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Article

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Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

The Relationship of Gold Price with the Stock Market: The Case of Frankfurt Stock Exchange

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ABSTRACT

This paper considers the relationship between two main economic variables: Gold and Stock market in Germany that is represented by the HDAX Index under the Frankfurt Stock Exchange. The researchers used monthly data collected from Bloomberg database spanning from August 2004 to September 2016 (12 years) in order to use them in the selected tests in this research which are: (Descriptive statistic tests, Pearson's correlation test, Unit root test to assure data are stationary for the Johansen's Co-integration test and the Granger Causality test.). The data were divided into three periods: Pre, during and post to financial crisis in order to measure the different effect in each period. The results showed that there is a correlation between gold and stock market that differs in each period, as for the whole period of 12 years there was a moderate positive correlation, before the financial crisis there was a very strong positive correlation, during the financial crisis the correlation was positive but weak and low which means its insignificant, while at the period after the financial crisis the correlation changed in nature as it became a strong high negative correlation. The co-integration test results were all the same for all the three different periods (before, during and after financial crisis) and also for the whole 12 years period that is there is a long run relationship between gold and stock market (represented by the HDAX Index). The same thing applies on the Granger causality test, as there was no Granger causality (No Cause-effect relationship) between gold and stock market.

Keywords: Gold Price, Stock Market, Frankfurt Stock Exchange, HDAX Index
JEL Classifications: C01, C58, G01, G11, G15

1. INTRODUCTION

This study is targeting two main variables: Gold and the stock market as they have an important position within today's economy and are highly significant assets for investors in the financial market.

Gold is the sacred precious metal that had a great position during the ancient times and played an important role in the human society (Toraman et al., 2011) this position can be attributed to the idea of it being seen as irreplaceable element because of its unique properties (Bilal et al., 2013). The gold use started with the manufacturing of precious jewelries which is still a big division of current gold forms circulated in the economy; it's used then moved to be a value carrier in the barter system all the way to the current money system where it started in the manufacturing of coinage then countries used it for Bills and gold certificates

(they mature at the end into gold coins) in their systems during the 19th century which helped emphasizing the gold standard money and then gold standard system during that period of time. The next step in the journey is the move to Britton wood system where the USA - and many other countries - nailed their currency and fixed their exchange rates to a cretin amount of gold; when this system ended the USD was set as a free floating currency – pure fiat money – therefore introducing the new fiat currency system after 1976 which represents the current state of economy. Now gold is still considered as a financial tool that holds the characteristics of a currency and a commodity within the same time along with its liquidity feature (Bhunia and Mukhuti, 2013). It's also still considered an important and leading asset and commodity in the metal market and industrial sectors (Hussain, 2013), as well as a precious personal property, an investment and saving tool, an exchange asset and a hedging asset against different situations (Hemavathy and Gurusamy 2014). Therefore this new era for gold

is characterized by it being an important asset and investment tool in the commodity mark; from its current importance in the financial market, the researchers decided to study its relationship to the stock market as many other studies focused on its relationship to other commodities or macroeconomic variables but rare are those studies that did it to the stock market.

When it comes to the stock market, its importance is undoubtedly unquestionable, in fact it is impossible to imagine a world without a stock market as it plays a vital role in the economy of any country, and helps towards the growth of the economy, and can cause a huge negative impact when not watched. The stock market can be divided into two main segments, primary market and secondary market. The first stock exchange was established back in 1531 in Belgium. However, they did not trade in stocks, but traded in bonds and promissory notes (Petram, 2011).

In 1929, the stock market crashed in September due to insanely large amounts of volumes of trading, which lead to the Great Depression of 1929. It was the longest and deepest depression the economy has ever fallen into. This is a great example to demonstrate that governments much keep an eye on the stock market and be on stand b to intervene only when necessary and not in an obvious or harsh manner. We live today in an open economy where any and every investor has access to stock markets internationally; investors now cannot imagine a world without the stock market. These stocks and their movements are closely related to and affected by different economy indicators such as inflation, gross domestic product (GDP), jobless rate, consumer price index (CPI), producer price index (PPI), along with other indicators.

Many investors opt to invest in the stock market as well as gold, in order to minimize or eliminate the systematic risk. It is also considered as an insurance against risk to invest in gold as well, as in, using gold as a hedging tool (Bhunia, 2013). This is because gold is seen as store of value, while the stock market is only seen as a return of value (Shahzadi, 2016). These characteristics of the gold and stock market is what drives the investor's behaviour when investing in gold or stocks. Hence, it can be concluded that gold tends to have some kind of a relationship with the stock market that may be affected by different economic variables.

The remainder of the paper is organized as follows. The next section briefly discusses the previous research and provides background information Hypotheses development. Then, research methods are discussed and results presented. The paper ends with a conclusion and limitations of the study and the Table 1 summarized the research objectives, methodology and results.

2. LITERATURE REVIEW

This part of the study aims to review the literature and Table 2 summarized the literature review. Going back to basics, gold is a chemical element metal that is characterized with its yellow slightly reddish color and carries the atomic number 79 and symbol "Au" in the periodic schedule which is derived from the old Latin word "Aurum." This "yellow metal" had its great position within the different ancient and current cultures and civilizations as a

sacred metal and valuable possession. This former and continues position that this metal yielded within all of those civilizations and cultures can be attributed to the idea of it being seen as irreplaceable element because of its unique properties (Bilal et al., 2013). The gold had a great position during the ancient times and played an important role in the human society (Toraman et al., 2011). However, this great position wasn't only restricted to the idea of being sacred as its use moved to the manufacturing of precious jewelries till it got introduced finally to the economy as a value carrier as it started to be used in the barter system for the purpose of efficient exchange.

The next step for gold entry into the economy was its use in the new money system that followed the barter system as a replacing system. In the new money system gold took an important outstanding part as it started to be used in the manufacturing of coinage around the world therefore taking the state of money in that time period; this position got reinforced by the change in preference that happened in European economies during the 13th and 14th centuries from silver to gold which caused a re-establishment to the gold minting coinage.

The use of gold as a base and representative of money then moved to a better state in the economy as its circulation increased in the economies and countries as they started to use Bills and gold certificates (they mature at the end into gold coins) in their systems during the 19th century which helped emphasizing the gold standard money during that period of time.

During those former periods and till before the World War II the gold was a somehow a base of money everywhere in what is called the gold standard system; when the World War I started the warring nations started to move from the gold standard system to the fractional gold standards in order to be able to inflate their currencies to be able to finance their war expense. This was somehow fixed after the war in some countries however this didn't continue for a long time as World War II happened and sealed the end of the gold standard system.

After the World War II the world in Britton wood conference decided to move the world money system to a new system that was called Britton wood system that is similar to the gold standard system as some people call it the "gold exchange standard". Under this system, the USA - and many other countries - nailed their currency and fixed their exchange rates to a cretin amount of gold. Therefore, central banks were able to exchange their USD holdings to gold at the set official US exchange rate of $35 per ounce. As a result of the change the USA did all the countries that had their currencies pegged to the USD had to also change their system and fix their currencies value to a fixed value of gold.

