Intermarket Analysis: Oil, Gold, US Dollar and Stock Market

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Abstract

The interdependence among the prices of oil, gold, the US dollar and stock market prices is of fundamental importance for any investment decision. This paper studies the bilateral relationships between these asset classes in order to identify direct and indirect relationships, positive and negative interactions by using regression analysis, and then tries to demonstrate if a simultaneous relationship exists between the four asset classes via the empirical methodology: the simultaneous equation approach. The international data used to do a regression analysis to identify the bilateral relationships between assets is from November 2011 to October 2021 on a monthly basis. The study relies on many theoretical findings to identify the negative or positive linkage. The main goal of quantifying these relationships, is to check if they are helpful in predicting and timing the next phase of the economic cycle. The findings reveal strong cross-market interactions. An inverse relationship between oil prices and stock prices was discovered, whereas gold and the USD had a large and positive impact on oil prices. Oil, USD, and stock market developments have an impact on the gold rate. The stock market, as well as the price of gold and oil, have a considerable negative impact on the US dollar. Therefore, after studying the relationships between those assets, the results will be helpful in predicting the economic cycle.

Keywords: Regression analysis, Oil price, Gold price stock market, Currency, Simultaneous equations

1. Introduction

Intermarket relationships have always existed; many events in the past have proven it. Analyst knew about its existence but didn't give it the proper attention. Stock traders didn't care about commodities; bond traders didn't pay attention to the stock market. Nowadays, analyzing the markets has changed, and applying intermarket analysis is a fundamental necessity. By definition, intermarket analysis is considered a branch of technical analysis. It studies the correlation between different asset classes in order to try to provide some information about the future direction of the economic cycle and the direction of different markets (De Castro Aguado, 2017).

The correlation between different markets is not static. Nonetheless, analysts study these fluctuations, trying to find the reason behind them. For example, when an investor is interested in buying gold, he will analyze its chart and the general macro-economic situation (Xiaojouan et al., 2021). However, it is also essential that he has a look at other asset classes that can affect its price, which will probably help him make a better decision. Analyzing a stock price without taking into consideration, for example, the dollar movement or the bond movement is an incomplete analysis.

The four main asset classes used in intermarket analysis are: stocks, commodities, currencies, and oil. The concept of intermarket analysis is both very obvious and very important. Investors should know how to analyze the behavior of the market since it is full of important information. The perception of the market has changed over time when analysis starts to realize the importance of it. The benefit of
The interdependence among the oil price, gold price, USD dollar and stock market prices puts forward fundamental importance for any investment decision. The motivation of the study will not only rely on the simultaneous equation approach between the four variables; however, it will find out the correlations between the components oil price, gold price, US dollar and stock market prices, and study the price movements in order to forecast the phase of the economic cycle. The unusual events make investors question their overview of the market and trigger an interest in the phase of the economic cycle. After doing the analysis, investors will be able to forecast the economic cycle from the change in the price of an asset.

Researchers discovered the significance of intermarket while doing studies on the movements between two assets by visualizing the charts. Many events during the years turned the theoretical study of many research into a reality. The purpose of this study is to emphasize the importance of intermarket analysis. It will highlight the direct and indirect, positive and negative relationships between different assets from a global perspective. It is important to understand the percentage of linkage that exist between markets and at what level the relationship is reliable. Starting by a statistical modeling, regression analysis, to study the relationship that exists between each two, then move to the simultaneous equation to identify the correlation between multiple assets that proves that one movement of one asset can have an impact on multiple assets at the same time.

Two statistical methods are used: regression analysis and intermarket analysis. The market will be analyzed by studying the correlation between the different variables based on a simultaneous equations system. What happens in one market could affect the other markets. Regression analysis and intermarket analysis are two reliable methods for identifying the impact of the gold price, oil price, US dollar, and stock market on each other; studying this relationship will benefit investors by providing an overview of the stage of the economy, as well as the Federal Reserve by allowing it to set monetary policy.

The structure of the article is organized as follows. This part begins by introducing the concept of intermarket analysis and then provides a general background of the study. At the end, a small summary of the flow of information is discussed as follow. The second part represents a literature review and theories. It is a review of important articles and books related to this study and the opinion of important authors, existing gaps are justified, many researches are taken into consideration. It will develop the research, studies, and articles related to intermarket analysis and which have proven the importance of intermarket analysis. Many investors and authors over the years have studied and proved the relationships that exist between assets. Doing a small review of these studies will be beneficial for the problem statement in this study. The third part elaborates on the conceptual model and develops the hypothesis. Moving to the next part, which is titled “research methodology” it starts by drafting a general approach to the philosophy of research questions and then moves to the techniques used to collect data. Then classify the dependent and independent variables and analyze the collected data. In this chapter, two statistical methods are used and developed: the regression analysis, to be able to prove the relationship that exist and the simultaneous equation, an equation that demonstrate a multiple relationship among the four markets at the same time. Quantitative approach to data collection and treatment is used. Part five covers the results obtained from the data and the study analyzed. It interpreted the results and compare them to the stated hypothesis. In this chapter, the validity of the study is confirmed through the data collected and tested. The final section concludes the study, discusses some limitations faced during the study, and provides an overview of further research and perspectives.

