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Geopolitical Risk and Financial Markets: Evidence from the 2022 Russia – Ukraine War

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Introduction

During recent years, the world has gone through different sorts of geopolitical and macroeconomic turmoil that have affected financial markets. Among these, the Russia–Ukraine war, which erupted on the 24th of February 2022, has been identified as one of the most significant for the global financial system. Because of the countries' significant economic roles in sectors such as energy and agriculture, the war caused radical disruption and volatility in the markets. This thesis aims to examine empirically how financial instruments such as stock indexes, commodities, and currencies have responded to the sudden flare of conflict.

The paper starts with discussing its main objects of study: financial markets themselves and their sensitivity to external disturbances. Chapter 1 provides an overview of the multiple segments of financial markets and introduces the structure and importance of asset classes. The main market forces that shape asset returns, including market volatility, investor sentiment, and macroeconomic variables, are emphasized in Chapter 2. The main body of this paper, provided in Chapter 3, is a detailed quantitative analysis. It utilizes an econometric model that attempts to isolate the effect of the event on the daily returns of the assets observed.

The focus of the empirical analysis is not primarily on measuring the effect of the war itself. Instead, the main intent is to capture how investor response and sentiment, the volatility of equity markets, and the fluctuations of the US dollar affect the performance of those financial instruments. In this context, the thesis is seeking to answer one pivotal question for investors: Which types of assets are classified as “safe havens” and which are most at risk in the event of a geopolitical crisis? The findings may provide significant implications for investment strategy and risk management in an unpredictable financial environment.

Chapter 1 – Overview of Financial Markets

1.1 Financial Markets

Consider an entrepreneur seeking to develop and launch on the market a food delivery application. The successful realization of the venture would require a substantial investment of capital, and the lack of sufficient financial resources could constitute a deterrent to entry. At the same time, an investor located in Spain has an abundant amount of money that he wishes to invest for retirement and to increase his savings. The collaboration between the two parties could yield a mutually advantageous outcome, and this is made possible by the existence of financial markets.

Financial markets are typically defined as a marketplace where the trading of financial holdings occurs. This term encompasses a wide number of organizations, including banks, building societies, and numerous other financial institutions situated in several capital centers all around the world. The essence of this marketplace is to facilitate the connection between two groups of people: Investors (Lender-Savers): Individuals who possess funds and are willing to either land them or invest them for a fixed period; and on the other side there are the Borrowers (Borrower-Spenders), those who are looking for capital as the entrepreneur in the example above, the government and companies in general. Nevertheless, it is imperative to first delineate the distinction between direct and indirect financing. In direct financing, the borrowers directly get money from lenders, who inject funds into the financial markets by selling financial instruments, which become claims on the borrower's future income or asset. Conversely, indirect financing introduces a pivotal figure in this marketplace, that of the financial intermediaries, such as banks, whose objective is to make a profit by facilitating the exchange of funds in the markets. This phenomenon is made possible because borrowers must bear the cost of withdrawing funds from the markets, which is often in the form of interest paid on the money borrowed or dividends paid to investors if we are talking about a company. At the same time, investors seek a return on their capital, which is a rational expectation given the risk of providing funds without the expectation of reimbursement. All these prompts lead to the question of how banks or other financial intermediaries generate profit. If the bank can strategically balance the fees charged to borrowers to set up a loan while allocating a smaller portion of those costs to investors, it can skim off a margin. This is the conventional method by which retail banks generate a profit by bringing together

individuals seeking financial resources and those willing to lend money in exchange for a return (MoneyWeek, 2011).

1.2 Importance of financial markets

This preliminary analysis of financial markets has shown how they play a pivotal role in capitalist economies in both developed and developing countries. In Italy, its awareness and significance are growing over time as it emerges from the investigation of Consob (Commissione Nazionale per le Società e la Borsa). The *"Rapporto 2021 sulle scelte di investimento delle famiglie italiane" ("2021 Investment Survey of Italian Households")* surveyed 2700 individuals between the ages of 18 and 74. This article's principal finding is that participation in financial markets is on the rise. Specifically, in 2021, the proportion of investors was 34% of the individuals involved in the study, while in 2019 it was about 30% ("Bollettino - AREA PUBBLICA - CONSOB", 2021).

As discussed in the preceding paragraphs, financial markets have a major role in the allocation of financial holdings, including money, bonds, or shares. This guarantees a consistent and reliable flow of capital among investors, companies, and the government. In this environment, the main actors receive appropriate treatment and can readily access capital, thereby fostering liquidity and the smooth functioning of the economy, while allowing investors to participate in capital returns over the long or short term. The aforementioned factors are essential for economic development and stability within a nation, considering also the role of financial markets in job creation, which in turn contributes to the reduction of the unemployment rate within a country. Therefore, the absence of financial markets would hinder the easy access and availability of capital and funds, making it difficult for businesses to raise funds for growth, for governments to finance projects, and for investors to participate in economic growth. This is inevitably the reason why financial markets have been identified as indicators of a country's economic health and influencers of monetary policies. Moreover, without them, there would be a sudden decline in economic activities such as commerce and trade, investments, and growth opportunities. This underscores the impact that financial markets have not only on the economy of a country but also on the global economy as a whole (Adam Hayes, 2024).