During this system gold was almost the synonym of money in the economy as everything that holds a value of money was somehow backed up by an amount of gold within the countries of the world; however, those " golden times" for gold reached their end when the USA - along with money other countries - decided to ditch the Britton wood system and set their USD currency as a free floating currency – pure fiat money –therefore introducing the new fiat currency system

Table 1: Summary of research objectives, methodology and results

Research objective	To examine whether a relationship of long term nature exists between the two main variables of the study the HDAX Index and gold over the period 12 years divided into 3-time frames: Pre, during and post financial crisis		To examine whether a casual or a casual and effect relationship exists between the HDAX Index and gold over the period of 12 years divided into 3 time frames: Per, post and during the financial crisis.		To understand the relationship between the two main variables in this research, the HDAX Index as a representative of the FSE and gold prices	
Research Question	Is there a long run equilibrium between gold price and HDAX Index?		Is there a casual relationship between the two variables?		Does correlation exists between gold prices and HDAX? How does co-integration, causality and correlation between gold prices and HDAX if any react to pre, during and post financial crisis?	
Hypothesis	Hypothesis 1: H_0: There is no long term equilibrium between the gold prices and FSE. H_1: There is long term equilibrium between the gold price and FSE.		Hypothesis 2: H_0: There is no causal relationship between the gold prices and FSE. H_1: There is a causal relationship between the gold prices and FSE.		Hypothesis 3: H_0: The relationship between the price of gold and FSE was not affected pre, during and after financial crisis. H_1: The relationship between the price of gold and FSE was affected pre, during and after financial crisis.	
Tests Applied	Johnson's Co-Integration Test		Granger Causality Test		Pearson's Correlation Test	
Results	Whole Period	Co-integration exist	Whole Period	No Causality	Whole Period	Moderate Positive Correlation
	Pre-Financial Crisis	Co-integration exist	Pre-Financial Crisis	No Causality	Pre-Financial Crisis	Very Strong Positive Correlation
	During Financial Crisis	Co-integration exist	During Financial Crisis	No Causality	During Financial Crisis	Weak Low Positive Correlation
	Post financial crisis	Co-integration exist	Post financial crisis	No causality	Post financial crisis	Strong high negative correlation
Results interpretation	A long run relationship exist between gold price and HDAX index in all periods		No causality at all in all periods		Correlation exist in all periods Only correlation got changed and affected	
Hypothesis Testing	Reject H_0		Accept H_0		Correlation Reject H_0 Co-Integration Accept H_0 Causality Accept H_0	
Interpretation	Consistent results prove that the relationship between the two is not a result of a contingent random event. The relationship although changed in nature (when noticing the correlation) continued to exist which also proves along with the causality test that there are endogeneity factors that affect both variables		Although the assets are correlated, they don't cause each other which indicates that there are common factors that may affect both of them resulting in their correlation and long run relationship; those factors can be endogenous factors. The consistency of the results supports the former assumption.		The correlation test shows the tremendous change of the relationship of the two variables which is mainly caused by the financial crisis. This indicates the change in trust of stock market because of the crisis as pre to it stock was an alternative to gold indicating high trust and safety; now it doesn't. Also, the results mean that when diversifying a portfolio, the addition of the two assets will be beneficial in risk reduction.	

FSE: Frankfurt stock exchange

after 1976; as the reference to gold got moved officially from the definition of dollar from the statuettes of USA because of the failure of their ability to support the USD within circulation with a proper amount of gold. The last currency to be separated from gold and marked the end of that system was the Swiss Franc in 2000.

This although it did end the "golden times" of gold it didn't really end its position as a synonym of money and as a valuable item; as it's still considered as a financial tool that holds the characteristics

of a currency and a commodity within the same time along with its liquidity feature (Bhunia and Mukhuti, 2013). It's also still considered an important and leading asset and commodity in the metal market and industrial sectors (Hussain, 2013), as well as a precieous personal property, an investment and saving tool, an exchange asset and a hedging asset against different situations.

Many countries still maintain a huge amount of gold reserves in their possession as an asset in their central banks as history has

Table 2: Literature review

Year	Authors	Country	Long term co-integration	Granger causality	Correlation
2013	Bhunia and Mukhuti	India	Yes	No and Bi-directional	Yes
2013	Bhunia	India	Yes	No and Bi-directional	
2015	Rao	India	Yes	No	
2014	Hemavathy and Gurusamy	India			
2013	Narang and Singh	India	No	No	
2013	Bilal et al.	India	Yes/No	No	
2013	Patel	India	Yes	Yes	
2014	Bhunia and Pakira	India	Yes	No or Bidirectional	
2016	Hemavathy and Gurusamy	India	Yes	Unidirectional	
2014	Srinivasan and Karthigai	India	No	No	
2011	Toraman et al.	USA			Positive and Negative
2001	Smith	USA	No	Unidirectional	
2011	Sujit and Kumar	USA	No	No or Bidirectional	
2016	Ben and Arfaoui	USA		yes	
2015	Azar	USA			Positive and Negative
2015	Wanat et al.	Europe		No	
2013	Abdul Basit	Pakistan	No		
2013	Shahzadi and Chohan	Pakistan	No	Cannot be applied	
2007	Malik and Hammoudeh	GCC			
2010	Al Janabi et al.	GCC			
2013	Mollick and Assefa	USA			Positive and Negatives
2010	Zhang and Wei	USA	Yes	Yes	Yes
2015	Bampinas and Panagiotidis	USA and UK		Uni and Bidirectional	
2010	Wang et al.	International	Yes		
2013	Choi et al.	South Korea		Yes	
2012	Chkili	International			

always proven that countries tend to always relay on gold a tool that counters the loans with payment difficulties.

During 2016 the total supply of gold recorded 4584 tons showing a 5% yoy increase and a total demand of 4315 tons with a 2% yoy increase according to the (World Gold Council, 2017). While during the first quarter of 2017 the global demand reached 10344.5 tons showing an 18% yoy decline than the first quarter of 2016 according to (World Gold Council, 2017) that also explained that this decline in the yoy percentage was a result to 2016 first quarter that registered itself as the highest first quarter for gold ever. The ETFs inflows registered a solid number of 109.1 tons, however, again this inflow is still considered low when compared with 2016 quarter 1 inflows which registered a high record.

2.1. Gold as an Investment Tool
Out of all of the precious metals, gold is considered one of the most precious and popular investment. Many studies on the gold investment suggested that it as one of the greatest investment tools for diversification. Jaffe (1989) also established that gold creates an advantage in diversification.

According to Sumner et al. (2010), diversification of a portfolio is essential throughout diverse worldwide markets, even if it be within different classifications of assets. "For at least some investors, an investment in gold has been seen as a good hedge or safe haven against stock market movements." The results of this study are similar to the findings of another study conducted by Lawrence et al. (2003). The researcher reported that there is no correlation between the returns on financial assets and gold. The lack of the correlation can be associated with the returns of financial assets dependant on the macroeconomic variables, while the return of the gold is independent. Results of other studies show

that gold is an excellent diversifier of a portfolio, and considered as a safe haven and a hedge against risk.