2. Literature review

Jhon J. Murphy, considered the father of intermarket technical analysis, published his first book, ‘Technical Analysis of the Futures Markets’, John Wiley & Sons INC, 1986, a very important book for technical analysts. Another book written by Jhon Murphy for technical analysts, “Technical Analysis: Trading Strategies for the Global Stock, Bond, Commodity, and Currency Markets” (John Wiley & Sons Inc. 1990) focus on the importance of intermarket analysis. The book “Intermarket Technical Analysis Trading Strategies for the Global, Stock, Bond, Commodity and Currency Markets” (John Wiley & Sons Inc. 1991) emphasis more the relationship between assets. Jhon J. Murphy study the four markets sectors by using a lots of visual aids like charts. The purpose of the book is to use technical tools to demonstrate the relationship between assets. However, the most important empirical studies done on intermarket analysis was the book
of Jhon J. Murphy “Intermarket Analysis, Profiting from Global Market Relationships” (John Wiley & Sons Inc. 2004) through which he begins by reviewing some important years in the 1980s and 1990s. Since history repeats itself, even for intermarket analysis, it is important to look at the previous years. All the way through his research, Jhon J. Murphy, came up with very important points: First, Jhon J. Murphy developed important relationships about the four markets. Second, according to him, technical analysis needs to emphasize their studies while doing chart analysis to be able to take into consideration other market movements. Third, intermarket analysis is defined as a revolution for technical theories. Technical analysis is the most suitable for intermarket analysis because it allows traders to move easily from one market to another and compare charts more easily (Scott et al, 2016). Fourth, the federal Reserve began to do market studies to have a better view of the future movement of the economy. Fifth, charts are important tools for intermarket analysis, Jhon J. Murphy considers them the most efficient method for analysis. Fundamental forecasting must include charts. During the years, many events have proven the importance of using charts, Wall Street analysis start to take into consideration the study of charts since it is very dangerous to neglect them. Sixth, every four years, the business cycle experiences an expansion followed by a recession. The recession, in its turn, became an expansion. This expansion and contraction give investors an overview of the economic which will help them while studying the linkages that exist between assets (Baker et al, 2020).

The year 1987 is considered the most important year for the development of intermarket analysis. This year should be taken as an example. Looking at the high volatility and the interactions of the assets between each other, investors realize the importance of intermarket analysis. The crash that happened in the second half of 1987 was a very good example for investors. Only the one who observed and studied the three other markets at the beginning of the year was able to forecast the movement of stock prices. When the stock market decreased, people started pointing fingers. Intermarket played an important role since it is the real explanation for that crash (Cave, 2020; Khalife et al, 2022).

As a summary of what happened, the stock market crashed during the 2nd half of 1987. The movement of stock prices had been noticed before it happened by the investors who monitored the other three financial markets. The bond prices keep increasing and commodity prices keep decreasing from year 1982 till year 1986. Fears of inflation, the CRB index of commodity prices begin to increase till it reaches the highest level of this year; however, the bond prices at that time begin to decrease. These signs give an early warning for what going to happen during the 2nd half of the year. In October 1987, bonds yield begins to increase above 10% and suddenly crash down. Since bonds are considered a leading indicator for stock market, the October stock market crash directly. The dollar also played an important role, early this year it starts to decrease until May 1987 where it started to increase till the end of August. In October it falls exactly like the bond yield and the stock market. During this year, the whole world was affected by this crash. Global markets fell together, the four sectors move together, the importance of intermarket analysis appeared. At that time, the diversification of global markets become a very important technic for investors.

Intermarket analysis makes an important appearance in 1990, during the first Persian Gulf war. Despite the Middle East crisis, the relationship that existed between different markets was very obvious. Treasury bond prices had been rising two years until the year 1990, where it starts to decrease from January till October. Commodity prices, on the other hand, start to increase at the beginning of the year and had affect the price of the dollar which it starts to decrease. As a result, from the Middle East invasion: Oil and gold prices increased; stock market, in comparison, start to decrease and oil prices affected the interest rate which also jumped during this year. These movements in prices have affected the economic which ended by a recession immediately after the invasion. Most important notes learned for year 1990 is that commodities and bond prices move in contrary directions; when dollar prices decrease, the price of the commodities increases; gold prices move in the opposite direction of the stocks; same for oil prices, which the prices move in opposite direction of the stock’s prices; a relationship exists between all the global market and the increase of oil prices was a warning of an upcoming recession.

Exchange rates are affected by oil prices (Bashir, 2022; Golub, 1983). Golub (1983) developed the reason for this effect between the two. The increase or decrease in the price of oil will have an impact on dollar movement since oil prices is denominated in US dollar. Paul Krugman analyses the relationship that exist between oil exporters, exchange rates and portfolio investment. As a summary, rising oil prices will lead to an increase in the country’s portfolio investment and a fall in the exchange rate. Other recent papers have also discussed this effect and
studied the relationship that exist between oil prices and U.S. trade balance (De Schryder & Peersman, 2015; Lawrence, 2022; Bodenstein et al., 2007). The VAR model’s is used to conclude that the decrease in interest rates will affect positively the commodities prices and that the decrease in dollar prices lead to a higher commodity price (Akram, 2009). Much research has developed on the bilateral relationship between exchange rates and oil prices (Sadorsky et al., 2010). Many studies have confirmed the relationship between stocks and oil prices. For example, oil price risk has a strong positive impact on stock price returns (Basher & Sadorsky, 2006). VECM is used to be able to analyze, in the long run, the relationships between crude stock markets and oil prices; however, after the year 1999, a negative long-term relationship appears (Miller & Ratti, 2009). Stock returns decrease while oil prices increase (Oberdorfer, 2009 Gokmenoglu & Fazlollahi, 2015). Studying gold price volatility gives the conclusion that there exists an important relationship between domestic gold prices and stock markets (Mishra et al., 2010; Ingalhalli & Reddy, 2016). The increase in gold rate is due to stock market (Le and Chang, 2012; Ali et al., 2020). The relationship that exists between exchange rate and stock prices by using a traditional approach (Dornbusch & Fischer, 1980). A linear and non-linear time series methodology was done to study the relationships between stock prices and exchange rates between 1991 and 2005 (Yau & Nieh, 2006).