The significance and function of financial markets have thus been clarified, thereby it is critical to make a clear differentiation among their various types. Financial markets comprise a large-scale ecosystem that can be categorized into different segments, based on the type of assets traded and their short-term or long-term nature. Each one of these markets boasts unique characteristics in terms of its impact on the economy, the amount of capital, and liquidity they generate, other than the individuals or entities involved, which vary significantly between them. A comprehensive understanding of these differences is indispensable for investors, as it enables them to assess the risks involved in the investment environment and the deriving opportunities and returns that may be generated. This knowledge will help to decide the most suitable time, strategy, and marketplace to invest ("What Are Financial Markets? Definitions, Functions, and Types of Financial Markets", 2024).

Indeed, this work aims to elucidate the dynamics of the different types of financial markets in response to an event of worldwide impact, the underlying rationales and critical factors leading to these shifts, and the investor responses, reactions, and measures to be taken to compensate for these movements. Their decision concerns the most appropriate financial market segment to choose in the event of such a geopolitical crisis. The analysis is based on a historical examination of the prices of the main indexes in each market. The following paragraphs will provide a more detailed overview of each type of financial market that is included and deeply analyzed in this work.

1.3 Money Markets

The predominant distinction between financial markets is the time at which they operate. The money market is, par excellence, the segment that is focused on the short term, usually with durations of less than a year. This market is focused on borrowing and lending funds and catering to the necessities of companies or governments needing to borrow money for a short time. In such cases, they are going to pay an appropriate interest rate that is commensurate with the risk involved, though the returns are not the highest. Indeed, money markets are distinguished by a high degree of safety and a relatively lower interest return than other markets. Nevertheless, these markets are essential to preserve economic stability. They facilitate access to funds for short-term investments, ensuring banks, governments, and companies manage their liquidity and maintain stable cash

flow. In this marketplace, individuals do not invest in stocks; rather, they purchase other financial holdings such as treasury bills, certificates of deposit (CDs), commercial paper, and short-term government or corporate bonds. These instruments indicate the amount of money borrowed or lent that should be returned after less than a year. At the wholesale level, the money markets include transactions between institutions and traders, with values ranging from $5 million to over $1 billion, so we are talking about significant trading volumes. On the other hand, at the retail level, the markets involve mutual funds purchased by individual investors and accounts initiated by bank customers, in which case the value of the transactions is significantly smaller (Adam Hayes, 2024).

1.4 Equity or Stock markets

Up to now, financial markets have been considered to deal with time horizons of up to about twelve months. However, when companies, governments, or entrepreneurs want to borrow money for more extended periods, they will tap into capital markets. The predominant example and possibly the most pervasive of these markets is the stock or equity market. In a nutshell, stock markets are venues where traders purchase and sell shares of publicly traded companies, such as Apple, Google, and Tesla, to cite some. In this marketplace, companies directly issue stocks or bonds, which are made available to the public either through initial public offerings (IPOs) or directly on the stock exchange markets. Regarding the latter, the most prominent and relevant listed exchanges are the New York Stock Exchange (NYSE), Nasdaq, and the London Stock Exchange. It is important to acknowledge that stock trading is highly regulated and is a major way for money to flow through the economy. The average trading volume in the U.S. stock market is as follows:

- New York Stock Exchange (NYSE): Trades around $1.5 to $2.5 trillion daily.
- Nasdaq: Trades around $200 to $300 billion daily.
- Total U.S. Stock Market: Daily trading volumes exceeding $3 to $5 trillion when including all exchanges and assets (stocks, ETFs, options, etc.), (“Ravindra Todkar”, 2019).

This segment of the financial market can be thought of as one of the most viable alternatives when companies need to raise capital and borrow money for a long period, such as 10 years. To illustrate, consider an aviation company willing to expand its fleet

of aircraft, which is a long-term investment. One method to fund such a costly project is to issue shares or large blocks of equity to investors, who then have the opportunity to buy them. A significant incentive for investors to proceed with the purchase is that they would immediately become owners of the company, gaining voting rights which enable them to exert direct influence on major corporate decisions. Furthermore, the perspective of financial gain generated by selling the purchased shares, contingent upon the appreciation of the intrinsic value of the stock resulting from the company's performance, is a further motivation. It is also noteworthy that some companies even distribute dividends to their investors, which constitutes another form of earnings for individuals ("What Are Financial Markets? Definitions, Functions, and Types of Financial Markets", 2024).