Alongside the dependency of stocks and bonds with the macroeconomic variables, they are as well exposed to global risk. Some studies explored the effect of risk and return from global and regional markets to domestic markets and vice versa. Mulyadi and Anwar (2010) determined that there is an effect of risk and return specially from leading markets, to smaller markets, although there is also impact from emerging markets to dominant markets in the world. "Gold investment is more advantageous than stock investment."

2.2. Impact of Different Variables on Gold
There are enormous macroeconomic factors that some way or another affect each other's movements or fluctuations a lot. As any change in any variable would cause an effect in another, and so it is important to consider/address these economic variables like: Exchange rate, Inflation rate, economy growth and downturns.

The following topics present the relationship between gold and some of main economic variables:

2.3. Gold and Crude Oil
Gold is considered as a safe haven that investors buy to hedge against market fluctuations and volatile market conditions. While oil is a very valuable source of energy and represents an excellent income to the oil producer countries. And as gold and oil are both valuable and significant investments in the financial market and the economy it is important to highlight the common things between oil and gold to illustrate the relationship between the two variables. Gold and oil are both "dollar-demonstrated asset," which means both commodities are determined or priced in U.S. dollar,

so usually when the U.S. dollar appreciates the price of both gold and oil will decrease (Šimáková, 2011) as investors from other countries than USA (or investors of other currencies than U.S dollar) will find these assets\commodities very expensive to buy. Since gold and oil are "dollar-demonstrated asset" then they have a very strong relationship, as if dollar fluctuates both assets will fluctuate together in opposite direction to the dollar.

Another important link between oil and gold is the macroeconomic variable the "Inflation rate." Oil prices affect the gold prices indirectly through the inflation rate, as a crucial factor in the economy oil prices can affect the inflation rate a lot, so when oil prices increase the inflation rate will increase causing the gold prices to rise. And it is known that gold is a good hedge against inflation rate as (Bhunia, 2013) stated, and since gold rises when inflation (that is affected by oil fluctuations) increase at around 60% of the time, then it can be said that oil and gold share a direct relationship. Toraman et al., (2011) also proved in his article "Determination of factors affecting the price of gold" that there is a positive relationship between gold and inflation.

Besides the "inflation rate," crude oil and gold are further related to each other because of the economic situation whether it be recession or growth. Again since oil has a focal role in the economy and affects the economic variables a lot, then when oil prices rises the economy would suffer a recession because of the excessive use of industrials that affects negatively most industries. This recession would dampen the stock market prices and investors will be frightened of losing their money, so as a rational action investors will search for an alternative asset that has a sustainable value like gold. Thus, the demand on gold will increase which increases the gold prices.

So overall when it comes to gold, the financial consultants always recommend to invest in assets such as gold during tough financial situations and economic downturns. Also, (Baur and Lucey 2009) stated that gold is not always a safe haven for stock market but only after negative shocks to the stock market. So the recessionary phase could be a good boost for gold prices. (Hemavathy and Gurusamy, 2014) stated that gold is a good hedge against inflation rate, financial crisis and some other economic variables.

2.4. Gold and US Exchange Rate
Since the gold is determined by the US dollar, then it always get affected by the demand-supply of the dollar or the US dollar's fluctuations. The factor that affects the dollar's value (which then affect gold prices) is the people's purchasing power which is affected by various economic factors or cases. In regard of exchange rate case, if US dollar depreciates against other currencies, then demand for US commodities will increase (especially gold since it is priced in US dollar) and so the prices of gold will increase. Because when US dollar decreases in value, it means that people in countries with different currencies will be able to buy or invest in US gold with a cheaper price (since gold priced in US dollar and the dollar decreased in value). On the other hand, if the US dollar increased in value against other currencies, the other currencies will decrease in value and so people with other currencies will pay more to buy gold from US or sometimes cannot

even afford buying gold so the demand on gold decreases which decreases the gold's prices, this negative relationship between gold and U.S. exchange rate was also proven by (Toraman et al., 2011) and (Šimáková, 2011). However, this inverse relationship could sometimes change to a positive relationship, depending on the other countries' situations, as if the other countries' currencies are facing economic problems or downturns then the people holding these currencies will not be able to purchase or invest in gold even if the US dollar depreciated. And so demand and price of gold will be low at the same time when the dollar is low too.

2.5. The Stock Markets
Stock market or equity market is essentially a place where the securities of all of the publicly listed companies are bought and sold. It plays a vital role in the economy of any country, and helps towards the growth of the economy, and can cause a huge negative impact when not being watched. The stock market can be divided into two main segments, primary market and secondary market. The primary market is where newly issued stocks are initially sold, through the process of Initial Public Offerings. While the secondary market is where the trading of all of the existing securities takes place (Retrieved from Investopedia).

The first stock exchange dates back to 1602, which was the Amsterdam Stock Exchange nd was founded by the "Dutch East India Company (Verenigde Oostindische Compagnie, or "VOC")." Printed stocks and bonds were traded first, as well as, this was the first stock exchanges to formally begin trading in stocks (Petram, 2011). Although, technically, the first stock exchange was established back in 1531 in Belgium. However, they did not trade in stocks, given that in the 1500s there was not any actual stocks to trade. Rather, they traded bonds and promissory notes.

Later on in the 1929, the stock market reached its peak around August, and then crashed due to different factors such as decline in production which led to a rise in the unemployment rate. All of this lead to the correction of the stocks which were overvalued due to the enormous number of traded shares in 1 day, which came up to 16 million shares. Then, the market collapsed which wiped out thousands of investors, and lead to the Great Depression of 1929, which is the most longest and brutal economic downturn which affected the entire western industrialized world. There was no reason why the 1929 recession should have taken longer, for the American economy was fundamentally sound. If the recession had been allowed to adjust itself, as it would have done by the end of 1930 on any earlier equivalence, confidence would have returned and the world crash need never have occurred. Instead, the stock market became an engine of doom, carrying to destruction the entire nation and, in its wake, the world.

This is why governments must closely monitor the movement of the stock market, and take action when necessary because the economic condition of a country could be endangered while at the same time not to interfere too much. When the stock market collapses, the economy collapses as well. This is mainly because the faith in the stock market is an indicator of the faith and health of the economy. For investors, the stock market has not always been equal to investing. But now, as we live in an open economy where

any and every investor has access to stock markets internationally, investors now cannot imagine a world without the stock market. These stocks and their movements are closely related to and affected by different economy indicators such as inflation, GDP, jobless rate, CPI, PPI, along with other indicators. Furthermore, the more the government deregulates the financial sector, the more sensitive a stock market becomes to different factors whether they be internal or external.