Generally, when an uncommon event occurs, the effects can be noticed in stock market and oil price movements (Shah, 2019; Aburidi 2022). Oil and commodities are invoiced in U.S. dollar, so oil prices are affected by the change U.S. dollar exchange rate. David K. Backus and Mario J. Crucini (2000) discuss the linkage between prices and trade volumes. Using a dynamic equilibrium model, changes in terms of trade and unstable relationships between quantities are driven by the change in oil prices. Oil prices are affected by the movement of U.S. dollar and exchange rate (Yousefi & Wirjanto, 2003). The study “Exchange rate of the US dollar and the J curve: the case of oil exporting countries” (2003), is done using the trade’s balances of exported oil on three countries Iran, Venezuela and Saudi Arabia. Second, the exchange rate can also impact the oil prices directly or indirectly. Since oil prices are invoiced in US dollar, it will be a good indicator of the future dollar price. Krugman and Golub (1983) said that the increasing in oil prices will lead to an increase in wealth oil exporters; however, a decrease in wealth oil importers will affect the exchange rate of the importing countries. Many others researches and observers discussed the negative correlation that exist between exchanges rates and oil prices. However, some of them suggested that the reason is due to monetary policy and interest rate movement change. The decrease in interest rate in a country lead to a weaken PPP of the local currency of that country, moreover price of national imports increased. Meanwhile, if the FED decrease the interest rate, the US dollar weakens on forex markets which will lead to a cheap import of commodities invoiced in dollar. During inflation, foreign investors tend to invest in oil rather than other assets, when the demand of oil will increase, the price will increase.

Usually, the study of intermarket analysis begins with the analysis of U.S. dollar and then the other three sectors. According to John J. Murphy (1991) there is a circular relationship between dollar and interest rate, the dollar can affect the movement of interest rate as much as the interest rate can affect the price of the dollar. The short-term rates have a high impact on dollar price than the long-term rate. As Murphy describe, sectors move as the sequence events as follow:

1. Interest rates increase; dollar price increase; gold increase and stock decrease;
2. Interest rates decrease; dollar price decrease; gold decrease and stock increase;
3. Interest rates increase; dollar price increase; gold increase and stock decrease.

This sequence takes usually several years, it can be done in one month or in many years. While studying these sequences, the relationship between stock prices and dollar can be notice, as a result, when the dollar bullish, the stock price will decrease.

According to Jhon J. Murphy (1991), commodities are considered as an indicator for investors to predict inflation. Since gold is a safe haven, during bad situations and crises, it is considered as the most important leading indicator for inflation. CPI and PPI are the two most important index for inflation, they reflect the degree of inflation in any country. Mr. Angell and the FED have studied the global effect that commodities prices have on the movement of inflation. James Baker asked to prepare a basket of commodities, including the gold, to be used for monetary policy, FED Governors Wayne Angell and Robert Heller confirm his opinion. FED Vice Chairman Manuel Johnson in 1988 has confirmed that the FED, while studying the market and to be able to set the monetary policy, gave more attention to commodities and interest rates. An
increase in the commodities prices will lead to an increase in inflation than to a more difficult monetary policy; however, a decreasing in the commodities prices will be easier for FED to set the monetary policy. The changes in commodities prices will be translated into the changes of PPI and CPI which are two inflation indices.

Studying the following charts, on a monthly basis, taking 20 years as a duration, to visualize the movements of prices.

It is better to visualize and study long term period to avoid high volatility, longer term investments outperform the market. The charts are extracts from finance.yahoo.com and trading.view.com. Starting by visualize the chart of gold price (Fig. 1), an up-trend starting from USD 250.00 in year 2003 till approximately USD 2000.00 in year 2021 can be noticed. A double crossover can be noticed. The 10-day moving average cross above the 50-day which gives us a bullish signal but still not confirmed by the 80-day moving average. Since the shorter maturity Moving Average crosses above the longer Moving Average a buy signal is generated. It will be confirmed when the 50-day (MA) crosses above the 80-day (MA). However, by looking at the chart of US dollar (Fig. 2) from 2002 till 2021, a decrease in the price of the US dollar can be noticed from approximately USD 120.00 till USD 94.00. A negative relationship can be deducted between gold prices and US dollar currency index.

Fig. 1 show an uptrend for gold price and for Dow Jones Industrial Average Index from USD 8000.00 (2003) till USD 34 000.00 (2021). The depreciation of the US dollar will raise commodity prices which will impact and have a bearish effect on equities. However, a stronger US dollar will weaken commodity prices and will have a bullish effect on bonds and stocks prices. The DJI average index increased. An uptrend (black line) is noticed and is acting as a support. The Moving Average Convergence Divergence line rises above the signal line, the indicator gives a bullish signal, which suggests that the price of the asset is likely moving up. Moreover, the MACD histogram increase (higher than zero) gives a buy signal.