Therefore, the predominant actors within the stock market are investors or traders and market makers (MMs). Brokers are then third parties to facilitate the exchange of shares between buyers and sellers (Adam Hayes, 2024). However, it is worth noting that investing in stocks is not straightforward and requires an understanding of market trends, company performance, financial analysis, and serious risk assessment. The stock prices of a company are subject to fluctuations driven by numerous forces. The major factors affecting their value are surely the supply and demand of the title, the financial status and performance of the company within the markets (which can be captured by economic reports), trader sentiment, influential political decisions, and even events that have a global or local impact (David R. Harper, 2024).

1.5 Commodity markets

The second segment of financial markets that will be a part of data collection for this work is the commodity markets. In contrast to what many people believe, the stock market is not the only place in which an individual can speculate on the price of an asset, hoping to receive a desirable return in the future. However, unlike the stock market, the commodity market is a venue specializing in the exchange of tangible financial holdings. In this marketplace, commodities are traded among investors. Their objective is to diversify their portfolio. The end of this paragraph will elucidate the rationale underlying this approach. Before delving into this segment, it is crucial to distinguish between the

two types of commodities that may be available to traders. The difference is based on their inherent nature, and they are:

- Hard commodities: This category includes precious metals (e.g., gold, silver, copper, platinum, etc.) and energy assets (e.g., crude oil, natural gas, gasoline, etc.).
- Soft commodities: These commodities are associated with agriculture (soybeans, wheat, coffee, etc.) and livestock and meat (Groww, 2015).

The main characters in the commodity markets have been outlined. The succeeding steps will address the mechanics of the markets, which are not as simple as those in the stock market. First and foremost, the commodity market is a physical marketplace, also known as the spot market. There, these primary products are bought and sold by individuals or companies. Nevertheless, it is indispensable to acknowledge the existence of the parallel, yet interconnected, world of the financial commodity or derivative markets. In this sector, individuals do not engage in the exchange of physical goods. Instead, they settle their future prices through futures contracts[1]. Only when the contract expires does the physical exchange materialize.

The complexity of commodity market trading outweighs that of stock trading. Its comprehension requires a broad awareness of the arduous world of the derivatives markets, which encompasses forwards, futures, and options. Once more, commodities can either be physically exchanged or can even be bought and sold on exchanges. Leading examples of these exchanges include the Chicago Mercantile Exchange (CME) and the New York Mercantile Exchange (NYMEX). Notwithstanding, commodities and stock markets are typically inversely related. Indeed, during periods of rising price levels (inflation), a decline in stock prices is commonly observed. Conversely, the prices of commodities traded exhibit a powerful boost. This explains why many investors decide to participate in this type of market. Primarily, it is a way to diversify a portfolio, thereby mitigating risks and potential losses. An additional advantage is that commodities can be utilized as a hedge against inflation, which may also lead to higher interest rates. Lastly,

[1] *A futures contract is a legal agreement to buy or sell a particular commodity asset, or security at a predetermined price at a specified time in the future* (Adam Hayes, 2024).

their relatively low sensitivity to market volatility makes this segment even more attractive to investors (Kim Oosterlinck, 2009).

1.6 Foreign exchange markets (FOREX)

To conclude this general overview of financial markets, this section will cover foreign exchange markets (FOREX). They are included in this work, but not as predominantly as the first two markets. Nevertheless, they still play a pivotal role within the financial environment. Indeed, it is the most actively traded market in the world. It is open 24 hours per day, 7 days per week. Every day, on average, over $7.5 trillion is traded, more than the figures we see in the stock and futures markets combined (Adam Hayes, 2024). This makes it the most liquid and active financial market.

In this segment, national currencies are traded globally. It facilitates individuals, businesses, and governments to buy and sell currencies, trying to derive a profit. More specifically, the currencies come in pairs, as exemplified by the USD/GBP pair. In this scenario, the US Dollar is the base currency. The British Pound, instead, is the counter currency. Investors will purchase this currency pair if they forecast a future appreciation of the dollar against the pound (or a depreciation of the latter). The factors that lead to a currency's value increase or decrease are rooted in major national and international economic, financial, and political events. For example, during Brexit, many traders expected the Pound to depreciate against the Dollar. This is what happened on the 23rd of June 2016, after the national referendum. In the span of a week, the value of the Sterling against the Dollar went down from 1.4851 to 1.3307 ("British Pound-U.S. Dollar History: 2016", 2016). This signified a depreciation of the British currency of 10.4% against the Dollar and an appreciation of the American currency. Hence, investors who opened the trade on the referendum day and closed it the week after generated a profit of 10.4%.

