

Explaining stock market returns: Evidence from the Dow Jones Industrial Average Index

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*“Rule No.1: Never lose money
Rule No.2: Never forget rule No.1”*

-Warren Buffett

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EXTENDED ABSTRACT

ENGLISH

Determining what influences the price of the stock market has always attracted the attention of the researchers, specifically by utilizing indexes like the Dow Jones and S&P 500. To explain stock market returns, authors have highlighted the influence of some macroeconomic indicators like GDP, unemployment rate and inflation, as well as other asset classes, for example gold, crude oil, currency and the yield of bonds.

In this final degree project, will be studied the determinants that affect the price of the Dow Jones Industrial Average in the long term from 1971 to 2021. A time series model will be used with 4 explanatory variables and also 3 control variables, coming from Stooq and FRED. The econometric analysis will answer the following questions: What are the relationships and dynamics between the Dow Jones Industrial Average and other asset classes? In which way did the determinants affect the Dow Jones under crisis? The results reveal that Gold and Interest rates have a negative relationship and impact on the price of the Dow Jones Industrial Average. On the other hand, the price of Crude oil and the Dollar have a positive correlation with the price of the Dow Jones. The Macroeconomic variables also prove that when the economy is growing with low inflation leads to higher prices for the Dow Jones. These results show that as long as the economy is doing well, together with a reduction of interest rates and the price of gold, in addition to rising prices in crude oil and the dollar, in that case the Dow Jones is going to perform well and its price is going to rise. The main limitation of this study is to only have studied the United states of America, as opposed to doing a multiple country study.

CASTELLANO

Determinar qué influye en el precio del mercado de valores siempre ha atraído la atención de los investigadores, específicamente mediante la utilización de índices como el Dow Jones y el S&P 500. Para explicar los rendimientos del mercado de valores, los autores han destacado la influencia de algunos indicadores macroeconómicos como el PIB, la tasa de desempleo e inflación, así como otras clases de activos, por ejemplo el oro, el petróleo crudo, la moneda y el rendimiento de bonos.

En este trabajo de fin de grado, se estudiarán los determinantes que afectan el precio del Promedio Industrial Dow Jones en el largo plazo de 1971 a 2021. Se utilizará un modelo de serie temporal con 4 variables explicativas y también 3 variables de control, provenientes de Stooq y FRED. El análisis econométrico responderá las siguientes preguntas: ¿Cuáles son las relaciones y la dinámica entre el Promedio Industrial Dow Jones y otras clases de activos? ¿De qué manera afectan los determinantes al Dow Jones en crisis? Los resultados revelan que el oro y las tasas de interés tienen una relación e impacto negativos en el precio del Promedio Industrial Dow Jones. Por otro lado, el precio del crudo y el dólar tienen una correlación positiva con el precio del Dow Jones. Las variables macroeconómicas también demuestran que cuando la economía está creciendo con baja inflación conduce a precios más altos para el Dow Jones. Estos resultados muestran que mientras la economía esté bien, junto con una reducción de las tasas de interés y el precio del oro, además del aumento de los precios del petróleo crudo y del dólar, en ese caso el Dow Jones va a tener un buen desempeño y su precio va a subir. La principal limitación de este estudio es haber estudiado únicamente los Estados Unidos de América, en lugar de realizar un estudio de varios países.

CATALÀ

Determinar què influeix en el preu de mercat de valors sempre ha atret l'atenció dels investigadors, específicament mitjançant la utilització d'índexs com el Dow Jones i l'S&P 500. Per explicar els rendiments del mercat de valors, els autors han destacat la influència d'alguns indicadors macroeconòmics com el PIB, la taxa d'atur i inflació, així com altres classes d'actius, per exemple l'or, el petroli cru, la moneda i el rendiment de bons.

En aquest treball de fi de grau, s'estudiaran els determinants que afecten el preu de la Mitjana Industrial Dow Jones al llarg termini de 1971 a 2021. S'utilitzarà un model de sèrie temporal amb 4 variables explicatives i també 3 variables de control, provinents de Stooq i FRED. L'anàlisi econòmic respondrà les següents preguntes: Quines són les relacions i la dinàmica entre la Mitjana Industrial Dow Jones i altres classes d'actius? De quina manera afecten els determinants al Dow Jones en crisi? Els resultats revelen que l'or i les taxes d'interès tenen una relació i impacte negatiu en el preu de la Mitjana Industrial Dow Jones. D'altra banda, el preu del cru i el dòlar tenen una correlació positiva amb el preu de Dow Jones. Les variables macroeconòmiques també demostren que quan l'economia està creixent amb baixa inflació condueix a preus més alts per al Dow Jones. Aquests resultats mostren que mentre l'economia estigui bé, juntament amb una reducció de les taxes d'interès i el preu de l'or, a més de l'augment dels preus del petroli cru i del dòlar, en aquest cas el Dow Jones tindrà un bon resultat i el seu preu pujarà. La principal limitació d'aquest estudi és haver estudiat únicament els Estats Units d'Amèrica, en lloc de realitzar un estudi de diversos països.

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1. INTRODUCTION

Wuhan, a Chinese city, has been the center of attention in 2020, the reason for that being, COVID-19, an incredibly infectious disease classified as a novel coronavirus, which has caused panic all over the world. COVID-19 is causing a massive destruction economically, it demolished the stock market earlier in March 2020 and with the enforcement of lockdowns by the governments, it is slowing down the real economy drastically (Dunford et al., 2020), about a 3% drop in global GDP, levels only seen before during the great depression back in 1929 (Cerboni et al., 2020).

The United States has been the epicenter of the pandemic, recording 20.727.799 cases, as of 01/01/2021, the highest number worldwide. It's GDP decreased 32.9% in the second quarter of 2020, which impacted the entire world, as it is the major contributor to the global economy, representing 24.42% of the world GDP. The Dow Jones Industrial, commonly used as a reflection of the economy, recorded the largest point crash ever in its history, driven by the global fear due to the coronavirus spreading.

Stocks all over the world were the first to take a hit by the novel coronavirus, which ended up causing massive fear, not just in other markets like commodities, cryptocurrencies or bond yields, but in the state of mind of society. To understand the impact, indexes like the S&P 500 or the Dow Jones are very popular in the scientific community, because they represent the real time sentiment of investors and are commonly used as a representation of the current state of the economy (Comincioli, 1996). Few recent studies have been published trying to understand the economic damage that the pandemic has caused. During the early days of confirmed cases, stocks reacted quickly crashing at an accelerating rate, as exponential new cases were being recorded (Ashraf, 2020; Yilmazkuday, 2020).