Whether the market was stocks, gold, oil or US currency, the main focus was always on the market being traded. Investors tried not to be affected by external events since it will overshadow the interpretation of the chart prices. A market cannot move and trade alone; for example, the stock market is strongly influenced by the bond market which is a leading indicator for equities. Intermarket analysis does not rely only on internal technical indicators.
and fundamental analysis of a particular market, intermarket studies look at the direction of price behavior of the relevant market. Intermarket analysis gives a more focus and importance to the definition of technical analysis. There is a strong relationship between bond market and commodities, it won’t be a full analysis if the study is limited only on bonds movement. At the beginning of 1990, the shock of bonds prices was only surprising for those who did not take into consideration the commodity market. Analyzing the Commodity Market is almost a mandatory for a good analysis of the bond market, as commodities and fixed income are so closely related (Kal et al., 2015). Finally, the movement of the U.S. dollar was also explained by intermarket analysis. Inflation occurred at the beginning of 1990, the increase in commodity prices impacted the collapse of the US dollar in 1989. Weakness in the US currency revived in 2022. The gold will be more secure compared to fixed income are so increasing. The study will validate three hypotheses:

H1: There is a solely bilateral relationship between markets;
H2: There is a simultaneous relationship between markets;
H3: The business cycle explains the intermarket analysis.

Lutz Y. Kilian and Cheolbeom Park (2009) conduct a study about the effect of oil price shock on stocks and how it differs whether the oil price shocks is driven by supply or demand. The changes in U.S. stocks prices, in the long run, is impacted by 22% from the demand and supply of oil prices. King (1985), confirmed that the decrease in stock market is due to an increase in oil prices; however, Chen et al. (1986) hypothesis that there are no relationships between stock markets and oil prices. Marco J. Lombardi and Ine Van Robays (2011) used a structural VAR model to identify the importance of non-financial and financial shocks to oil supply and demand. According to the study of Ine Van Robays (2012), higher microeconomic uncertainty increases oil shocks effect on oil prices. Using a structural threshold VAR model, he calculated the impact of oil demand and supply shocks. Macroeconomics uncertainty affect oil price volatility, when uncertainty increase the oil price volatility increase. Many studies have proven that the negative bilateral relationships between oil and gold is due to monetary policy and interest rate movements (Khaled et al., 2022). When the FED decrease the interest rate the dollar weaken in value and the imported commodities invoiced in US dollar become cheaper. Zhang et Wei (2010) study the fact that oil prices and gold prices are influenced by the same factors such as US
dollar or economic crises. Oil, used for inflation hedge, is considered as a risky asset whereas the gold is considered as a safe haven which gives us the negative relationships between the two. Two theories can be conducted:

1. There is an indirect relationship between oil and gold. The increases of oil price will have a negative impact on the economy and will push investors to buy more gold as an alternative asset.
2. U.S. inflation rate affect both gold and oil prices. As said before, gold and oil prices are invoiced in USD, and any variation in the US dollar will impact both prices. Since the strength of the currency is driven by inflation rate, so inflation rate influences the price of oil and gold.

Starting 1971, gold moved to floating exchange rate which made the price of the gold related the USD external value. In 2008, the IMF proved that the changes in gold prices since 2002 was related to the changes of US dollar. Gold is negatively related to the US dollar for several reasons: When the price of dollar decrease, the other local currencies affected by the changes will increase in value which led to an increase of the demand on commodities including gold. When the price of dollar begins to decrease in value investors try to look for other assets for investment including gold. Investors should take in consideration that the dollar price may change due to inflation rate, monetary policy and the economic stability of the country.

Both dollar and interest rate are affected by the movement of interest and inflation rate thus there is a direct relationship between them. When the dollar prices increase, the inflation and interest rate decrease which is bullish for stocks (Mitra and Bhattacharjee, 2015). On the other hand, when the dollar decreases, inflation and interest rate increase which is bearish for stocks. As said, history repeat itself, past years has proved the follow concept of Jhon J. Murphy: “A falling dollar becomes bearish for stocks only after commodity prices and interest rates start to rise”, the opposite is correct as well.

Intermarket analysis can demonstrate that all markets, financial and nonfinancial, domestic or global, are interconnected, so focusing the attention on a specific market without considering the movements of other assets prices puts the investor at risk because he is missing important directional clues. When market analysis is limited to a single market, the analyst is frequently left in the dark (see Fig. 3).

Traders and investors can no longer analyze any financial market in isolation, whether it’s the stock market in the United States or gold futures (Arfaoui & Rejeb, 2017).