Today, many investors opt to invest in the stock market as well as gold, in order to minimize or eliminate the systematic risk. It is also considered as an insurance against risk to invest in gold as well, as in, using gold as a hedging tool (Bhunia, 2013). This is assuming that the investor is keeping an eye on the stock market and the gold, and observing the relationship between them so that the investor can generate profit while hedging the risk. The stock market plays a vital role in an economy for different reasons. Mainly, because it provides a continuous flow of money that helps in stimulating the economy, which promotes growth and capital formation. It also is the heartbeat of an economy, or a reflection of the conditions in the economy.

2.6. Frankfurt Stock Exchange (FSE)

The FSE, known as FSE or (FWB in German spelling), represent the 10th largest securities exchanges in the world in regards of market capitalization, and it also represents a very significant and efficient international trading centers in the world. It is considered to be the largest or main stock exchanges in Germany (regionally) as it generates more than 85% of Germany's turnover. The FSE contains over than 200 market participants from many different countries in the world other than Germany, and it is currently located in Frankfurt city within Bankenviertel in the Innenstadt district which is known as "The Central Business District." The FSE is operated by its owners.

2.7. History of FSE

The year 1585 was the birth year of FSE, in which the Frankfurt tradesmen or dealers agreed to establish a united or fixed exchange rate to facilitate trading and so the FSE was established. In the 16th century a lot of development occurred regarding trading, first the name "Burs," which means exchange, appeared as an official name for the merchants meeting or assembly for the first time ever and the then the meeting was moved to be held in a new building at "Liebfrauenberg." Then the first quotations sheet was printed and published for currency exchange rate purposes. The regular trading in FSE begins in Germany at the 18th century.

The FSE was affected hardly by the WWI, and as a result all the foreign stocks were eliminated from the "German quotation sheet." The post to WW1 damages were still influencing the financial market and, especially in Germany where the Nazi party was interfering heavily in the business and financial sectors, and the inflation rate was causing a lot of losses to the securities with monetary value. After the collapse of the WWI and especially the Nazi regime in Germany, the FSE was considered as an unofficial exchange for trading in 1945 and remained closed for around 6 months, but it was reopened again at the same year as the first stock exchanges in Germany under the protection of the US military government.

At the end of the 19th century, specifically in 1988, Germany introduced its leading index which is the HDAX index. This index is still one of the main indexes in FSE until today which represents the 100 best performing companies in Germany (The German HDAX index represents what does the American Dow Jones index [DJI] is).In 1997 Germany introduced a comprehensive electronic system for the cash market called "Xetra" in which it started a new era of stock exchange trading in Germany and still operates as a very successful electronic trading system.

During the 20th century a lot of improvements and developments appeared, like in 2003 the FSE market was divided into new three divisions: "Prime Standard, General Standard and Entry Standard. Also in this century there were 3 times attempts to merge the FSE with the London stock exchange in 2000 and 2005. The third and last attempt was in 2016 that failed and was blocked by the European Commission at the last preparation of the merging procedure as a result of Britain decision to leave the EU membership. Finally in 2017 the "Deutsche Börse" introduced a new "segment scale" that facilitates access to traders or investors and improves the growth of small and medium-sized enterprises (SMEs).

2.8. Xetra-the Current Electronic Trading System used by FSE

As mentioned above, the FSE uses the Xetra system, which is an international electronic trading system that has been successful since the beginning of its launch, as it was one of the first electronic trading systems on earth that currently involves over than 90% of the total stock trades in FSE in Germany.

Xetra is considered one of the most successful "leading electronic trading platforms" in the world, as it offers all types of electronic trading securities like: Stocks, warrants contracts, bond, and commodities for all foreigners' investors. Also the Xetra system is able to meet the requirements of cross border-trading that is continuously growing and changing. So overall, Xetra has made the trading process easy to access and flexible for all investors around the world. These effective features of Xetra encouraged or attracted foreign investors around the world to invest in Germany as Xetra system created an excellent trading framework for foreigners and other market participants. Thus, those worldwide investors (that were attracted by Xetra) were one of the most important keys that benefited Xetra system & FSE to be successful and known worldwide.

Xetra trading system runs various number of important indices, some of these indices are the DAX, which is equivalent to the DJI in America and to the FTSE 100 in London that contains the 30 best performing companies in the FSE. Other important indices under the Xetra are CDAX, MDAX, TecDAX, VDAX and Eurostoxx50. The HDAX Index (one of the research variable used in this study) is under the FSE and it's calculated by "Deutsche Börse" to comprise the DAX, MDAX, TecDAX indices all together in order to present the best 100 performing companies in FSE. This means that the HDAX Index is "covering all sectors and comprising the shares of the largest companies listed in the Prime Standard segment."

Xetra system has shown it strengths, abilities and what it is capable of in the competitive market, and that's why it was adapted by many different countries all around the world like: Ireland, China and Austria. So, it can be said that Xetra system was the main reason behind FSE success that contains a significant percentage of all trading securities in Europe. Now a day's FSE is considered to be one of the most focal and efficient stock exchanges in the world.

Another major shock that took place in the financial market besides the Wall Street Crash of 1929, which resulted in the Great Depression of 1929 is the Financial Crisis of 2008. Amadeo (2017) said that the Dow Jones Industrial Average crashed and fell by 777.68 points, by the end of September 2009, which was one of the largest nosedives in a single day; due to mainly some major factors such as the issues with securitization of loans, loosening of the lending standard, credit rating agencies inflating ratings, credit defaults, oil prices, and the burst of the housing bubble, which all lead to the bankruptcy of several major banks as well. One is these banks is the "Lehman Brothers" bank in New York, the breakdown Lehman Brothers, the chaosin the international financial markets began and the world felt the shock.

Many local and international banks in the United States went bankrupt and were either seized by the government, or bailed out some banks in order to help them survive the financial crisis. The National Bureau of Economic Research (2012) said that the United States suffered from the financial crisis and fell into deep recession. This was the most recent and most severe financial crisis, where the economy is yet to completely recover. The major security that contributed towards the financial crisis is the mortgage loan backed security.

Due to the loosening of the lending standard, people who have a high possibility of defaulting acquired adjusted rate mortgage loans, and the lenders who offered these loans sold shares for securities that were backed by these risky mortgage loans. These loans accumulated over a long period of time from 2002 to 2008 (Schelkle, 2012). By the time the loans defaulted and the houses were foreclosed, the prices of these houses suffered from a nose-dive and were not worth anywhere near the loan or securities. All involved parties got affected by the domino effect and a lot of investors went bankrupt.

Many of these investors were international investors, whether they be individual, a mutual fund or corporations had their investments become solvent. The financial crisis and economic crisis touched down on Europe given that Greece was weighing down the Euro area with a ton on debt from over spending for a decade. Some of the governments in Europe eitherheld or bailed out more than five weak banks. The chaos in the financial markets reached Germany at a terrifying speed. Not only investors, but ordinary people got affected.