Understanding how certain determinants influence the price of the stock market is extremely important, due to its close relationship with the real economy (Comincioli, 1996). These can provide clarity by showcasing how they impacted the stock market and the economy throughout time. Furthermore, comprehending these dynamics can also help a lot in creating a better investment portfolio that protects better capital during big economic downturns. However, so far, most of the studies out there have used COVID-19 cases to understand the impact of this variable to the stock market, having said that, using COVID-19 cases as a determinant won't work in the long term because as we have already seen, the negative relationship between new cases and stock prices was only observed during the first 60 days of confirmed cases (Ashraf, 2020). That is why, for the purpose of this study, the stock

market will be analyzed from a different perspective, one that does not consider the influence of COVID-19, but the dynamics of other asset classes such as Gold, Oil, Bond yields and Currency, because they can help understand what influence they had over time on the financial markets.

There is previous research about the dynamics of the stock market with other variables. Some show that GDP and other macroeconomic variables like the transportation cost of raw materials or unemployment, have a positive relationship with returns on the stock market (Setiawan, 2020; Liu & Sinclair, 2008; Vithalbai, 2020; Stopford, 2009; Bakshi et al., 2010). However, some others suggest that other asset classes like commodities or bond yields have a negative relationship with stock market returns (Bhunia & Das, 2012; Baur & Lucey, 2010; Hillier et al., 2006; Gisser & Goodwin, 1986; Papapetrou, 2001; Apergis & Eleftheriou, 2002; Blanchard et al., 1993). Therefore, certain trends are already noticeable, proving that when there is prosperity, the stock market grows and so related indicators, however, when there is flat or negative growth, other assets provide better returns. Despite that, there is a big vacancy in terms of how these variables have affected the stock market over a really long time series and the impact of crises like the one we recently experienced on major stock indices.

The aim of this final degree project is to fill a gap in the literature with a quantitative analysis on the dynamics of the stock market and other asset classes like gold, crude oil, bonds and currency. These key variables will help better understand how these determinants have affected the stock market over the long term. This final degree project will answer the following questions: What are the relationships and dynamics between the Dow Jones Industrial Average and other asset classes? In which way did the determinants affect the Dow Jones under crisis?

The period (1971 - 2021) will serve to analyze the Dow Jones Industrial Average which will be the dependent variable of this study. The length of the price action is of extreme importance, as it entails different types of behaviours facing different events throughout the history of the United States, from high inflation phases to booming economic growth like in 1980 to facing devastating depressions such as the 2008 Lehman Brothers collapse.

This study will be closely related to the degree of ADE, as concepts from Macroeconomics, International Economics and Statistics will be used to create fresh perspectives and understand the dynamics and patterns of the financial world.

This final degree project is structured as follows. In Section 2, theoretical background is presented, highlighting variables that influence the stock market returns. Section 3 describes the objective of the study and the hypothesis raised. Section 4, 5 and 6 will expose the econometric method and data. The final section, number 7, will contain the conclusions of the study.

2. THEORETICAL BACKGROUND

The Dow Jones Industrial Average Index is the most widely used stock market index in the world. This index got its start on May 26, 1896 and was created by Charles H. Dow, one of the founders of The Wall Street Journal, who began researching the history of stock prices all the way back in the 1880s. After lots of work he came up with an index covering twelve major industrial stocks of that time. Twelve years later this index expanded its composition to 20 stocks, and in 1928 the index reached 30 stocks. The Dow Jones is for many investors, including professionals in the investment community, one of the most useful tools, not only because of its longevity and wide dissemination, but also its simplicity (Milne, 1966). An important factor of its composition is that it only has thirty well known mature blue chip stocks, which represents about 30-35% of the total stock market value of all stocks listed on exchanges (Lin et al., 2021).

Indexes such the S&P 500 and the Dow Jones Industrial are also very popular in the scientific community. According to Chen (2009), the S&P 500 or the Dow Jones allows us to understand the entire economy of the United States, therefore being incredibly useful to generate new insights, for example detecting potential recessions in the US and global market (Chen, 2009). One great example of this interconnection was the strong contraction of liquidity in financial markets that started in 2007, which affected the US and worldwide real economies through the downturn of consumption, investments and widespread unemployment (Cerboni et al., 2020). Other studies like Cerboni et al. (2020), utilized index because they have a volatility index linked to it, which allows for a better understanding of the markets and human psychology, more specifically the emotions of greed and fear (Cerboni et al., 2020). Many of the recent studies published about the effects of COVID-19 on the economy have also utilized the Dow Jones Industrial Average (Mazur et al., 2021).

Since 1971 the Dow Jones Industrial Average has been through many different phases. The first one going from 1970 to 1980, known as the great inflation and led the DJI to close the decade at the same price it had started. Economic growth is weak during this period, resulting in high unemployment (Orphanides, 2002). For central banks like the FED, that means one thing, easy money policies. These measures allowed for full employment again in the early 1970s, but it also resulted in high inflation. To reverse this, the central bank started to raise interest rates, up to 20%. Commodities also had a significant rise which impacted the economy and the stock market (Nelson, 2005).

The following distinctive phase was from 1980 to 2000. It was during this period that the United States of America entered the longest economic growth of its history, commodities started to lower in price, inflation started to go down and major tax breaks allowed the economy and the stock market to grow exponentially. Despite that, one of the worst stock market crashes happened during this period, “The black Monday”, which happened in 1987, resulting in a -22.6 percent drop in the Dow Jones Industrial in a single session (Zagha & Nankani, 2005).

The decade after that was full of turbulence, and went from 2000 till 2010, with two of the biggest bubbles burst, the Dotcom bubble in the early 2000s and the housing bubble in the late 2000s. This led to the famous great recession, which was the worst economic downturn since 1929 and started in 2008 when the U.S. housing market cracked. This slowed down the GDP by more than 10 percent and the unemployment rate reached levels of 25 percent. To combat it, the central banks started to print money again and lowered interest rates to incentivize the economy. Behind some of the reasons this major crisis happened include excessive loose monetary policy, extended period of low interest, excessive borrowing and lending. The recovery after the 2008 great recession was slow. The stock market started setting new all-time highs a few years after the crash and unemployment got lower year by year (Foo & Witkowska, 2017). That was until we got hit again by another major recession, the COVID-19 crash, which has been one of the most severe in recent history, however it has also proved to be one of the fastest recoveries (Ashraf, 2020).

To better understand how the dependent variable of this study (Dow Jones Industrial Average) has been affected, it is necessary to be aware of its relationship with other economic indicators and asset classes.