The financial markets are heavily influenced by the business cycle. The phases of business cycle, such as expansion and contraction give an economic framework for the explanation of the bond, stock, and commodity markets’ interconnections. Furthermore, the business cycle illustrates the chronological order in which these three financial markets emerge. The intermarket process is illuminated by a deeper analysis of the business cycle, which confirms that what is observed on the price charts makes economic sense. Moreover, intermarket analysis can be useful to figure out where the business cycle is right now and can play an important part in economic forecasting. The asset allocation process is influenced by a basic understanding of the business cycle. Each stage of the business cycle can affect positively or negatively the movement of assets, for example, the start of the economy expansion will affect positively financial assets while the end of the expansion will affect positively the commodities. The economic cycle is utilized to explain the natural chronological rotation that occurs between gold, stock, oil and US dollar (Dai et al., 2020). The Journal of Commerce Index, which is composed of industrial commodity prices, is the basis for the majority of the commodity research. This is not the same as the CRB Index because it excludes agricultural markets. Martin Pring divides the trade cycle into six stages:

- Stage one: stocks and commodities falling;
- Stage two: stocks turn up and commodities falls;
- Stage three: commodities turn up;
- Stage four: stocks and commodities rising;
- Stage five: stocks turn down (commodities rising);
- Stage six: commodities decrease.

3. Methodology

3.1. Data and design

Positive paradigm, a philosophical idea of August Comte, is the research philosophy that can define this study. Positivism is based on observation, reality and historical data. This research philosophy differs from interpretivism and pragmatism because it relies on facts and objective oncology, a necessary for science study. Moreover,
positivism believes on the importance of using other scientific methods and on the knowledge, gain using systematic and theoretical approach from others financial research papers. It relies on quantitative approach and adheres the necessary knowledge through observation and measurement that can be trusted; the research is limited to data collection and observation. The study is fundamental research as it tends to explain the interdependencies between oil, stock, gold price and US dollar. The objective of this research is to explain and increase knowledge. It is based on a quantitative research design while using scientific method. It uses deductive reasoning, where collected data is done to investigate about the problem and use the analyzed data and conclusion done to prove the hypothesis formed. A deductive approach is about testing the hypothesis developed based on existing theory: There is a solely bilateral relationship between markets, there is a simultaneous relationship between markets and the business cycle explains the intermarket analysis. Empirical research is used as a type of research methodology. This type depends on evidence to obtain the research outcomes, it depends on observation and data collection. As empirical research, the study relies on scientific research to be able to measure the probability of the variables. The investigation method uses quantitative market research for observation to test the empirical method. Monthly data are used for the sampling period spanning from November 2011 to October 2021. The historical data, secondary data, collected from finance.yahoo.com are crude oil price, gold price, U.S. dollar index and Dow jones industrial average. All the collected data are homogenous and priced in U.S. currency.

3.2. Tools and techniques of data collection

Regression analysis studies and estimates the relationship between a series of independent variables and a single dependent variable. The regression analysis helps investors find the trend of data, value assets and find the existing relationships between multiple variables. Two elementary types of regression analysis are the simple linear regression with multiple linear regression. When we talk about multiple linear regression (2), multiple independent factors are used to forecast the outcome of the dependent variable Y; besides when we talk about simple linear regression (1), one independent variable is used to describe or predict the outcome of the specific dependent variable Y:

\[ Y = a + bX + u \]  \hspace{1cm} (1)

\[ Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + \cdots + b_t X_t + u \]  \hspace{1cm} (2)

Where Y is the unknown variable trying to predict it (dependent variable). X is the known variable used to predict Y (independent variable). a is the intercept. b is the slope. u is the regression residual.

Simultaneous equation is a set of linear simultaneous equation. The model of regression analysis is defined as a single equation; however, the simultaneous equation is composed of two or more equations.

\[ y_1 = z_0 + z_1 y_2 + z_2 x_1 + \epsilon_1 \]  \hspace{1cm} (3)

\[ y_2 = y_0 + y_1 y_1 + \epsilon_2 \]  \hspace{1cm} (4)
The four variables selected are correlated with each other and correlated with the global business cycle. The Dow Jones Industrial average will be the indicator for stock market prices, which is the price weighted measurement stock market, the price of gold is invoiced in US currency. Gold is considered as the most actively traded of all metals and is a good hedge against inflation. The crude oil prices are used for data study due to its standing within the world’s economic and political systems, crude oil trading provides excellent profit chances in practically all market scenarios. US dollar index represent the prices of U.S. dollar used for the calculation. U.S. dollar is the main global currency which measure the value of U.S. dollar relative to the value of several foreign currencies. The multiple linear regression equations show the existing of multiple dependent variables and one independent variable. The study is done by analyzing four different models. In each model, one single market is considered as independent variables; for example, looking at the first model, the oil price is considered as an independent variable. Moderator variables function as a catalyst in a regression analysis. They play an important role by affecting the relationships that exist between dependent and independent variables. Many factors, like interest rates, monetary policies, bonds... acting like catalyst, have an impact on oil, gold, U.S. dollar and stock market. Moreover, the control variables cannot be denied, they don’t have as much as importance as independent and dependent variable; however, their influenced cannot be overlooked. The study of other market studied should be taken into consideration since they affect the relationship between dependent and independent variables.