Still, the German economy is considered to be comparatively invulnerable to the crisis, but only in individual markets such as environmental and engineering. This is because the demand for the products that are under these markets remained still. Even though Germany was sure that they could sell their products to China, India and Russia if the demand for their products fell in other countries such as the United States, or other European countries. Unfortunately, the German economy learned the hard way that during a difficult emergency time in the Euro area and the world since 2008-2009, a country with deficit or even surplus, the situation will get more difficult with a prolonged trade deficit of the trading country.

The FSE and the HDAX reacted to the international financial crisis in a similar manner as to the DJI in the United States and the Nikkei-225 in Japan, the HDAX by >10% and continued to fall. This was one of the sharpest fall in the past 5–10 years.

2.9. Gold Price Versus the Stock Market

The gold witnessed an active movement of buy orders to fill the reserves of central banks within the last 10 years especially in countries like China, India, Philippines and Russia (Bilal et al., 2013); as said before, gold continued to be used as an investment tool especially in the early 2009 (Narang and Singh 2013) even after the end of the Britton wood system as maintained its position and continued to rise regardless of the circumstances of the economies throughout the history (Mukhuti and Bhunia 2017).

Those features of gold are not the same of the stock market; for example gold is perceived as a commodity that was able to maintain its value and even rise even when faced by different circumstances (Mukhuti and Bhunia, 2017); therefore we can notice that gold is considered as a store of value while the stock market is not, as its seen as a return of value instead (Shahzadi, 2016). Based on the former we can easily understand why investors think that gold is considered safer than the stock market which is considered as a risky investment. These risk characteristics of the two variables gold and stock market lead the investor's behavior when investing in them as it's easy to notice that everyone buys and keeps gold while few enter the stock market and take the decision to own stocks.

This favor to gold by investors according to some studies didn't come from nowhere as when observing the movement an inverse relationship can be seen to exist between the two (Abdul Basit, 2013). This inverse relationship can be explained in two different ways; the first is due to the investors behavior as whenever the stock market crashes (or vice versa, saying gold), investors directly panic and most of them won't wait till the stock market (or gold) restores its health, they just withdraw their investments from the stock market (or gold) and start searching for a safe haven or a place with a rising profit to keep them in which is represented usually by the other alternative whether its gold or stock market.

The other reason that may justify the current general negative relationship between the two is their reaction to the other economic variables as their reaction tend to be different and in fact opposite to each other. To further explain, gold just tend to respond in adaptable way to the factors that tend to send shocks to the stock market causing its crash; therefore, keeping it safe and sound at the times where stock market is crashing and vice versa.

An example for some economic factors or conditions that gold showed a success in overcoming them and adapting to them

while stock market received a shock because of them will be the increase of inflation rates, as whenever it increases gold increases too resulting in it being a hedge against it (Bhunia, 2013), while the stock market suffers because of it. Other examples will be credit crisis, debt, commodity shocks, currency price shocks and exchange rates (whenever USD ER fall the gold goes up and stocks get negatively affected) and bank collages.

Therefore, it can be seen that gold may tend to have some kind of a relationship with the stock market that may be affected in its nature by different economic variables, time period and country where this relationship will be studied. Thus, the researchers opted to view the different literatures – although rarely found - that study or mention this relationship in as many different countries to finally decide the country to conduct the research on, as this research will help add a great amount of knowledge as it will help in reaching a better understanding of two of the most important assets in the world gold and stocks.

3. CRITICAL LITERATURE REVIEW

Different countries cases of the relationship between gold and stock market were viewed totaling 26 papers; ten studies conducted by researchers from India, five studies from the USA and eight studies conducted in different countries around the world, while only one study conducted in Europe.

Different results were stated regarding the long term relationship (co-integration) between gold, other variables and stock market as most researchers specifically eight stated that there is a long term relationship between gold, other variables and stock market such as (Bhunia and Mukhuti, 2013), (Hemavathy and Gurusamy, 2016) In India (Zhang and Wei, 2010) In the USA and (Wang et al., 2010) in international scope, while six authors agreed that there is no long term relationship between the variables such as (Narang and Singh, 2013) in India, (Sujit and Kumar, 2011) in USA and (Shahzadi and Chohan, 2013) in Pakistan.

When it comes to causality relationship between gold, other variables and stock market, five researchers found that there is no causality relationship between the variables such as (Bilal et al., 2013) in India and (Wanat et al., 2015) in Europe. While four researchers found no causality or bidirectional relationship exists between the tested variables such as (Sujit and Kumar, 2011) in USA. Two studies showed a unidirectional causality between the variables and one study found a unidirectional and bidirectional relationship which is (Bampinas and Panagiotidis, 2015) in USA and UK. Finally another four studies found that there is a causality relationship between the variables such as (Ben and Arfaoui, 2016).

In terms of the correlation between gold, other variables and stock market, there were two studies stated that there is a sort of correlation between the variables like (Bhunia and Mukhuti, 2013) in India and other four studies found a positive and negative correlation between the variables considering different time span, conditions and different variables like (Mollick and Assefa, 2013) and (Toraman et al., 2011) in USA.

4. GAP OF KNOWLEDGE

Based on the former literature it can be noticed that there is a gap of knowledge in this topic as this relationship was not studied thoroughly as it either lacks conducting sufficient tests in the same paper or being included as a secondary relationship along with other variables. It was noticed also that European zone lacks such studies that consider the relationship between gold and stock market as only one study was found, this study also included other variables, did not conduct enough tests and didn't focus on a certain country. Therefore, the researchers opted to fill this gap of knowledge by choosing Germany specifically FSE to be the case of their study as it's ranked as the 4th gold consumer and has a strong stock market as FSE is ranked as the 10th worldwide.

This paper studies the relationship of gold prices with the FSE. It is known that gold and stocks are two significant factors that have a huge impact on the financial markets that has a very crucial role in the world by influencing the country's whole market, and help in measuring the health of the economy including the GDP and other factors that could easily affect the economy and so the whole world. Stocks are very risky and unstable securities and in order to explore any possible factors that could make a decent change in them at any possible way a proper analysis and studies have to be conducted. Stocks are affected by enormous of known and unknown variables like oil, inflation, interest rate, GDP... etc., that must be carefully studied and examined in order to find out the possible reasons behind the stocks' long term and short term movements. Also, one of the possible variables that has a very strong position and plays a big role in the economy is the (yellow metal) gold. Gold is considered as one of the safe haven investments in the world that people buy for hedging purposes, and it is seen as an irreplaceable element due to its unique kind (Bilal et al., 2013). The problem here is that no one really knows the truth about the connection or relationship between these dominant factors (gold and stocks) and, if any, how to use this relationship in a positive way that could improve the world. Because it has been noticed that there is a lack of studies available in the research field regarding the relationship between stocks and gold specifically and there is no study found that can clarify the relationship between the two variables. So, conducting such new emerging kind of study that examines and focuses on the relationship of two of the most important variables (gold) and its effect on stock market will contribute massively to the gap of knowledge.

4.1. Aim of the Study
To examine and understand the relationship between gold and stock market represented by FSE that is represented by the HDAX Index.