2.1. Economic Indicators

GDP is the main economic indicator and its relationship with the stock market has also been studied and identified positively by the scientific community. Researchers from Indonesia found that the Indonesian stock market from 1999 to 2019 showed a positive correlation with GDP (Setiawan, 2020). Similar results were found in Chinese studies, where they found that the stock price from mainland China (from 1992 to 2003), Hong Kong (from 1973 to 2003) and Taiwan (from 1967 to 2003), indicate that there is a causal link in GDP and stock prices in the long run in all three regions. The study also suggests that stock prices are a leading indicator of economic growth in the short run, however economic growth is the main determinant of the stock markets in the long run (Liu & Sinclair, 2008).

On the other side of the pacific, researchers from the United States of America, found that analyzing the american stock markets from 1953 to 1995 confirm similar results, stock variations are explained by future values of real activity in the United States. Despite that, they also found that the regressions look quite different starting from 1980, when there seems to be a breakdown in the relationship between stock prices and GDP (Binswanger, 2000).

Unemployment rate is also considered very important among global investors and the scientific community. According to Arestis et al. (2007), which conducted a study in nine euro area countries, including: Austria, Belgium, Finland, France, Germany, Italy, Ireland, the Netherlands and Spain, their statistical analysis shows that there is a negative relationship between unemployment and the accumulation of capital. In other words, the higher the amount of capital in the stock market, the lower the unemployment rate is. That is why Arestis et al. (2007), also suggests that policy makers should focus on encouraging enough accumulation of capital, as opposed to promoting labour market flexibility (Arestis et al., 2007).

In the study from Schlingemann & Stulz (2020), which is more recent literature, found similar results but in the United States of America and with data of public corporations all the way back to the 1950s. The study suggests that over time stock market capitalizations are less linked to employment and GDP, as it was found that in the 1970s, employment explained 50.7% of the variation in the stock market, on the other hand, in the 2010s, the number drops to only 21.8% (Schlingemann & Stulz, 2020).

According to the scientific community, CPI (Consumer Price Index) or also known as inflation, is another important economic indicator. Researchers Humpe & Macmillan (2009), conducted a study using monthly data over 40 years on the long term effects of consumer price index on the stock market in the US and Japan. They concluded that CPI impacted negatively on the stock market prices (Humpe & Macmillan, 2009). The exact same results were found in a study on the Bombay Stock Exchange (SENSEX), which is the biggest stock market index in India. According to Kedia & Vashisht (2020), the rise of inflation leads to a downfall in the BSE Sensex index in proportion to the increase in inflation, suggesting that CPI is one of the most important macroeconomic variables that affect the stock markets, and knowing this relationship can help navigate the markets, by understanding when the best time to invest is, based on inflation rates (Kedia & Vashisht, 2020). Therefore, the general

consensus in the scientific community is that high inflation rates will make the stock market go down, on the other hand, low inflation rates will help the markets go up (Humpe & Macmillan, 2009; Kedia & Vashisht, 2020).

According to literature (Hashemzadeh & Taylor, 1998; Modigliani & Cohn, 1979), interest rates seem to be one of the most important determinants of stock market returns. Further studies (Apergis & Eleftheriou, 2002; Blanchard et al., 1993) conclude that interest rates and inflation have a positive relationship and the continuous reduction of both is expected to contribute to a more substantial increase in stock prices, thus, higher economic growth. Despite that, according to Saini & Sehgal (2020), that conducted a study on advanced and emerging markets on a time series from January 1999 to December 2017, concluded that even though the negative relationship between interest rates and stock returns holds true, during and right after a period of crisis, there is a reversal in the relationship, which can be explained by the change of investors outlook on perceiving worst economic conditions, therefore readjusting their expectations (Saini & Sehgal, 2020).

The Purchasing Managers Index (PMI) is another important indicator used by central banks, investors and sector managers, which indicates the direction of economic trends in manufacturing and services sectors. When the index is greater than 50 percent it suggests that there is expansion, however when the levels are lower than 50 it indicates contraction (Akdağ et al., 2020). Researchers like Renna (2019), have studied the effects this indicator has on stock closing prices by utilizing monthly data for PMI and stock index from the U.S., suggesting that there is a positive relationship between the three major U.S. indices and the purchasing managers index, therefore even though not considered perfect, it is a good indicator for the current economic condition (Renna, 2019).

Another leading indicator seems to be the Baltic Dry Index, which is an indicator of transportation costs for raw materials shipped by sea. The reason there is a positive relationship between stocks and the baltic dry index, is because it is considered that the supply structure of the shipping industry is generally predictable and relatively inflexible, making it a leading indicator of economic activity, and as previous studies suggest, GDP is positively associated with higher stock returns (Stopford, 2009). According to Bakshi et al. (2010), it was found that there was also a positive relationship between BDI growth and commodities, that is because commodities are positively related to industrial production, both in developed and emerging countries (Bakshi et al., 2010).

2.2. Relationship of the stock market with other asset classes

Previous literature has been studying the relationship between the stock markets and bonds. According to a recent study Lin et al. (2018), which conducted an analysis on the U.S. stock market and bond market for the periods from 1988 to 2014, it was found that the relationship stock-bond has changed in the last decades, changing from positive to negative in the late 1990s. It was also found that bonds perform exceptionally well in crisis scenarios (Lin et al., 2018). In the study of Shahzad et al. (2017), they found that the price of bonds and stocks have a positive relationship, despite that, bonds play an important role in a diversified portfolio, as it was found that when stocks and gold performed badly, bond acted as a safe haven (Shahzad et al., 2017).

The relationship between oil prices and stock markets is well studied. Most literature believes there is a negative correlation of oil prices and the financial markets, which means that as oil prices increase, stock prices decrease. According to Gisser & Goodwin (1986) this is because the increase of oil prices increases the production cost, the higher production costs affect cash flow and decreases stock prices (Gisser & Goodwin, 1986; Papapetrou, 2001). Taking those findings, Huang et al. (1996) concluded that oil prices can affect stock prices not only by the future cash flows but also indirectly through an impact on the interest rate used to discount the future cash flows (Huang et al., 1996). Oil prices and inflation rates have also been found to have a positive relationship and are linked with the same intensity (Naifar & Al Dohaiman, 2013). Despite that, according to recent researchers Chkir et al. (2020), the dependence between WTI and the stock markets are significantly positive, and with the highest dependence during a period after the collapse of the oil prices in 2014, therefore suggesting that an oil appreciation should follow a stock market appreciation (Chkir et al., 2020). These results go along with what actually happened in recent years and during this COVID-19 crisis.

The scientific community has been studying the nature and influences of the gold market. Some analyzed the hedge potential of gold against the dollar, concluding that gold has served as a hedge because it has attributes of an asset and cannot be produced by authorities that produce currencies, this makes gold's value increase as states devalue their currency by printing more of it (Capie et al., 2005). Studies relevant to the relationship of gold to stock market returns are scarce, especially those trying to understand if gold is a great safe haven. Despite that, the scientific community agrees that gold is used as a safe haven and can play a diversifying role in investment portfolios, not just in the United States but all around the world (Bhunja & Das, 2012; Baur & Lucey, 2010; Hillier et al., 2006).