3.3. Multiple liner regression analysis

This study uses a statistical method “Multiple Linear regression” that illustrate the strength of the connection among dependent and independent variables. It is developed in a global framework using international data The data range from October 2011 till November 2021 in a monthly basis for all the variables so no need to adjust the data frequency. Ten years is considered as a long-term investing. Taking into consideration a long-term investing is better than a short term since long period exhibit lower volatility. Recently data were collected, and the problem of data gaps was not faced, so the accuracy of the prediction will be better. Taking the closing price of the four assets, all the data are collected from finance.yahoo.com and are homogenous since they are priced in U.S. dollar currency. Since all variables have exponential growth, it is better to take the logarithmic scale as it helps linearize the variable and therefore enhance the predictability of our model. The regression model is estimated via these equations:

$$\text{Log(stock)} = \beta_1 + \beta_2\text{log(oil)} + \beta_3\text{log(gold)} + \beta_4\text{log (us dollar)} + \epsilon_1$$

(5)

$$\text{Log(oil)} = \alpha_1 + \alpha_2\text{log(stock)} + \alpha_3\text{log(gold)} + \alpha_4\text{log (us dollar)} + \epsilon_2$$

(6)

$$\text{Log(gold)} = \delta_1 + \delta_2\text{log(stock)} + \delta_3\text{log(oil)} + \delta_4\text{log (us dollar)} + \epsilon_3$$

(7)

$$\text{Log (us dollar)} = \gamma_1 + \gamma_2\text{log(oil)} + \gamma_3\text{log(gold)} + \gamma_4\text{log(stock)} + \epsilon_4$$

(8)

Where Log(stock) is the logarithm of stock prices. Log(oil) is the logarithm of oil prices. Log(gold) is the logarithm of gold price. Log (us dollar) is the logarithm of stock prices. $\epsilon$ is the regression residual. $\beta_1$, $\alpha_1$, $\delta_1$ and $\gamma_1$ are constant. $\beta_2$ is the impact of oil on stock after controlling for the impact of gold and US dollar.

The serial correlation test is composed of three important tests: Durbin-Watson test, LM test and Correlograms/Q-statistics. The calculation is done using EViews version 9.

Durbin-Watson test. The Durbin Watson displays values less than two, which suggests that the regression’s residual term has a strong positive first order autocorrelation, which make the model not as much vigorous and weak to predict.

Serial Correlation LM test. P-values of LM test is lower than 5%, this means that there is a serial correlation in the residuals up to the specified order which makes the model for the four equations less robust and weak to forecast.

Correlograms and Q-statistics. Another test for serial correlation's order, the Fig. 4 select diagnostics for the first 18 lags from those equations. Since P-values of Q-statistics is lower than 5%, there is a serial correlation in the residuals. The Q-statistics is significant at all lags, indicating significant serial
correlation in the residuals, the residuals are auto-correlated which makes the model less robust and weak to forecast (see Fig. 5).

Augmented dickey-fuller test. Table 5 shows that the P-value is significantly higher than 5% and the ADF T-statistic is higher than the three critical values. Therefore, the null hypothesis of the unit root is not rejected and all the data are not stationary (see Table 1).
4. Empirical results

4.1. Results from quantitative analysis

The regression results for equation (5) is illustrated in Table 2, The constant/intercept \( c \) have a negative value, which suggest that the expected value on stock will be less than 0 (-17.09313) when all independent variables are set to 0. At 95% confidence level, the model shows that a 1% increase in oil will lead to a 0.3793% increase on average in stock, a 1% increase in gold leads to a 0.9239% increase on average in stock and a 1% increase in US dollar led to a 4.1577% increase on average in stock in the long run, and this is statistically significant as the P-value of the \( t \)-test is less than 5%. On the other hand, the constant in equation (6) is higher than zero which suggest that if the economy was moving along the stable path, the oil price would be equal to 26.94. The model shows that a 1% increase in gold leads to a 0.617% decrease in oil price, a 1% increase in US dollar leads to a 4.886% decrease in oil price and a 1% increase in stock price will lead to 0.3729% increase in oil price.

The constant in equation (7) is positive which mean that the economy was moving along the stable path,
the gold price would be equal to 15.720. A 1% increase in oil price will lead to 0.28% decrease in gold price, if stock prices go up by 1%, gold prices will increase by 0.041% and a 1% increase in US dollar leads to a 2.53% decrease in oil price, and this is statistically significant as the P-value of the t-test is less than 5%. The equation (8) show a positive constant. A 1% increase in oil price will lead to 0.14% decrease in US dollar, a 1% increase in stock market will lead to a 0.116 increase in US dollar and a 1% increase in gold will decrease the US dollar by 0.15%.

Testing for variable’s statistical significance, the T-Test. Statistical significance is the likelihood that a relationship between two or more variables is caused by something other than chance. As mentioned, P-value is lower than 5%, all the independent variables are statistically significant, the relationship between the variables is caused by something other than chance (see Table 3).

Model’s goodness of fit. The coefficients are statistically significant, the adjusted R-squared gives a goodness of fit, this shows that the dependent variable is 62.62% explained by the independent variables which is not consider as a very good value. Looking at Table 4 and Table 6, the R-squared is higher than 70%, which means that a high percentage of movements of dependents variables are completely explained by movements in the index. The probability F-statistic is equal to zero, less than 1% it shows that the overall significance of the model is good and that the overall model fits well.

Other research employs a variety of statistical methods. They used different statistical methods to demonstrate and prove the relationship among those assets. The prices of oil, gold, the US dollar exchange rate, and stock prices are all endogenous variables, and Xi (i 1 …, 4) contains vectors of their exogenous determinants as additional controls required for identification. A fine identification of the system requires differences between Xi.

Other research is based on charts and technical analysis (from the 1980s to the present). Charts are a

Table 3. Regression analysis, Model’s valuation of the first model: Log(stock) c log(oil) log(gold) log(us_dollar).

