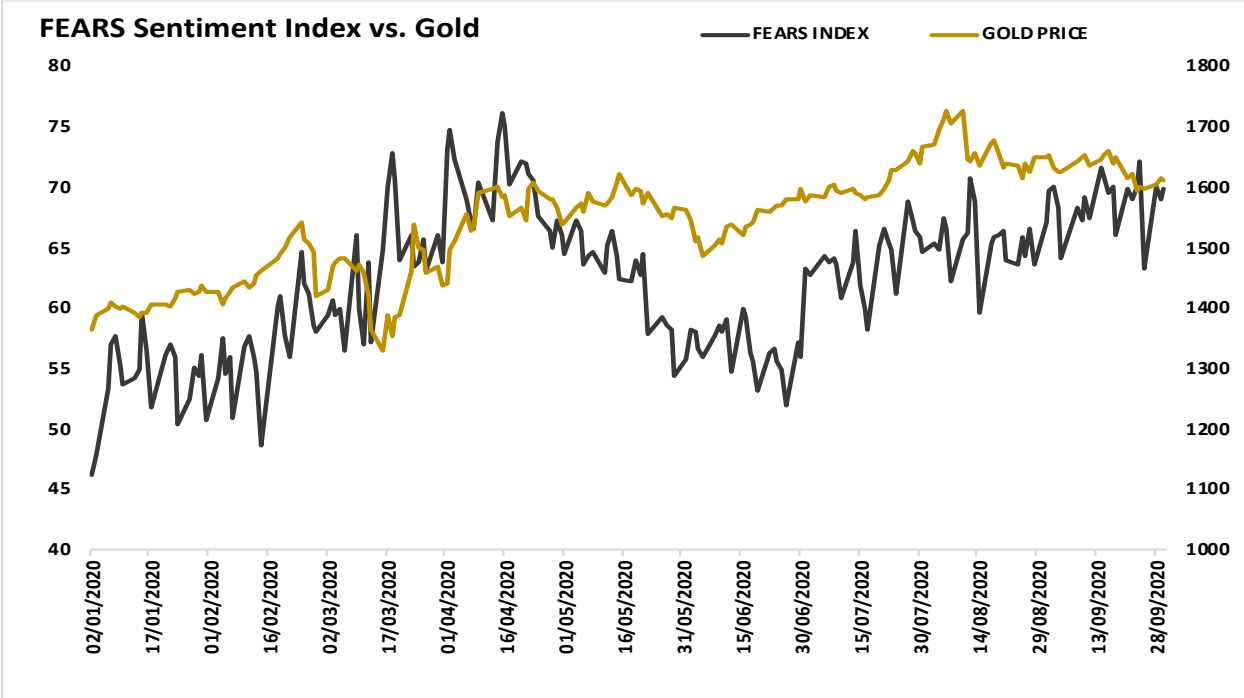

Figure 11 *The graph presents the development of FEARS index and price of gold in 2020, on daily data. A general pattern is that when the FEARS index rises, the price of gold would increase as well, with an exception in March 2020, when the financial markets suffered a major setback, a possible consequence of a 'panic sell-off' of gold, as a means of generating cash to settle the losses occurred, with the Covid-19 outbreak.*

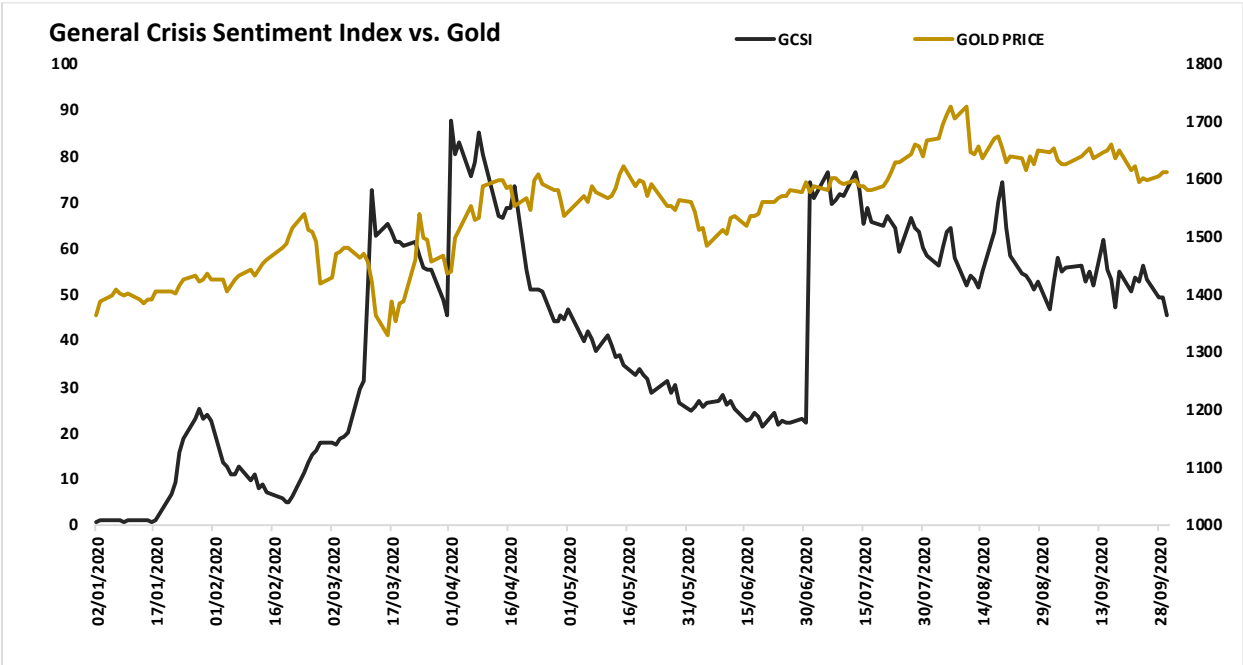

Figure 12 *The graph presents the development of GCSI index and price of gold in 2020, on daily data. The general trend is that a rise in GSCI index would trigger an increase in the price of gold, with two major exceptions: March and July 2020. The first opposite move can be ascribed to the fact that with the Covid-19 outburst, investors opted to a 'panic sell-off' of gold, as a means of generating cash to settle losses occured with the Covid-19 outbreak. Additionally, in July, after a period of decline, there is a spike in the index, a probable explanation of the second worldwide wave in Covid-19 cases, and there is an evidence of increase of the gold's price as a consequence.*

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