Shahzad et al. (2017), conducted a study in developed countries also has similar views, because it was found that gold has a low or negative dependence on the stock market, therefore being a strong hedge and a diversification tool (Shahzad et al., 2017). Nevertheless, Baur & Lucey (2010) argues that gold is generally not a safe haven for bonds in any market, and only functions as a safe heaven for a limited time, around 15 trading days (Baur & Lucey, 2010).

The scientific community is interested in knowing if all stocks around the world have any causal relationship. Because the U.S. stock markets are the most important, authors Bhunia & Yaman (2017), studied the relationship between nine asian stock markets with the US financial market and found there was a positive correlation for most of the analyzed countries, however the Vietnamise stock market was the exception, which had a negative relationship, therefore making it a great opportunity for diversification (Bhunia & Yaman, 2017). Similar studies utilizing the same control variables, major U.S. stock exchanges, like the one Balios & Xanthakis (2003) did, in which the DJI was the endogenous variable and where European and Japanese stock markets were the exploratory variables, found that there was a positive relationship between the stock indices in all three continents (Balios & Xanthakis, 2003). Comparable to previous studies, but updated to recent COVID-19 times, Sharda (2020) analyzed the relationship between all G7 countries' stock market response during the unprecedented downturn, where it was found that all stock exchanges had a positive correlation, except Canada (Sharda, 2020).

Cash is considered the most liquid asset, therefore the scientific community has studied its relationship with stock returns. In the case of Johnson & Soenen (2004), in which they studied the US equity market and the US dollar, they found a strong relationship between the S&P 500 and the price of the dollar against seven foreign currencies (Johnson & Soenen, 2004). Bahmani-Oskooee & Sohrabian (1992) also found that there is a dual casual relationship between the stock market in the U.S. and the price of the dollar (Bahmani-Oskooee & Sohrabian, 1992).

2.3. Conclusions of the theoretical background

Understanding what affects the price of the stock market has been challenging because the economy is very complex, therefore the scientific community has done extensive research on it. Until now, we have seen plenty of studies that have tried to understand the markets by following a fundamental approach, one that looks at the relationship between stock market returns and macroeconomic indicators like GDP, CPI or Unemployment, suggesting that

stock prices rise as the entire economy grows. There are also those, who are interested in understanding the dynamics of different asset classes like commodities or bond yields, finding that they have a negative relationship with returns in the stock market, therefore the right amount of different asset classes minimizes the risk by diversifying a portfolio. Despite that, this study will look at all these dynamics by analyzing a very long time horizon and how major crises have affected the price of the stock market. Previous literature will be extremely important to set the base for this study.

In Table 1, can be observed a summary of the effects of different variables that have an impact on stock returns and are analyzed for this project.

Table 1. Summary of the variables that have an effect on the dependent variable.

| | | |
|---------------------|------------------|--|
| ECONOMIC INDICATORS | GDP | <ul style="list-style-type: none"> • Setiawan, 2020 • Liu & Sinclair, 2008 • Vithalbhai, 2020 • Binswanger, 2000 |
| | Unemployment | <ul style="list-style-type: none"> • Arestis et al., 2007 • Schlingemann & Stulz, 2020 |
| | CPI | <ul style="list-style-type: none"> • Humpe & Macmillan, 2009 • Kedia & Vashisht, 2020 |
| | Interest rates | <ul style="list-style-type: none"> • Hashemzadeh & Taylor, 1998 • Modigliani & Cohn, 1979 • Apergis & Eleftheriou, 2002 • Blanchard et al., 1993 • Saini & Sehgal, 2020 |
| | PMI | <ul style="list-style-type: none"> • Akdağ et al., 2020 • Renna, 2019 |
| | Baltic Dry Index | <ul style="list-style-type: none"> • Stopford, 2009 • Bakshi et al., 2010 |
| ASSET CLASSES | Bonds | <ul style="list-style-type: none"> • Lin et al., 2018 • Shahzad et al., 2017 |
| | Crude Oil | <ul style="list-style-type: none"> • Gisser & Goodwin, 1986 • Papapetrou, 2001 • Huang et al., 1996 |

| | | |
|--|-----------------------------|--|
| | | <ul style="list-style-type: none">• Naifar & Al Dohaiman, 2013• Chkir et al., 2020 |
| | Gold | <ul style="list-style-type: none">• Capie et al., 2005• Bhunia & Das, 2012• Baur & Lucey, 2010• Hillier et al., 2006• Shahzad et al., 2017 |
| | International stock markets | <ul style="list-style-type: none">• Bhunia & Yaman, 2017• Balios & Xanthakis, 2003• Sharda, 2020 |
| | USD | <ul style="list-style-type: none">• Johnson & Soenen, 2004• Bahmani-Oskooee & Sohrabian, 1992 |

Source: Elaborated by the author.

3. OBJECTIVE AND HYPOTHESIS

The main objective of this study will be finding the determinants that have influenced the price of the Dow Jones Industrial Average Index since 1971. This will shed light on the most important questions for the study: What are the relationships and dynamics between the Dow Jones Industrial Average and other asset classes? In which way did the determinants affect the Dow Jones under crisis?

Based on the historical background and from the raised questions, it is possible to distill 4 empirical hypotheses about the factors that have influenced the price of the Dow Jones Industrial Average since 1971.

***H1.** There is a negative relationship between the interest rates of bonds and the price for the Dow Jones Industrial Average.* As Saini & Sehgal (2020), Apergis & Eleftheriou (2002) and Blanchard et al. (1993), that conducted studies in advanced and emerging markets, found that the continuous reduction of interest rates incentives inflow of capital into the stock market, thus, raising its returns.

***H2.** There is a positive relationship between the price of crude oil and the price for the Dow Jones Industrial Average.* Authors Chkir et al. (2020), who studied the effects of the price of oil on multiple stock exchanges, found that there was a strong positive dependence between the price of crude oil and the stock market.

***H3.** There is a negative relationship between the price of gold and the price for the Dow Jones Industrial Average.* According to Shahzad et al. (2017), Bhunia & Das (2012), Baur & Lucey (2010) and Hillier et al. (2006), that conducted studies in Asia, Europe and North America, found that gold is considered a safe haven and when stock markets face crashes, the price of gold rises, making it a great option to diversify a portfolio.