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>LOG(STOCK)</th>
<th>Time:</th>
<th>22:25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>10/24/2021</td>
<td>Observations:</td>
<td>120</td>
</tr>
<tr>
<td>Variable Coefficient</td>
<td>0.379317</td>
<td>Std. Error</td>
<td>0.086765</td>
</tr>
<tr>
<td>C</td>
<td>–17.09313</td>
<td>t-Statistic</td>
<td>4.371769</td>
</tr>
<tr>
<td>LOG(OIL)</td>
<td>0.2937317</td>
<td></td>
<td>9.91408</td>
</tr>
<tr>
<td>LOG(GOLD)</td>
<td>0.923975</td>
<td></td>
<td>8.51954</td>
</tr>
<tr>
<td>LOG(US_DOLLAR)</td>
<td>4.157656</td>
<td></td>
<td>10.41022</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.626265</td>
<td>Mean dependent var</td>
<td>9.91408</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.616599</td>
<td>S.D. dependent var</td>
<td>0.289929</td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.197522</td>
<td>Akaike info criterion</td>
<td>–0.546274</td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>3.73846</td>
<td>Schwarz criterion</td>
<td>–0.471358</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>37.85648</td>
<td>Hannan-Quinn criterion</td>
<td>–0.52654</td>
</tr>
<tr>
<td>F-statistic</td>
<td>64.79345</td>
<td>Durbin Watson stat</td>
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<tr>
<td>Prob(F-statistic)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Regression analysis, Model’s valuation of the second model: Log(oil) c log(gold) log(stock) log(us_dollar).

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>LOG(OIL)</th>
<th>Time:</th>
<th>22:36</th>
</tr>
</thead>
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<tr>
<td>Date:</td>
<td>10/26/2021</td>
<td>Observations:</td>
<td>120</td>
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<tr>
<td>Variable Coefficient</td>
<td>0.372921</td>
<td>Std. Error</td>
<td>0.085302</td>
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<td>C</td>
<td>26.93659</td>
<td>t-Statistic</td>
<td>4.371769</td>
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<tr>
<td>LOG(GOLD)</td>
<td>–0.617199</td>
<td></td>
<td>7.51265</td>
</tr>
<tr>
<td>LOG(US_Dollar)</td>
<td>–0.486187</td>
<td></td>
<td>–4.934296</td>
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<tr>
<td>LOG(STOCK)</td>
<td>0.372921</td>
<td></td>
<td>–15.64793</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.755633</td>
<td>Mean dependent var</td>
<td>4.31634</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.749313</td>
<td>S.D. dependent var</td>
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<td>S.E. of regression</td>
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<td>Akaike info criterion</td>
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<td>Sum squared resid</td>
<td>3.675427</td>
<td>Schwarz criterion</td>
<td>–0.483632</td>
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<td>Log likelihood</td>
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<td>Hannan-Quinn criterion</td>
<td>–0.543545</td>
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<tr>
<td>F-statistic</td>
<td>119.5654</td>
<td>Durbin Watson stat</td>
<td>0.497629</td>
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<tr>
<td>Prob(F-statistic)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
crucial visual tool for determining the connections between assets. When conducting a study, visualize Price charts are required for intermarket work because it requires examining so many different marketplaces. The simplest and most effective method for examining intermarket links is chart analysis. It significantly increases the value of technical analysis. It enables experts to discuss topics that were previously only open to security analysts and economists. John Murphy explains that market analysis's major benefit is that it enhances the market analyst's peripheral trading vision. Trying to trade within markets without intermarket awareness is like driving a car without checking the side and rear-view mirrors. In other words, it is extremely risky. Intermarket analysis can be applied to any market, anywhere in the world. Intermarket analysis gives a more comprehensive picture of how the world market behaves (see Fig. 6).

Many analyses can be done to predict the relationships among assets, and the results discussed later on will be the same for all.

Model’s Visual Representation. After regression, plotting the actual versus fitted values of the dependent variable, along with the residuals, in a graph. This gives visual evidence on whether the models correctly predict the dependent variable.

The model three show a red line and green line which are almost the same, the model fairly forecasts the variation in U.S. dollar over time. There is a small significant over or underestimations in any of the time periods, between red and green lines. The visual representation of the second model shows the red line or actual line and green line or fitted line are somehow the same but still shown some difference between the two, the model does not forecast the variation in gold prices. Moreover, the graph gives us visual evidence that the error is stationary.

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The final model shows a red line and green line which are almost the same, so the model fairly
forecasts the variation in US dollar over time. There is a small significant over or underestimations in any of the time periods, between red and green lines. Moreover, the graph gives us visual evidence that the error is stationary.