4.2. Research Objectives
• To understand the relationship between the two main variables in this research, the HDAX Index as a representative of the FSE and gold prices.
• To examine whether a relationship of long term nature exists between the two main variables of the study the HDAX Index and gold over the period of 12 years divided into 3 time frames: Per, post and during the financial crisis.

- To examine whether a casual or a casual and effect relationship exists between the HDAX Index and gold over the period of 12 years divided into 3 time frames: Per, post and during the financial crisis.

4.3. Research Questions

1. Is there a long run equilibrium between gold price and HDAX Index?
2. Is there a casual relationship between the two variables?
3. Does correlation exists between gold prices and HDAX?
4. How does co-integration, causality and correlation between gold prices and HDAX if any react to pre, during and post financial crisis?

4.4. Research Hypothesis

4.4.1. Hypothesis 1
H_0: There is no long term equilibrium between the gold prices and FSE

H_1: There is long term equilibrium between the gold price and FSE.

4.4.2. Hypothesis 2
H_0: There is no causal relationship between the gold prices and FSE

H_1: There is a causal relationship between the gold prices and FSE.

4.4.3. Hypothesis 3
H_0: The relationship between the price of gold and FSE was not affected pre, during and after financial crisis.

H_1: The relationship between the price of gold and FSE was affected pre, during and after financial crisis.

5. METHODOLOGY AND DATA

5.1. Sources of Data
The study used secondary data of gold price and HDAX Index which were obtained from Bloomberg which depends on credible sources.

5.2. Research Design
This study is an empirical study where the data measured is downloaded into the weekly prices of the HDAX index and the gold, and then compressed into monthly data. It was retrieved from Bloomberg in USD. The reason behind choosing 12 years that cover the periods of the pre, during and post the financial crisis is that it enables the researchers to study the effect on different periods, and observe the changes in this relationship.

Next, the data was divided into three periods pre, during and post the financial crisis. This is done in order to be able to identify and analyze the relationship between the prices of gold and stock. The data for the period before the financial crisis begins from the 6th of August 2004, up to the 28th of December 2007. As for the data for the period during the financial crisis, it starts from 4th of January 2008, up to the 30th of December 2011. Lastly, the data for the period after the financial crisis begins from the 6th of January 2012, up to the 30th of September, 2016. Eviews 9 has been used in order to analyze the data. Tests such as Descriptive Statistics, Augmented Dickey Fuller (ADF), Pearson's Correlation, Johansen's Co-integration and Pairwise Granger Causality Test.

6. EMPIRICAL RESULTS AND DISCUSSION

In this part the study presents the results of the empirical tests conducted along with their interpretations are presented.

6.1. Descriptive Statistics
The Descriptive statistics test is an analytical test that provides a general view of the data. It evaluates the different time series under testing by using the mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque-Bera and probability. The results of this test show that the data is not distributed normally. This is because the mean and standard deviation of the HDAX index is found to be higher than that of the gold. The skewness of the entire period of 12 years is below zero for both the HDAX index and the gold, which means that the entire series are skew in a negative direction. While the gold has a positive skewness curve as the result is above zero for all the periods. As for the skewness of the HDAX index, it shows a positive skewness for the periods before and during the financial crisis. But as for the period after the financial crisis, it has a negative skewness. Lastly, the kurtosis of both the gold and HDAX is in Table 3, which means that the series for both of the variables are oblate.

6.2. Granger Causality Test
This test examines whether there is a cause and effect relationship between the two variables (HDAX Index &Gold) by proving that they share a common long run trend. The hypotheses are as follows:
(H_0): There is no cause and effect (Granger causality) between the two variables:

If the (probability) $P > 5\%$, then the null hypothesis (H_0) is accepted.
(H_1): There is a cause and effect (Granger causality) between the two variables

If the (probability) $P < 5\%$, then null hypothesis (H_0) is rejected.

Since the probabilities of all different periods are more the 5% then there is no Granger causality between the two variables.

6.3. Pearson's Correlation Test
Pearson's Correlation test was conducted to help understand if there is a positive, zero or a negative relationship and correlation between the variables HDAX index and gold. The hypotheses therefore are:
- (H_0) There is no correlation If the result is $= 0$
- (H_0) There is correlation If the result $\neq 0$.

The results of the test could range from $+1, 0$ to -1. These numbers could indicate that that there is perfectly positive correlation where the variables are moving in the same direction if the result showed $+1$, no correlation as in no relationship if the result was (0), or a perfectly negative correlation where the variables are moving in opposite directions respectively (-1).

The results in Table 4 showed a great change; this change in correlation when interpreted means a lot. The 0.938 very strong positive correlation pre to the financial crisis shows that in that

Table 3: HDAX index unit root test

Augmented Dickey-Fuller test statistic						
Results of HDAX index unit root test-at level						
Particulars	Test statistics	1% critical value	5% critical value	10% critical value	P	Interpretation
Intercept	−1.926	−3.476	−2.882	−2.578	0.320	Not stationary
Intercept and trend	−2.620	−4.023	−3.441	−3.145	0.272	Not stationary
None	−0.447	−2.581	−1.943	−1.615	0.810	Not stationary
Final results: Data must be moved to first difference.						
Results of HDAX index unit root test at 1st difference						
Intercept	−9.279	−3.476	−2.882	−2.578	0.000	Stationary
Intercept and trend	−9.256	−4.023	−3.441	−3.145	0.000	Stationary
None	−9.232	−2.581	−1.943	−1.615	0.000	Stationary

time the stock market can be seen as a safe place as its correlation shows that it can replace gold in a portfolio in that time as they move in the same direction. When the financial crisis happened, the correlation drops to 0.253 (a weak, low positive correlation (not very significant)) reflected the uncertainty in the market during the crisis as some people withdraw their money from stock market that crashed while others stayed. The current situation shows the loss in trust in the stock market as a result to the crisis as it is no longer considered a safe investment equivalent to gold as its correlation flipped to a −0.807 (a strong, high negative correlation). In general, the whole period of 12 years scored a positive correlation at 0.482 (a moderate positive correlation).

6.4. Unit Root - Augmented Dicky Fuller Test

The ADF test is necessary to assure that the tested time series data are stationary and so ready to be used in other tests, as the non-stationary data are not able to provide an adequate result. The time series data are required to be stationary especially for the Johanson's correlation test. The hypotheses are as follows:

(H_0): The time series data have a unit root (non-stationary):

If the (probability) P > 5%, accept the null hypothesis (H_0).
(H_1): The time series data do not have a unit root (stationary):

If the (probability) P < 5%, then rejects null hypothesis (H_0).

The Table 5 illustrate that the time series data of the two research variables (HDAX Index and Gold) were non-stationary at level. Because, the test statistics values at the three particulars are more than the critical values at the 1%, 5% and 10%. And the probability 0.3199 is <0.05, which accepts the null. Therefore, the data were moved to be tested at the first difference and the results showed that the data are stationary at the first difference, as the test statistics values at the three particulars are more than the critical values at the 1%, 5% and at the 10% significance levels. And the probability 0.3199 is <0.05, which rejects the null hypothesis.