***H4.** There is a positive relationship between the price of the dollar and the price for the Dow Jones Industrial Average.* According to Johnson & Soenen (2004), which studied the US Equity markets, found there is a strong positive relationship between the US equity market and the US dollar.

A summary of the mentioned hypotheses of the effects on the dependent variable (Dow Jones Industrial Average Index) are presented on Table 2.

Table 2. Summary of the hypotheses of the study.

| HYPOTHESIS | VARIABLE | EFFECT ON THE DEPENDENT VARIABLE | AUTHORS |
|------------|----------------------------|----------------------------------|---|
| H1 | 10 - Year Government Bonds | - | <ul style="list-style-type: none">• Saini & Sehgal, 2020• Apergis & Eleftheriou, 2002• Blanchard et al., 1993 |
| H2 | Crude Oil | + | <ul style="list-style-type: none">• Chkir et al., 2020 |
| H3 | Gold | - | <ul style="list-style-type: none">• Shahzad et al., 2017• Bhunia & Das, 2012• Baur & Lucey, 2010 |
| H4 | USD | + | <ul style="list-style-type: none">• Johnson & Soenen, 2004 |

Source: Elaborated by the author.

4. METHODOLOGY AND DATA

The empirical method of analysis that best suits this study is the time series, as it is shown in other similar papers (Liu & Long, 2020). A time series analysis allows us to observe a variable over successive periods of time. Time series has two ways to plot the data, the first one, the linear trend model, in which the plotted data is graphed using a straight line. On the other hand, the logarithmic trend model, commonly used in finance because of the exponential growth of assets, plots the data in a constant rate of growth, that means that the changes in a chart will show in proportion to the previous movements, making it easier to observe the evolution of the data (Wei, 2006). Mind that the transformation uses natural logarithms, where the base is $e \approx 2.71828$.

For the purpose of this study, two models will be used, depending on the exponential nature of the variable. The first one is the Log-linear, which will be used in the case of the dependent variable (Dow Jones Industrial Average) being in logarithmic scale and the independent variable being in linear scale. The second model will be Log-Log, in which both the dependent and the independent variables are in logarithmic scale.

The Log-linear model is represented as follows:

$$\log(Y) = \beta_0 + \beta_1(X) + \theta D + \epsilon_i$$

The Log-Log model is represented as follows:

$$\log(Y) = \beta_0 + \beta_1 \log(X) + \theta D + \epsilon_i$$

Both regressions are similar, the only difference is that in the Log-Log model, X it is also on a logarithmic scale. By observing the regressions, $\log(Y)$ represents the dependent variable of the study (Dow Jones Industrial Average Index Price), b_0 is the expected mean value of Y when $X=0$ therefore the intercept term, b_1 represents the constant rate of growth (trend coefficient), X is the explanatory variable, θD is the dummy variable that switches from 0 to 1 and finally ϵ_i is the error term.

The dependent variable of the study will be the Dow Jones Industrial Average Index, because it is composed of the most capitalized companies in the United States at a given time, therefore representing a big portion of the economy (Comincioli, 1996). This study will utilize a set of exploratory variables that will contribute to provide clarity in the variations they have on the dependent variable, that includes Interest rates (USA 10 year bond yield), Crude oil (WTI), Gold (XAU/USD) and USD (Dollar). Moreover, the control variables GDP, CPI and Unemployment rate, will be considered in this study due the direct relationship with the stock market. Furthermore, a set of dummy variables will be included in the model for a proper specification.

The time series constructed utilizes data in quarterly close from 1971 to 2021 for all variables. Sourced from Stooq, the Dow Jones Industrial Average, WTI Crude Oil, Gold, U.S. Dollar Index, 10 - Year U.S. Bond Yield, Unemployment rate of the United States and Consumer Price Index of the United States. Finally, GDP of the USA, sourced from the Federal Reserve Economic Data.

Table 3 shows the sources and data availability that will be used in this study. Table 4 displays a list of the variables used in this project and their definitions. Table 5 shows a summary of the statistics in quarterly close, starting from 1971 to 2021, with a total of 200 observations.

Table 3. Summary of the data sources.

| VARIABLE | DATA AVAILABILITY | SOURCE |
|------------------------------|-------------------|---|
| Dow Jones Industrial Average | 1971 - 2021 | • https://stooq.com/ |
| Crude Oil (WTI) | 1971 - 2021 | • https://stooq.com/ |
| Gold | 1971 - 2021 | • https://stooq.com/ |
| U.S. Dollar | 1971 - 2021 | • https://stooq.com/ |
| 10 - Year U.S. Bond Yield | 1971 - 2021 | • https://stooq.com/ |
| GDP | 1971 - 2021 | • https://fred.stlouisfed.org |
| Unemployment rate | 1971 - 2021 | • https://stooq.com/ |
| CPI | 1971 - 2021 | • https://stooq.com/ |

Source: Elaborated by the author.

Table 4. Definitions of the exploratory variables.

| VARIABLE | DEFINITIONS |
|------------------------------------|---|
| Dow Jones Industrial Average | Price of the Dow Jones Industrial Average Index |
| Dow Jones Industrial Average (Log) | Logarithmic price of the Dow Jones Industrial Average Index |
| Gold | Price of Gold |
| Gold (Log) | Logarithmic price of Gold |
| U.S. Dollar | Price of the U.S. Dollar |
| WTI - Crude Oil | Price of Crude Oil |
| 10 - Year U.S. Bond Yield | Yield of the 10 - Year U.S. Bond |
| GDP ⁺ | GDP of the USA (Millions of USD) |
| GDP (Log) | Logarithmic GDP |
| Unemployment Rate | Unemployment Rate of the USA |
| CPI | Consumer Price Index of the USA |
| 1973 | Dummy for the Oil Crisis starting in 1973 |
| 1987 | Dummy for the Black Monday crisis starting in 1987 |
| 2000 | Dummy for the Dotcom crisis starting in 2000 |
| 2008 | Dummy for the Subprime crisis starting in 2008 |
| 2020 | Dummy for the COVID-19 crisis starting in 2020 |

All the variables are in quarterly close.

⁺Calculated as magnitudes

Source: Elaborated by the author.