4.2. Validation of the research hypothesis

Model 1 shows an existing relationship between the oil price, gold price, US dollar and Stock market. The three dependent variables affect directly and positively the stock market (Sekmen, 2011). However, the negative relation between stock and oil prices can also be proven from the analysis of the first model. This negative relationship is also viewed and analyzed by much research (Basher et al., 2012; Oberndorfer, 2009). The economic situation affects directly the price of stock market and the monetary policy is linked to the stock market. As a conclusion, the expectation and forecasted economic behavior is viewed by the stock market such as speculation or hedging. Both gold and crude oil affect positively each other's (Wang & Chueh, 2013). Interest rate has an impact on gold prices crude oil prices and US dollar so when the FED decides to decrease interest rates to boost the economy the prices of the variables will fluctuates. As a result, investors prefer to invest in gold market for speculation since a decrease in interest rate will affect negatively the U.S. dollar. Indeed, crude oil prices may increase to a level and trigger inflation, while the FED, to be able to monetary the economy, may tighten monetary policy. Both gold and crude oil are linked by the movement of interest's rate and inflation. During October 2011 till November 2021, the U.S. dollar have a negative impact on oil because of the economic situations of this period. Because long-term inflation is a concern for monetary authorities, when crude oil prices reach a specific level, the Fed may undertake tighter monetary policies to moderate the economy like raising interest rates to decrease the effect of inflation caused by rising oil prices. Commodity pricing data, according to the Fed, can help policymakers make better decisions. In terms of gold and crude oil prices having a feedback impact on the U.S. dollar, both gold and crude oil prices push the U.S. dollar currency higher. The purpose of this study is to use
regression analysis to emphasize the interdependencies between all markets during the period 2011–2021. Our data reveal that there is evidence of a genuine influence as well as strong interactions between oil, gold, the US dollar, and stock prices. Indeed, the study discovered that stock markets, gold, and the US dollar had a major impact on oil prices. Some important points discussed: Financial markets are interrelated, so no market move alone; Charts are an important rule for intermarket studies and should be taken into consideration; Focusing on charts, as mentioned, is important for investors; The technical analysis is the preferred vehicle for intermarket studies; The four sectors studied are U.S. dollar (currencies), gold (commodities), oil (commodities) and stocks; US dollar and gold prices trend in opposite direction as well as US dollar and CRB index; Gold and CRB index move in the same direction.

5. Conclusion

The relationships between all markets, financial and nonfinancial, domestic and international, was one of the most important lessons in 1980s. The events of the last decade have demonstrated that markets do not operate solely. Intermarket analysis impact interest rate movements, economic growth, inflation and Federal Reserve policy. The results highlight the linkage as follow, U.S. dollar, gold and stock market affect the oil prices; gold prices are affected by the changes of stock market, US dollar and oil prices. There are usually indirect consequences that reinforce global interdependencies and underline the financialization of commodity markets. The high demand of oil and gold as financial assets, either for speculation or hedging, can be explained by the strengthening of direct and indirect relationships between all markets which indicate that the performance of financial assets is influenced by one another. Furthermore, there are other variables to consider while dealing with such interdependencies. The present results confirm the theories discussed and the existing empirical literature. It confirms a strong globally relationships between oil, gold, stock and U.S. dollar while studying the importance of intermarket analysis for future movement of assets, intermarket analysis is one of many tools used to interpreted the direction of the market. The uses of regression analysis have demonstrated a simultaneous relationship between the four markets. These results obtained are essential in answering the investors’ objective of finding the importance and purpose of studying intermarket. The data collected have practical implications on how the linkage between the markets can forecast the phase of the economy.

Intermarket work is crucial in the fields of asset allocation and economic forecasting. The stock market’s role as a leading economic indicator has long been acknowledged. When the American market reached its peak in March 2000, for example, this was exemplified in a classic way. The first official announcement of a U.S. recession didn’t come until March 2001, after a delay of one year in the economic community.

Markets have a way of looking into the future to “discount” economic trends as far away as six months. We can detect inflationary or deflationary movements early on thanks to commodities. The currency, the dollar, behaves similarly. Bond movement indicates whether interest rates are moving upward or downward, which provides valuable information about the health of the economy. Additionally, each of these patterns has an impact on how the economy and stock market are moving. Intermarket analysis also aids in identifying which area of the financial spectrum offers the greatest possibility for gains.

For instance, deflationary tendencies from 2000 to 2002 made bonds a considerably more powerful asset class than stocks. At the same time, a weaker dollar made gold a desirable stock option. By the end of 2002, longer-term intermarket charts were giving indirect signal that gold and other commodities were starting to take precedence over bonds and stocks for the first time in twenty years. By studying these intermarket movements, investors have a higher chance of being in the appropriate asset class at the right time—and out of the wrong ones.

The study faced many issues regarding the regression analysis. The data collected is in U.S. dollar currency provide a universal overview of the feasibility of this strategy; and the results may not be applicable across other markets. Moreover, the study faced gaps while collecting the historical data. On the other hand, the analysis bears several limitations. First, the strategy was built manually over EViews and Microsoft Excel programs lacking automation, making it time-consuming. Second, the statistical analysis showed a positive serial correlation, slightly decreasing the robustness of our model. Adding more variables is expected to make the spread less trendy (Müller & Watson, 2013), and the model more robust statistically and better to forecast, hence enhance the model by reducing the serial correlation. Three, our analysis was conducted during a period of 10 specific years; hence not providing information on the efficiency of this
strategy during other period. Finally, Durban Watson statistic is slightly lower than 2 which make our model less robust.

There is still a lot of work to be done before saying that we have a complete understanding of how markets interact. Just by thinking we’ve got it all figured out, something unexpected happens. However, nothing happens by chance or accidently; there is almost always a reason for the shift. The intermarket idea outlined in this study is intended to be guideline rather than strict regulation. One of the fundamental technics to survive and success is the ability to adapt to the changing market conditions. This is true for intermarket analysis as well as any other type of market studies. Despite the fact that the breadth of intermarket research is extensive, forcing investors to stretch their imaginations and broaden their vision. It’s an important place for investors to conduct market research and find trading possibilities to be able to increase the profit as much as possible.

References