1.7 Overview of the work

Now that the financial markets have been carefully examined, it is dutiful to describe the scope of this work. Indeed, the subsequent section of this study will explore the main forces that may affect returns in the stock markets. Later on, statistical regressions will be run to meaningfully analyze and comprehend the impact of the Russia-Ukraine war on the prices of the main stock market indices in both developed and developing countries, and this is the reason why China and India are included. The interpretation of the results

will be focused on identifying the critical factors that lead to an increase or decrease in the price of an index, and the reasons behind it. The examination will be based on the correlation that these dependent variables have with the stock value throughout the occurrence of the studied event.

As previously mentioned in this paper, data and information summarize the historical prices of the main stock market indices in both developed countries (the United States, Germany, and Italy) and two other countries considered developing economies (China and India). The chief objective is to ascertain the critical factors that are responsible for the rise or fall in the price of national indices. Hence, the analysis encompasses historical data from the following indices:

- S&P 500. This index is designed to monitor the share prices of the 500 largest publicly traded companies in the United States. It represents 80% of the total US stock market's value, so it reflects perfectly the overall performance and sentiment of investors in the largest economy of the world ("What Is the S&P 500? | S&P Meaning – HSBC UK", 2025).
- DAX. It tracks the performance of the 40 largest German companies listed on the Regulated Market of the Frankfurt Stock Exchange (FSE). It offers a valuable overview of how the performance of Europe's largest economy ("DAX | STOXX", 2025).
- FTSEMIB. It is a stock index consisting of the largest and most liquid companies on the Italian national stock exchange ("What Is the FTSE MIB 40? | IG UK", 2019). The selection of this specific index is primarily motivated by the fact that it is important to understand what happens economically speaking in our country, and how the Italian stock markets and companies react to external factors.
- SSE Composite Index. This index comprises all stocks traded on the Shanghai Stock Exchange (SSE). It serves as an effective barometer for the Chinese economy, which is currently the fastest-growing in the world ("What Is SSE Composite Index", 2019).
- BSE SENSEX. It serves as the benchmark stock market index for India. It is a composite of the 30 most traded stocks on the Bombay Stock Exchange (BSE) (Bajaj Finserv, 2023).

The rationale underlying the choice to analyze national indices rather than just companies is that the former, in most cases, accurately reflects the stock performance of companies in that country and how they react to the event analyzed in this thesis.

Nevertheless, the present study aims not only to apprehend the impact of the war on the stock market. The implications of the observed event will also be analyzed on the commodity market side. The rationale is straightforward. As previously mentioned in the commodity market paragraph, an inversely related relationship between the two markets is typically observed. The intent is to determine whether this phenomenon is consistently respected in most scenarios. Therefore, it is forecasted that a rise in the prices of commodity futures contracts accompanies a decrease in stock index prices. However, will this always be the case? This inquiry will be addressed in the second part of this work. The data collection is focused on the historical prices of three commodities' futures. All of them are traded on the NYMEX and include:

- Crude Oil WTI Futures.
- Natural gas Futures.
- Gold Futures, which is typically seen as a safe-haven asset.

These are the most traded commodities between investors. Moreover, these materials are closely interconnected to critical geopolitical events. Indeed, after their occurrence, the prices of some of these commodities have greatly reacted, either increasing or decreasing. An evident case is the price of natural gas after the Ukrainian war, which has increased substantially in the following weeks.

At the same time, it is critical to acknowledge that currencies are generally regarded as safe-haven assets. This is one of the main reasons why investors include them in their portfolios. Therefore, this study will also analyze the impact of the conflict on the Swiss Franc (CHF) paired with the US dollar. The choice of the Swiss currency is not random, since it is recognized as one of the most stable and safest currencies. This is primarily explained by Switzerland's policy of political neutrality and fiscal prudence. These decisions have consistently permitted the value of the Franc to increase over the last decades. This perception of a robust currency has led people to consider it a safe-haven asset, especially during periods of high market volatility and uncertainty, which will be discussed in the forthcoming chapter.

Chapter 2 - The Sensitivity of Financial Markets to Market Forces

This chapter will provide an exhaustive illustration of the main market forces that play a pivotal role in financial markets. It will elucidate the impact of these forces on the prices of the various financial instruments traded in the stock, commodity, and FOREX markets. This is fundamental to understanding the financial movements in the segments in which data has been collected.

Given the multitude of factors that influence the dynamics of financial markets, it would be impractical to conduct an in-depth analysis of each one of them. Moreover, in some instances, their correlation with asset prices is not statistically significant enough to necessitate detailed consideration. Therefore, this chapter will focus on the analysis of the main market forces that will also be incorporated into the quantitative regressions presented in Chapter 3. The further objective of this work is to demonstrate the significance of the correlation between the selected market forces and the prices of financial instruments across different segments whose performance has been observed.