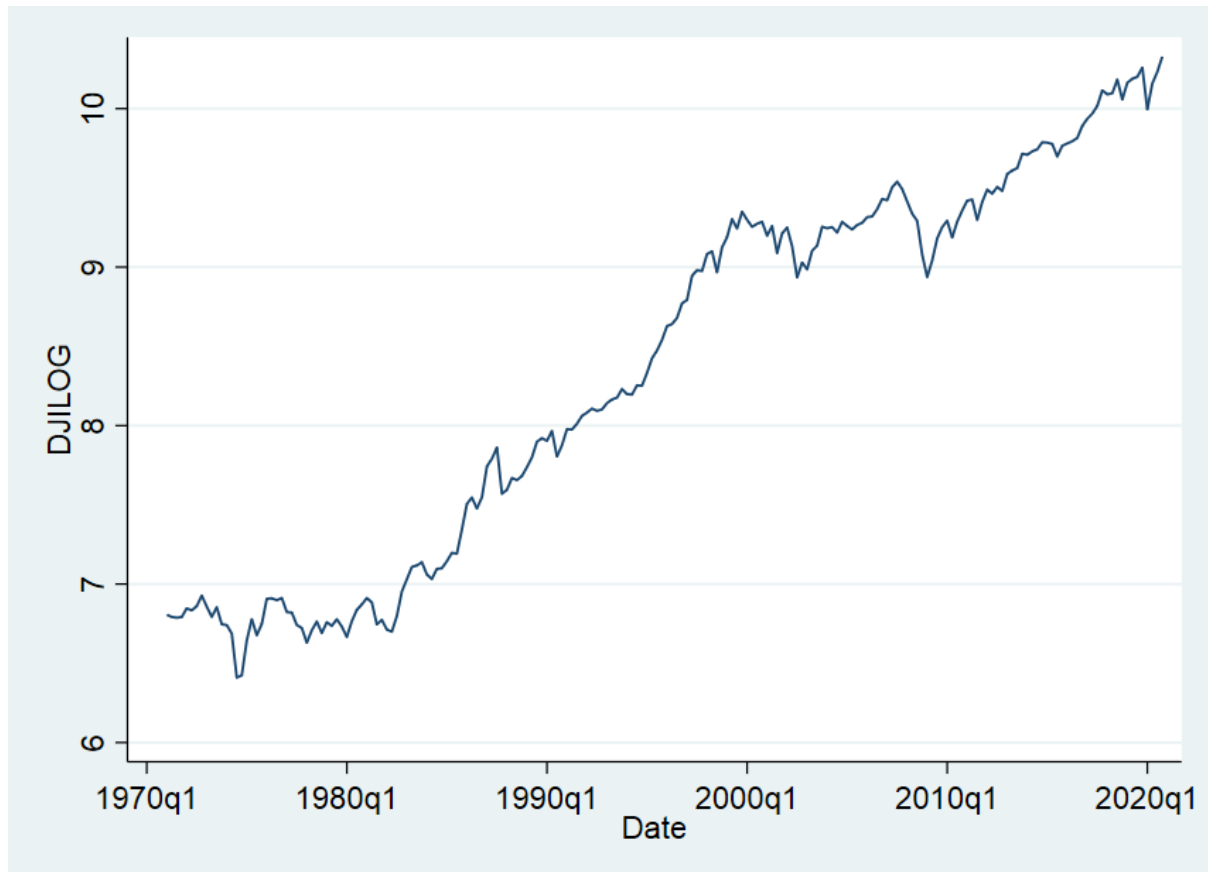
Table 5. Summary of statistics.

| VARIABLE | OBS | MEAN | STANDARD DEVIATION | MIN | MAX |
|------------------------------|-----|----------|--------------------|----------|----------|
| Dow Jones Industrial Average | 200 | 7705.152 | 7329.083 | 607.9 | 30606.48 |
| Gold | 200 | 592.6997 | 465.4487 | 39.1 | 1898.705 |
| U.S. Dollar | 200 | 69.65316 | 10.85811 | 51.415 | 105.98 |
| WTI - Crude Oil | 200 | 36.9431 | 27.7973 | 3.56 | 140.46 |
| 10 - Year U.S. Bond Yield | 200 | 6.160458 | 3.186423 | 0.658 | 15.84 |
| GDP | 200 | 9199.916 | 6160.946 | 1135.156 | 21717.30 |
| Unemployment Rate | 200 | 6.2535 | 1.635623 | 3.5 | 11.1 |
| CPI | 200 | 3.9018 | 2.985232 | -1.43 | 14.76 |

Source: Elaborated by the author.

4.1. Evolution of the historic price of the Dow Jones Industrial Average Index (DJI)

Graphic 1. Representation of the Dow Jones Industrial Average Index (1971 - 2021) in logarithmic scale.



Source: Elaborated by the author on data from Stooq.

The Dow Jones is composed of the 30 most capitalized companies in the United States of America. When it first began, it represented the average of 12 businesses. In 1916 that number increased to 20, and in 1928 it was increased again to 30 companies. Through time, the companies forming this index have changed, as new ones came disrupting. When looking at the overall trend of the index shown in Graphic 1, it is very clear that there is an uptrend, meaning, a constant increase in price in the long term. There have been, however, certain big economic downturns that have really affected the index, like the crude oil crisis in 1973, the “Black Monday” in 1987 that caused a -22.61% drop in price in a day, the 2008 Lehman Brothers collapse and the most recent one, the COVID-19 crisis, which was the biggest point drop in its history.

5. RESULTS

The results obtained regarding standardized coefficients of the Dow Jones Industrial Average are shown in table 6. The strategic modeling of this project consists of three estimation models (Regression 1, Regression 2 and Regression 3) all analyzed between 1971 and 2021. Regression 1 has all explanatory variables, control variables and dummy variables, Regression 2 does not include the dummy variables, and finally Regression 3 does not include the price of Gold. The dependent variable is the Dow Jones industrial Average in logarithmic scale, due to the exponential nature of its price, for all the regressions.

By observing Table 6, all the explanatory and control variables have a significant effect on the dependent variable. In the first regression that includes Gold, WTI, 10 - Year U.S. Bond Yield, GDP and Unemployment Rate, parallelly in the second regression, those significant variables include the same plus the U.S. Dollar, and finally the third regression includes as significant as the first one plus CPI without considering the price of Gold.

Referred to Gold, an increase of one standard deviation in Gold provokes a decrease of the price of the DJI by approximately 0'23 points for Regression 1 and 2. These results confirm the negative relationship between the price of gold and the price of the Dow Jones Industrial Average studied by the literature (Shahzad et al., 2017; Bhunia & Das, 2012; Baur & Lucey, 2010) and highlights the safe haven and diversification tool. Therefore, confirming the expectations about the third hypothesis (**H3**)

When it comes to the U.S. Dollar, an increase of one standard deviation in the USD leads to an increase of the price of the DJI by approximately 0'005 points in the second regression. These results confirm the positive relationship between this variable and the price of the Dow Jones, agreeing with the fourth hypothesis (**H4**), that previous literature also recognizes (Johnson & Soenen, 2004).