6.5. Johnson's Co-integration Test

This test has two types: Trace and Eigenvalue, both has the same hypothesis:
(H_0): There is no co-integration between the variables

If the (probability) P > 5%, then the null hypothesis (H_0) is accepted and (H_1) rejected.

Table 4: Correlation matrix

Part A: Correlation test 12 years		
Description	HDAX Index	Gold
HDAX Index	1.000	0.482
Gold	0.482	1.000
Result: Moderate positive correlation		
Part B: Correlation test pre-financial crisis		
HDAX index	1.000	0.938
Gold	0.938	1.000
Result: Very strong positive correlation		
Part C: Correlation test during the financial crisis		
HDAX index	1.000	0.253
Gold	0.253	1.000
Result: Weak, low positive correlation not very significant		
Part D: Correlation test post financial crisis		
HDAX index	1.000	−0.807
Gold	−0.807	1.000
Result: Strong, high negative correlation		

(H_1): There is co-integration between the variables

If the (probability) P < 5%, then the alternative hypothesis (H_1) is accepted and (H_0) rejected.

Whenever a co-integration exists it means that a long run relationship and equilibrium exist between the variables.

The two tests were applied (Tables 6-10 and the summary in Table 11) on the whole period and three sub periods of pre, during and post financial crisis. The results of the two tests were similar and were also consistent in the 4 periods of whole, pre, during and post as the probability ranged for the trace test from 0.000 to 0.002, while it ranged from 0.000 to 0.004 for the Maximum Eigenvalue test. This P value means that the (H_0) is rejected and (H_1) is accepted therefore it can be concluded that a co-integration exists in all the 4 periods, thus, a long run relationship and equilibrium was found between the two variables gold and HDAX Index in all the 4 periods as co-integration means long run relationship and equilibrium.

The results can then be interpreted as that when the results showed a great consistency during the whole period and the 3 sub periods, it indicates that the relationship between the two variables is strong, stable and not a coincidence; it didn't occur as a result of a sudden event that drove a instantaneous relationship. However, when indicating stability of the relationship it refers to its pure existence and not its nature as when relating to the

formerly explained correlation test we can see that the nature of the relationship changed from very and highly positive one before the crisis to a low positive during it to a tremendous change as it flipped to a strong negative. This consistent stable existence and changing nature when combined with the result of Granger Causality test of no existence cause and effect between the two variables indicates that the two variables movements are related to each other and this related movement is not a result of them causing each other; this therefore means that there are other endogenous variables that affect the two variables HDAX Index and gold in the same time causing them to have a long run relationship and a correlated movements.

6.6. Hypothesis Testing
Tables 12-14 show the results of hypotheses based on Granger Causality and Johansen's Co-Integration tests.

6.6.1. Hypothesis 1
As all the results of Johansen's co-integration test with its two types Trace and Max Eigenvalue in the 4 periods proved the existence of a co-integration between the two variables gold and HDAX Index which means a long run relationship and equilibrium; it can be said that the (H_0) is rejected and (H_1) is accepted.

Table 5: Gold unit root test

Augmented Dickey-Fuller test statistic						
Results of gold index unit root test-at level						
Particulars	Test statistics	1% critical value	5% critical value	10% critical value	P	Interpretation
Intercept	−1.597	−3.476	−2.881	−2.577	0.482	Not stationary
Intercept and trend	−0.875	−4.023	−3.441	−3.145	0.955	Not stationary
None	0.740	−2.581	−1.943	−1.615	0.873	Not stationary
Final results: Data must be moved to first difference						
Results of gold unit root test at 1st difference						
Intercept	−9.838	−3.476	−2.882	−2.578	0.000	Stationary
Intercept and trend	−9.915	−4.023	−3.441	−3.145	0.000	Stationary
None	−9.915	−4.023	−3.441	−3.145	0.000	Stationary

Table 6: Johansen's co-integration maximum Eigen value - 12 years

Unrestricted co-integration rank test (maximum eigenvalue)					
Hypothesized No. of CE (s)	Eigen value	Trace	Critical value at 5%	P**	Probability interpretation
None*	0.139	20.952	14.265	0.004	The P (0.004) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.
At most 1*	0.096	14.099	3.841	0.000	The P (0.000) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.

Max-eigenvalue test indicates 2 co-integrating eqn (s) at the 0.05 level
*Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P
Result: There is a long run relationship between the two variables gold and HDAX Index

Table 7: Johansen's co-integration trace test-pre-financial crisis period

Unrestricted co-integration rank test (trace)					
Hypothesized	No. of CE (s)	Eigen value	Trace	P**	Probability interpretation
None*	0.429	36.087	15.495	0.000	The P (0.000) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.
At most 1*	0.322	14.794	3.841	0.000	The P (0.000) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.

Trace test indicates 2 co-integrating eqn (s) at the 0.05 level
*Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P
Result: There is a long run relationship between the two variables gold and HDAX Index

6.6.2. Hypothesis 2

As all the results of Granger Causality test in the 7 periods proved that there is no cause and effect between the two variables gold and HDAX Index; it can be said that the (H_0) is accepted and (H_1) is rejected.

6.6.3. Hypothesis 3

When it comes to the Granger Causality it can be seen that the results were stable during the 4 periods that is there is no causality; therefore, it can be said that the (H_0) is accepted and (H_1) is rejected. This means that the causality didn't get affected by the financial crisis.

Table 8: Johansen's co-integration eigenvalue test - pre-financial crisis period

Unrestricted Co-integration rank test (maximum eigenvalue)					
Hypothesized	No. of CE (s)	Eigen value	Trace	P**	Probability interpretation
None*	0.429	21.292	14.265	0.003	The P (0.003) is <5% (0.05), therefore reject H0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.
At most 1*	0.322	14.794	3.841	0.000	The P (0.000) is <5% (0.05), therefore reject H0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.

Max-eigenvalue test indicates 2 co-integrating eqn (s) at the 0.05 level
*Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P

Table 9: Johansen's co-integration trace test-during financial crisis period

Unrestricted cointegration rank test (trace)					
Hypothesized	No. of CE (s)	Eigen value	Trace	P**	Probability Interpretation
None*	0.460	38.447	15.495	0.000	The P (0.000) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.
At most 1*	0.197	10.098	3.841	0.002	The P (0.002) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.

Trace test indicates 2 co-integrating eqn (s) at the 0.05 level
*Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P
Result: There is a long run relationship between the two variables gold and HDAX Index

Table 10: Johansen's co-integration trace test - post financial crisis period

Unrestricted co-integration rank test (trace)					
Hypothesized	No. of CE (s)	Eigen value	Trace	P**	Probability interpretation
None*	0.366	47.003	15.495	0.000	The P (0.000) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.
At most 1*	0.329	21.948	3.841	0.000	The P (0.000) is <5% (0.05), therefore reject H_0 that states that there is no co-integration between the variables which means there is a long run relationship between the variables gold and HDAX Index.