To conclude, the present chapter will first delve into the law of supply and demand. Subsequently, the focus will shift to other crucial market forces. These include interest rates, the Volatility Index (VIX), and investor sentiment.

2.1 Law of Demand and Supply

This first paragraph will address the law of demand and supply. It is the basic economic principle that drives the setting of the prices of almost everything. This law elucidates the interaction between the quantity of goods that consumers are willing to acquire (demand) and producers are willing to provide (supply). In a competitive market, the intersection between these two curves determines the price of a given good. The demand for every asset is positively correlated with its price. Thus, if the demand rises, the price of that good grows as well. On the other hand, supply exhibits a negative correlation. Indeed, when the production of an asset is increased, it renders it more available to consumers, therefore, the price is destined to fall. Vice versa holds in both cases. Hence, whenever demand decreases or supply increases, a drop in the price is observed.

To illustrate this law, consider the context of the FOREX market. Assume that the U.S. Federal Reserve (FED) decides to increase interest rates. This policy would attract many

foreign investors since returns in the US would be higher. Accordingly, the greater the number of investments in America, the higher the demand for its currency, with which investors purchase those US assets. As a direct consequence, the value of the Dollar will grow in relation to other currencies. Appreciation is observed, characterized by an increase in the demand for the asset. This is what happened in 2022-2023 with the Federal Reserve's aggressive monetary policy aimed at counteracting the increasing level of inflation in the country. In approximately one year, the benchmark interest rate jumped from almost 0% to between 5.25%-5.50%. This attracted more foreign investors to America, who had to convert their currencies into US dollars to purchase US assets. Concurrently, the FED reduced the quantity of money in circulation. In the end, the increase in demand and the decline in supply of the currency led to a significant appreciation of the US dollar in relation to major other currencies (Mengxue Tian). This phenomenon is a clear consequence of the law of demand and supply, which is valid for all asset classes.

Nevertheless, it is crucial to acknowledge that demand and supply are not the only forces that determine the price of a good. Otherwise, investing would be a straightforward task, and returns would be guaranteed. An investor would only need to interpret the levels of demand and supply of a stock, a currency, or a commodity, and that would suffice. However, not all that glitters is gold, and when it comes to price predictions, thousands of other factors come into play. The multitude of these factors is such that it would be unmanageable to enumerate all of them. Therefore, this work will address only the most influential and relevant forces that impact the sensitivity of financial holdings.

2.2 Interest Rates

In the paragraph above, the impact of interest rates on the foreign exchange market has been observed. However, it is not the only segment of financial markets affected by this instrument. Interest rates are adjusted by a country's central bank to maintain the economy as healthy as possible. It helps to slow or smooth the impact of rising inflation and to stimulate economic activity during periods of recession. Central banks can affect the overall interest rates by acting directly on the federal funds rate. They are the interest rates at which financial institutions borrow or lend funds. Moreover, whenever a change in federal fund rates occurs, an adjustment in rates set by every other financial entity or

business is observed. Therefore, it is evident that the interest rate imposed by a central bank exerts a significant influence on the economy of a country as a whole. This impact also extends to financial markets and the spending habits of consumers. The following paragraph will elucidate the interconnectivity of these financial mechanisms and explain why changes in the interest rate set by the central bank are so powerful.

The impact on spending is trivial yet crucial to mention. A lower interest rate implies lower costs for borrowing. Individuals and companies become more willing to borrow funds for big purchases. Consequently, consumption is boosted, and a general increase in spending is observed. On the other hand, an increase in interest rates generates the opposite effect. In this scenario, investors and businesses opt to cut back on spending and prioritize saving, as it becomes more expensive to get funds. A direct consequence of this change in spending habits is reflected in the stock market. This segment is the fastest to respond to fluctuations in the federal fund rate.

As previously stated, if the central bank decides to raise interest rates, the cost of borrowing capital grows. This causes two unpleasant situations for a typical company. Firstly, it can decide to conserve financial resources and wait for the interest rates to decline again. This leads to a reduction of capital raised, therefore fewer investments, which negatively impacts growth prospects. At the same time, if a business requires additional funds and must resort to borrowing, its debt costs would rise substantially. Both factors inevitably compromise the revenues of a company and profit expectations for the future. Therefore, the cash flow is expected to decline. This chain of events can culminate in a drop in the price of a company's stock.

In addition, if a great number of businesses experience a negative impact from rising interest rates, then the whole market will go down consequently. This phenomenon is then reflected in the negative performance of key indexes, such as the S&P 500 or Dow Jones. However, we shouldn't paint ourselves all with the same brush. Indeed, some industries profit from a scenario of rising interest rates. The main beneficiary is the financial industry, which includes banks, brokerages, mortgage companies, etc. The rationale underlying their advantage is straightforward. These are the financial institutions that lend money to other entities or individuals. Therefore, if the cost of

borrowing rises, their return will be higher too, because they are now permitted to charge higher interest rates and so generate a profit (Chris Seabury, 2024).