Furthermore, WTI has the similar positive effect on the price of the DJI increasing it for one standard deviation approximately by 0'0035 points in the first regression, 0'002 points in the second regression and lastly 0'0024 points in the third one. Therefore, the second hypothesis (**H2**) of this project is confirmed, giving this positive relationship between the variables studied and finding similar results to Chkir et al. (2020).

The reverse effect happens with the 10 year treasury bond yield, an increase of one standard deviation leads to a decrease of approximately 0'09 points in the price of the Dow Jones for the first regression, by 0'1 points for the second regression and by 0'09 points for the third regression. These results, as well as Saini & Sehgal (2020), Apergis & Eleftheriou (2002) and Blanchard et al. (1993) found, suggest there is a negative relationship between interest rates and the price of the stock market, making a continuous decrease of the interest rate a great scenario for the stock market to keep going up. Therefore, confirming the first hypothesis (**H1**).

Table 6. Standardized coefficients of the Dow Jones Industrial Average.

| VARIABLES | REGRESSION 1 | REGRESSION 2 (No dummy variables) | REGRESSION 3 (No Gold) |
|---------------------------|--------------------------|--------------------------------------|---------------------------|
| Gold (Log) | -0.226*** (0.0368) | -0.225*** (0.0384) | |
| U.S. Dollar | 0.00270 (0.00142) | 0.00547*** (0.00148) | 0.00124 (0.00153) |
| WTI - Crude Oil | 0.00348*** (0.000696) | 0.00171* (0.000705) | 0.00233** (0.000734) |
| 10 - Year U.S. Bond Yield | -0.0856*** (0.00583) | -0.0951*** (0.00576) | -0.0888*** (0.00635) |
| GDP (Log) | 1.204*** (0.0509) | 1.288*** (0.0531) | 0.957*** (0.0342) |
| Unemployment Rate | -0.0691*** (0.00913) | -0.0546*** (0.00954) | -0.0253*** (0.00734) |
| CPI | -0.00410 (0.00755) | 0.00977 (0.00750) | -0.0949*** (0.00886) |
| 1973 | -0.0275 (0.0742) | | -0.0398 (0.0811) |
| 1987 | -0.122 (0.0771) | | -0.239** (0.0816) |
| 2000 | 0.176* | | 0.300** |

| | | | |
|--------------|-----------------------|--------|----------------------|
| | (0.0866) | | (0.0921) |
| 2008 | -0.221*** (0.0591) | | -0.199** (0.0645) |
| 2020 | 0.534*** (0.0949) | | 0.469*** (0.103) |
| Observations | 200 | 200 | 200 |
| r2 | 0.9867 | 0.9829 | 0.9840 |

Standard errors in parentheses.

* p < 0.05, ** p < 0.01, *** p < 0.001

Time horizon: 1971 - 2021

Dependent variable (Dow Jones Industrial Average Index) in logarithmic scale

Source: Elaborated by the author.

When it comes to control variables, an increase of one standard deviation in the GDP provokes an increase of the price of the Dow Jones by approximately 1'20 points in the first regression, by approximately 1'3 points in the second regression and finally by approximately 0'96 in the third regression. The results confirm that there is a positive relationship between GDP and the stock market found in previous literature (Setiawan, 2020; Liu & Sinclair, 2008; Vithalbhai, 2020; Binswanger, 2000) and highlights the importance of positive economic growth for the stock market to appreciate in price. On the other hand, an increase of one standard deviation in unemployment rate produces a decrease in the price of the DJI by approximately 0'07 points for regression 1, by approximately 0'055 points for the second regression and by approximately 0'03 points in the third regression. These results confirm the findings of a negative relationship between unemployment rate and the stock market of previous literature (Arestis et al., 2007; Schlingemann & Stulz, 2020). The same negative effect is observed in the variable CPI, where an increase in one standard deviation leads to a decrease in the price of the Dow Jones by approximately 0'095 points in the third regression. Therefore, suggesting the same negative correlation between the CPI and the stock market as shown in previous literature (Humpe & Macmillan, 2009; Kedia & Vashisht, 2020).

Regarding the dummy variables, the financial crisis of 1987, known as the "Black Monday", led in a matter of hours global stock exchanges to plummet, the Dow Jones dropped 22'6 percent in one day, which is the largest one day stock market decline in history. What prompted the crash was the fact that the Dow Jones gained 44 percent in a matter of seven months and there were concerns about a potential asset bubble (Bernhardt & Eckblad,

2013). Therefore, this crash ended up having a negative impact on the DJI, as seen in the third regression. During the Dot com bubble, the Dow Jones was not affected by it because in the 2000 the technological components did not represent a major share of the index (Jones & Kincaid, 2014), consequently leading to a price increase in the DJIA index as shown in regression 1 and 3. On the other hand, the global financial crisis of 2008 triggered the most serious economic downturn since 1929. During the first months of the great recession, economic output, global trade and equity markets plummeted lower than they did in the first months of 1930 (Drezner & McNamara, 2013). This provoked a massive downtrend on the Dow Jones, in other words, it had a very negative impact on the price of the DJI, represented in regression 1 and 3. Finally, the novel COVID-19, due to lockdowns and the almost shutdown of the economy, affected the price of the Dow Jones. Despite that, global stock markets had an aggressive V shape recovery, which made the DJI break new all time highs before the end of the year (Ngwakwe, 2020). Therefore, as regression 1 and 3 show, the COVID-19 crisis had a positive impact on the Dow Jones Industrial Average.

In order to provide more confirmation with the results provided, it is convenient to perform a robustness test model. This test divides the entire time series into two, the first model going from 1971 to 2008 and the second from 2008 to 2021. As it can be observed in table 8 in Annex 1, the regressions implemented show that even though the regressions are divided, the significance and relationships remain the same for the time series of 1971 - 2008. On the other hand, as shown in table 9 in Annex 2, for the time horizon of 2008 to 2021, the significance of the exploratory variables worsens, despite that the relationship between the variables and the Dow Jones remains the same.

In Table 7 can be observed a summary of the hypotheses of the research with its expected effects and authors and the results found, therefore, to the accept or reject of the hypothesis.

Table 7. Summary of the hypotheses with the results found.

| HYPOTHESIS | VARIABLE | EFFECT ON THE DEPENDENT VARIABLE | | AUTHORS | RESULTS |
|------------|----------------------------|----------------------------------|-------|---|---------|
| | | Expected | Found | | |
| H1 | 10 - Year Government Bonds | - | - | <ul style="list-style-type: none"> • Saini & Sehgal, 2020 • Apergis & Eleftheriou, 2002 • Blanchard et al., 1993 | ✓ |
| H2 | Crude Oil | + | + | <ul style="list-style-type: none"> • Chkir et al., 2020 | ✓ |
| H3 | Gold | - | - | <ul style="list-style-type: none"> • Shahzad et al., 2017 • Bhunia & Das, 2012 • Baur & Lucey, 2010 | ✓ |
| H4 | USD | + | + | <ul style="list-style-type: none"> • Johnson & Soenen, 2004 | ✓ |

Source: Elaborated by the author

6. CONCLUSIONS

This final degree project presents an empirical study of research about the determinants that have affected the Dow Jones Industrial Average Index since 1971. In order to contribute to the literature, this study provides a quantitative analysis of the dynamics between the DJI and other asset classes. The research investigates the relationships between the Dow Jones and Gold, WTI, 10 year treasury bond yield and USD, from 1971 to 2021.