Trace test indicates 2 co-integrating eqn (s) at the 0.05 level
*Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P
Result: There is a long run relationship between the two variables gold and HDAX Index

When it comes to the Pearson's Correlation, it can be seen that the results weren't stable as the correlation changed dramatically during the 4 periods; therefore it can be said that (H_0) is rejected and (H_1) is accepted. Meaning that Correlation relationship got affected by the financial crisis.

When it comes to Johansen Co-integration it can be seen that the results of both of its types were stable during the 4 periods that is there is co-integration, thus long run relationship and equilibrium. Therefore, it can be said that the (H_0) is accepted and (H_1) is rejected. This means that the long run relationship didn't get affected by the financial crisis.

7. CONCLUSION AND POLICY IMPLICATIONS

The research findings showed that there could be a relationship between the two variables HDAX Index and Gold, as there was a long run relationship (Co-integration) between the variables during the four different periods (he whole period, pre, during and post financial crisis). Besides that, there is a correlation between the variables whether it be negative or positive. This correlation however, was extremely affected by the financial crisis as the time series pre to the financial crisis had a very strong positive

Table 11: Johansen's co-integration test summary

Period	Test	Results
All data (12 years)	Trace test	Result: There is a long run relationship between the two variables gold and HDAX Index (1)
	Maximum Eigenvalue test	Result: There is a long run relationship between the two variables gold and HDAX Index (2)
Pre-financial crisis	Trace test	Result: There is a long run relationship between the two variables gold and HDAX Index (3)
	Maximum eigenvalue test	Result: There is a long run relationship between the two variables gold and HDAX Index (4)
During financial crisis	Trace test	Result: There is a long run relationship between the two variables gold and HDAX Index (5)
	Maximum Eigenvalue test	Result: There is a long run relationship between the two variables gold and HDAX Index (6)
Post financial crisis	Trace test	Result: There is a long run relationship between the two variables gold and HDAX Index (7)
	Maximum Eigenvalue test	Result: There is a long run relationship between the two variables gold and HDAX Index (8)

Final Result: There is a long run relationship between the two variables gold and HDAX Index.

Table 12: Granger causality test

Granger causality test								
Null hypothesis	Tests applied on different periods							
	Whole period-data		Pre financial crisis		During financial crisis		Post financial crisis	
	F-statistics	P	F-statistics	P	F-statistics	P	F-statistics	P
HDAX Index to Gold	1.024	0.362	1.425	0.255	2.696	0.077	2.590	0.087
Gold to HDAX Index	0.351	0.705	0.388	0.682	1.116	0.336	0.353	0.704
Final results: No Granger causality between HDAX Index and Gold during the different periods.								

Table 13: Johansen's co-integration maximum eigen value

Johansen's Co-integration maximum Eigen value					
Unrestricted co-integration rank test (maximum Eigen value)					
Description	Eigen value	Trace	Critical value	P	Interpretations
Whole period					
None	0.139	20.952	14.26460	0.0038	There is a long run relationship
At most one	0.096	14.010	3.841466	0.0002	
Pre-financial crisis					
None	0.429	21.292	14.26460	0.0033	There is a long run relationship
At most one	0.322	14.794	3.841466	0.0001	
During financial crisis					
None	0.460	28.349	14.26460	0.0002	There is a long run relationship
At most one	0.197	10.098	3.841466	0.0015	
Post financial crisis					
None	0.366	25.055	14.26460	0.0007	There is a long run relationship
At most one	0.329	21.948	3.841466	0.0000	

Table 14: Johansen's Co-Integration trace test

Johansen's Co-integration trace test				
Unrestricted co-integration rank test (trace)				
Description	Eigen value	Trace	P	Interpretations
Whole period				
None	35.051	15.495	0.000	There is a long run relationship
At most one	14.010	3.842	0.002	
Pre-financial crisis				
None	36.087	15.495	0.000	There is a long run relationship
At most one	14.794	3.842	0.001	
During financial crisis				
None	38.447	15.495	0.000	There is a long run relationship
At most one	10.098	3.842	0.002	
Post financial crisis				
None	47.003	15.495	0.000	There is a long run relationship

correlation which means that HDAX Index and Gold movements are alike.

While during the financial crisis, the positive correlation became weak and low which was not significant, until finally, post financial crisis, the positive correlation that occur before the financial crisis between HDAX Index and Gold became the opposite which is a strong, high negative correlation. Thus, we can conclude that the financial crisis did affect the correlation between the two variables but they maintained their co-integration or long run relationship through the market shock, the financial crisis.

Another important result of this study are the Granger causality test findings. The results showed that HDAX Index is not a reason that affects Gold and also Gold is not a reason that affects HDAX Index. Therefore, it can be said that HDAX Index and Gold do have a link that can be addressed or considered in order to get the most benefit out of it.

7.1. Policy Implications

Some of the research's recommendations are demonstrated below:
- Investors are recommended to take this study's findings into consideration when making their choice as to whether to invest in gold or stocks.
- For risk averse investors who want to reduce the systematic risk in their portfolio, they can diversify the portfolio by investing in both gold and stocks.
- As for a risk seeker type of investor, they are recommended to choose whether to invest in gold or stock and not a combination of the two. This is because the gold and stock move in an opposite direction, as in, when the gold increases, the stock prices fall. This has been proven by the Pearson Correlation test.
- Investors, who want to hedge themselves from the fluctuations of the stock market, must invest a portion of their total investment in gold. This is so that the investor will be protected against the uncertainty of the stock market, as the stock market is not considered as a safe place for investment anymore.
- Although there is a long term relationship and there is a correlation between the gold and HDAX index, the gold doesn't affect the HDAX index and the HDAX index doesn't affect the gold as well. There must be other variables that affect

both at the same time, which needs to be studied therefore investors and other people reading this research need to keep that in mind when thinking about investing in gold and stock market.
- The findings of this research should aid in constructing portfolio strategies for investors and others who are active in both, the commodity market and the financial market.

7.2. Suggestions for Further Studies
- One main direction to take into consideration may be to conduct explanatory studies as this study is an exploratory in nature. This can be done on "why" gold and HDAX Index do not affect each other although they have a long run relationship, or the endogenous variables that affect the two variables together causing them to have a long run relationship.
- Another direction may be to study different time periods, such as historical data prices.
- An alternative suggestion in another part of the world, besides the Euro zone where no such studies were conducted to help creating a larger picture of the relationship between those variables and fill the gap of knowledge such as Asian, African or Scandinavian countries.
- Another alternative direction can also be to conduct a study in order to examine the relationship between different stock exchanges in different regions, including the short and long term relationship.

All of the above suggestions could also include studying the macroeconomic variables and the microeconomic variables and factor and their connection and effect on the relationship between gold price and stock market together; such as the macroeconomic variables like the inflation, jobless rate, non-farm payrolls rate, exchange rate, and other factors.

8. ACKNOWLEDGMENT

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