So far it has been elucidated the impact of interest rates (in particular the federal funds rate, imposed by the central bank) on the FOREX and stock markets. However, it is crucial to point out that they strongly influence other segments, particularly the bond market. Furthermore, they also serve as a key instrument to affect the macroeconomic landscape of a country. Their manipulation by the central bank aims at reversing the effects of inflation or recession in a nation. However, this is not intrinsic to financial markets; therefore, it is enough to provide this quick insight, with the focus instead being placed on the other market forces that play a pivotal role in the financial markets, such as the volatility index (VIX), which will now be illustrated.

2.3 Volatility Index

Before discussing this influential market force, it is crucial to acknowledge the concept of volatility. Volatility is an instrument utilized to measure the frequency and magnitude of price fluctuations. It illustrates how much the price of a financial holding rises or falls in a given period. It follows that higher volatility implies large and unstable price fluctuations. Instead, if the prices of financial instruments rise or fall in a regular and stable pattern, volatility is low. There are two types of volatility:

- Realized volatility, which deals with past prices. It is computed using historical price changes of assets.
- Expected volatility, which looks to the future. It measures the expected future fluctuations of prices that are implied by an analysis of option prices. The VIX index falls into this category ("VIX Index", 2025).

With that being clarified, the VIX index will now be carefully examined. It was introduced in 1993 by CBOE Global Markets and was the first index to ever provide an estimate of future market volatility. Nowadays, it serves the same function. Indeed, *The VIX is an index that measures expected volatility on the S&P500 for the next 30 days. It is calculated from the trading of options for the next 30 days.* Although the VIX is based on the performance of the S&P 500, many investors believe that it is still a general indicator of the volatility of the entire stock market. It can therefore be argued that this index *aims to reflect investor expectations for the 30-day predicted volatility of the stock*

market. This is the primary reason why it is recognized as the world's "fear gauge" of the market.

So far, we have inferred that the VIX index generates a 30-day forecast of stock market volatility. This is achieved by aggregating the weighted prices of S&P 500 index puts and calls. The final result provides an estimate of the expected price fluctuations in the stock market. Therefore, the behavior of investors is strongly influenced by the trend of this index. Indeed, VIX assesses the level of risk, anxiety, or uncertainty in the market.

It is peculiar to notice that VIX and the S&P 500 performance are negatively correlated. Whenever high volatility is observed, investors are more "scared" and uncertain about the stock market performance. This level of nervousness usually causes the S&P 500 to fall. On the other hand, when the volatility index falls, the market is experiencing stability. Hence, investors feel more relaxed and comfortable about investing. The trust in the performance of the stock market rises, which usually causes the S&P 500 index to grow as well. For example, this inverse relationship was observed during the 2008 financial crisis. During this period, the VIX index reached its maximum score of 89.53 points. At the same time, the S&P 500 experienced one of the worst moments in its history in terms of returns.

Then, it must be illustrated the interpretation of the VIX index to comprehend the decisions taken by investors based on it. The key indicators are as follows:

- Between 0 and 12. The expected volatility of the stock market is very low. There is a period of general stability, the economy is growing at a fair rate. It is associated with bull markets, and the S&P 500 index tends to go up. To visualize things in perspective, the lowest value of 9.14 was reached in November 2017.
- Between 13 and 19. Regular volatility is forecasted for the next 30 days. There is no reason to panic if the VIX stays between these levels. However, the problem comes when it continues to rise, which means a period of instability is around the corner.
- 20 or higher. It predicts that the stock market will be more volatile over the next 30 days. These scores are observed during periods of market stress. This sentiment can be caused by scarce economic health, recession, political tension, or financial

crisis. These periods are frequently linked to bear markets, and the S&P 500 is generally observed to fall, as mentioned above (Adin Lykken, 2024).

In conclusion, it has been explained what the VIX index is and how its score should be interpreted. Moreover, it has been observed that investor sentiment can be strongly influenced by expected market volatility. Indeed, the market force examined in the following section is a measure of investor sentiment, as this factor can have a strong impact on the performance of financial markets in general.

2.4 Market Sentiment

The last section of this chapter will concentrate on an additional crucial determinant of financial market dynamics. Indeed, investor sentiment contributes significantly to market fluctuations. This concept refers to the collective feeling and psychological biases exhibited by investors. These beliefs alone can influence the prices of financial assets, independently of the rational and practical analysis conducted by experts. It is peculiar how psychological factors can distort the real value of financial instruments, including shares, bonds, commodities, etc. Still, this is what is observed in financial markets, particularly in the stock market, as was previously mentioned. Needless to say, when investor sentiment is promising and bullish, more people feel that it is the right time to enter the market. This positive feeling has been observed to inflate asset prices, resulting in the typical growth of the market. Conversely, when investors experience uncertainty or fear about the performance of assets, they either sell them or don't buy them. This dynamic contributes to a decline in those asset prices even without considering what data and analytics could instead point out.