This study presents four factors that determine the price of the Dow Jones. The first finding affirms that there is a negative relationship between interest of the bond yields and the price of the DJI. Therefore a reduction in this variable increases the price of the Dow and its return. Regarding the second finding, it argues that there is a positive relationship between crude oil prices and the Dow Jones Industrial average. Referring to the third finding, the empirical research shows that there is a negative relationship between the price of gold and the price of the Dow Jones. The results presented give to the literature a highlight of the importance of this factor, because the increment of this commodity leads to a substantial reduction in the price of the Dow. Lastly, the results found in the last finding suggest that there is a positive correlation between the USD and the DJI.

Furthermore, empirical findings shed light on some additional factors regarding the determinants of the price of the Dow Jones. On the one hand, another significant coefficient that affects the price of the DJI is the GDP, which allows us to conclude that economic growth leads to a better return on investment for the Dow Jones. On the other hand, unemployment rate and inflation lead to a decrease in the price of the Dow. Which means that the economy is not doing very well and money printing is probably out of hand. Moreover, not all the crises that have occurred since 1971 had a negative effect on the price of the Dow Jones, because of its dynamic change of businesses and ponderation.

The analysis of the determinants of the Dow Jones can help understand the impact these variables have on the real economy too, as the stock market and GDP are so closely related. Identifying these determinants can help propose better portfolio management by diversifying investments for a better risk adjusted return, therefore reducing the impact of future potential economic crises.

As graph 1 shows, the general trend for the Dow Jones is an uptrend. However, out of the time horizon studied (1971 - 2021), approximately 20 years its price goes down or sideways, that includes from 1971 to 1980 and from 2000 to 2010. Therefore, a portfolio that also

includes assets that perform well during this time is a must. It is important to diversify not only with different businesses like the Dow Jones does, but also with other asset classes, including Gold and Bonds, because of the negative relationship they have with the stock market. Considering the 50 years studied, the Dow Jones has performed well during 30 years, that means 60% of the time, consequently a well balanced portfolio could look something like 60% Dow Jones, 15% Gold and 25% Bonds. The reason a portfolio should have more bonds than gold is because they are less volatile and the negative relationship is lower, making it a better option knowing that the stock market tends to do better more than half of the time, the higher the negative relationship the worse the asset will perform during the times that the Dow Jones performs the best.

The main limitation of this study is not to have the same time horizons available for all variables. Furthermore, this time series analysis was conducted in only one country, further research could carry out further analysis on the impact of these variables on other countries with important indices like Japanese Nikkei.

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8. ANNEX

8.1. Annex 1 Standardized coefficients 1971 - 2008

Table 8. Standardized coefficients of the Dow Jones Industrial Average | 1971 - 2008.

| VARIABLES | REGRESSION 1 | REGRESSION 2 (No dummy variables) | REGRESSION 3 (No Gold) |
|------------------------------|-------------------------|---|---------------------------|
| Gold (Log) | -0.472*** (0.0668) | -0.474*** (0.0659) | |
| U.S. Dollar | -0.00497* (0.00222) | -0.00248 (0.00213) | 0.00215 (0.00231) |
| WTI - Crude Oil | 0.00437*** (0.00117) | 0.00364** (0.00116) | 0.00219 (0.00131) |
| 10 - Year U.S. Bond Yield | -0.0415*** (0.0108) | -0.0513*** (0.0101) | -0.0919*** (0.00937) |
| GDP (Log) | 1.311*** (0.0645) | 1.353*** (0.0607) | 0.984*** (0.0522) |
| Unemployment Rate | -0.0584*** (0.0131) | -0.0600*** (0.0132) | -0.0932*** (0.0141) |
| CPI | -0.0150 (0.00895) | -0.000399 (0.00788) | -0.0268** (0.0102) |
| 1973 | 0.171* (0.0670) | | 0.0983 (0.0771) |
| 1987 | -0.125 (0.109) | | -0.229 (0.126) |
| 2000 | 0.135 (0.0755) | | 0.230** (0.0865) |
| Observations | 148 | 148 | 148 |
| r ² | 0.9807 | 0.9793 | 0.9719 |

Standard errors in parentheses.

* p < 0.05, ** p < 0.01, *** p < 0.001

Time horizon: 1971 - 2008

Dependent variable (Dow Jones Industrial Average Index) in logarithmic scale

Source: Elaborated by the author.

8.2. Annex 2 Standardized coefficients 2008 - 2021

Table 9. Standardized coefficients of the Dow Jones Industrial Average | 2008 - 2021.

| VARIABLES | REGRESSION 1 | REGRESSION 2 (No dummy variables) | REGRESSION 3 (No Gold) |
|------------------------------|---------------------------|--------------------------------------|---------------------------|
| Gold | -0.0000946 (0.0000891) | -0.000160 (0.000104) | |
| U.S. Dollar | 0.00239 (0.00345) | -0.00710 (0.00401) | 0.00306 (0.00340) |
| WTI - Crude Oil | 0.00244** (0.000705) | 0.00159 (0.000910) | 0.00220** (0.000668) |
| 10 - Year U.S. Bond Yield | 0.00668 (0.0229) | -0.00398 (0.0273) | 0.0265 (0.0133) |
| GDP (Log) | 2.349*** (0.284) | 3.559*** (0.251) | 2.179*** (0.235) |
| Unemployment Rate | -0.0200 (0.0134) | 0.0339** (0.0117) | -0.0297** (0.00982) |
| CPI | 0.0105 (0.00894) | 0.0170 (0.0105) | 0.00525 (0.00745) |
| 2008 | -0.166*** (0.0383) | | -0.157*** (0.0374) |
| 2020 | 0.325*** (0.0593) | | 0.343*** (0.0570) |
| Observations | 52 | 52 | 52 |
| r ² | 0.9849 | 0.9725 | 0.9845 |

Standard errors in parentheses.

* p < 0.05, ** p < 0.01, *** p < 0.001

Time horizon: 2008 - 2021

Dependent variable (Dow Jones Industrial Average Index) in logarithmic scale

Source: Elaborated by the author.