It is evident that investor sentiment is not a rational model. It does not depend on tangible factors or indicators. Everything is rooted in psychological traits that derive from external events. The preceding section provided an illustrative example of his phenomenon. Market volatility, as measured by the VIX index, is regarded as the most influential driver of investor feelings. Indeed, as was already illustrated, periods of high volatility tend to amplify fear, while low volatility typically results in heightened confidence and general optimism. A multitude of other elements can affect investor sentiment. Indeed, macroeconomic indicators, such as GDP growth, unemployment rate, or inflation data, are frequently considered by investors. When the economy of a country is stable and

thriving, inflation is contained, and GDP is growing, investors perceive this as an opportune moment to participate in the market, which positively influences asset values. Then, it is trivial that periods of significant market performance have been shown to lift investor confidence. Conversely, bear markets have been associated with general pessimism and risk aversion.

In addition, investors react expeditiously to geopolitical events. During periods of war, political instability, or trade tensions, the situation tends to worsen rapidly. For instance, wars typically result in energy crises or regional conflicts, with many industries experiencing a negative response. At the same time, political turbulence can bring up the problem of tariffs or sanctions. These events often engender a climate of uncertainty. Consequently, investor sentiment is known to decline, and this negatively impacts the performance of the market as well. It is also crucial to cite behavioral biases such as herding or overconfidence. These biases can lead investors to react disproportionately to news events, amplifying the emotional response to external stimuli. The willingness to follow the crowd and act promptly are further forces that exert influence on investor sentiment.

As previously mentioned, investor sentiment relies on the feelings and mood of investors. Thus, there is no mathematical model that can accurately calculate it. However, there exist tools to measure this variable. For instance, investor sentiment can be quantified using the AAII (American Association of Individual Investors) Sentiment Survey. In this survey, investors are asked a simple question*: Do you feel the direction of the stock market over the next six months will be up (bullish), no change (neutral), or down (bearish)?* Therefore, this index is reflective of the sentiments and expectations of investors, which can serve as a determinant of financial markets' dynamics.

In conclusion, this chapter has elucidated some of the explanatory variables that will be included in the quantitative analysis that will be developed in the next chapter.

Chapter 3 – Quantitative Analysis

The previous chapters have established the theoretical basis of this work. Chapter 1 gave a broad understanding of how financial markets work by explaining how they are organized and by briefly describing some elementary types of financial markets, including the stock market, the commodity market, and the foreign exchange market. These segments and the financial instruments traded within them ground the empirical analysis that follows. Chapter 2 subsequently identified and described the key external forces impacting the pricing behavior of financial assets. Of these, interest rates, market volatility (as measured by the VIX index), and investor sentiment emerged as three important factors determining market reaction to exogenous shocks.

This third chapter moves to the empirical center of the study. It attempts to estimate how an event of worldwide impact can potentially affect the performance of financial markets by using a quantitative method. In particular, this section examines the impact of the Russia-Ukraine war on the daily returns of certain financial instruments, including stock indices, commodity prices, and safe-haven assets, previously introduced in the first Chapter. To perform this analysis, a series of regressions will be applied, in which the daily price return of a stock is the dependent variable. The independent variables instead include a dummy variable for the occurrence of the event, the volatility index (captured by the VIX), and the performance of the dollar index, captured by the DXY.

The purpose is to identify patterns and correlations between the selected external shock and financial asset prices and evaluate the importance of each explanatory variable in influencing market responses. In so doing, this study is designed to offer some insights about which assets are more robust than others in extreme conditions (leading to the identification of the so-called “safe-haven assets”) and provides investment advice, in decision making, in such an uncertain and turbulent environment.

3.1 The regression model and its variables

The quantitative analysis is carried out by a linear regression model aimed at estimating the impact of the major event. The core regression model is the following:
$Y_t = \beta_0 + \beta_1 \cdot WarEvent_t + \beta_2 \cdot VIX_t + \beta_3 \cdot DXY_t + \varepsilon_t$
In this specification:

- β_0 is the intercept. It represents the expected opening price of the asset in the absence of the event and when all other variables are equal to zero.
- Y_t is the dependent variable and represents the opening price of a financial instrument at time t.
- $WarEvent_t$ is the dummy variable. It assumes the value of 1 in the days following the event and the value of 0 otherwise. Its coefficient represents the direct impact of the war on open prices of the financial instrument.
- VIX_t is the regressor that reproduces the 'fear' of investors during periods of market instability and solidity, and will be measured by the CBOE Volatility Index VIX. It is therefore linked to the previous regressor, but the interpretation of the coefficient is different. Indeed, β_2 catches the relationship between periods of high market volatility and financial assets performance.
- DXY_t is the variable that represents the Dollar Index (DXY), therefore, the value of the dollar relative to the value of other global currencies. In a period of crisis, the index should increase because investors consider the dollar a safe place to store money. The coefficient helps understand how investors shit to the USD when markets are volatile, and whether the return on the observed financial assets are affected by the strength of the dollar and the eventual magnitude of the effect.
- ε_t is the error term that is always included in a regression. Its importance comes from the fact that it captures the impact of all the other omitted variables, not present in the model, on the asset's price at time t.

In this study, the event examined is one: the outbreak of the Russia-Ukraine war. This model allows the isolation of the impact of this episode from broader market dynamics. This guarantees an accurate identification of the market forces that contribute most significantly to changes in prices of the financial instruments observed during this turbulent period.

3.2 Quantitative Impact of the Russia–Ukraine War

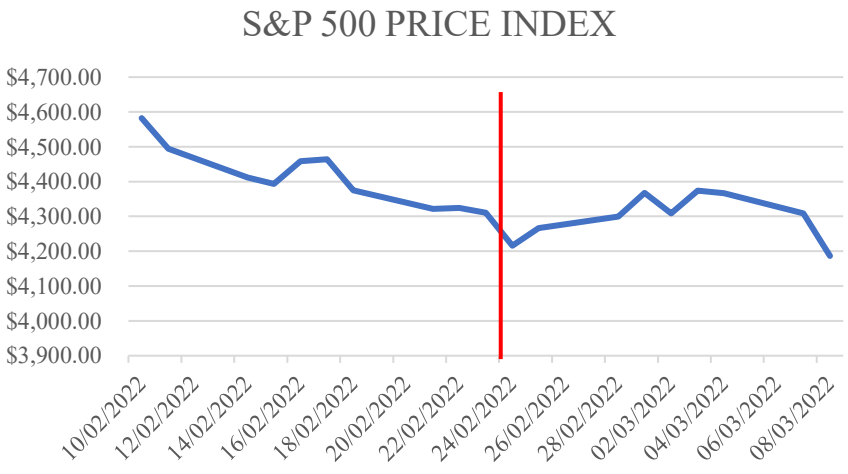
The first part of this chapter is devoted to the quantitative analysis of the short-term effect of the war between Ukraine and Russia on the financial assets observed. The period under review, and the period in which the data collection took place, extends from February 10 to March 8, 2022. The war broke out on February 24, and this information will be

important for the subsequent regressions, when the dummy variable "WarEvent" will be assigned the value of 1. Each analysis will be aimed at understanding how different financial markets have reacted to this period of instability. The reference model is the one described in the previous paragraph. The asset return is the dependent variable, which always remains the same, and the regressors include the war dummy, the VIX, and the Dollar Index (DXY). The sequence of events will commence with the stock markets, followed by commodity markets and the foreign exchange (forex) market. Therefore, each section will highlight unique market reactions and key transmission mechanisms.

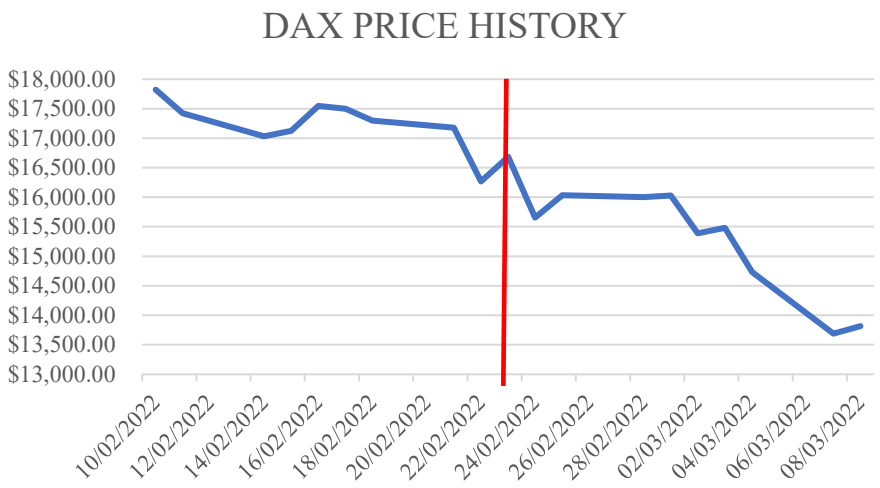
3.3 Impact on Stock Markets

The analytical investigation begins with an examination of the stock market. It is important to bear in mind that the financial assets subject to scrutiny are as follows: S&P 500 (United States), DAX (Germany), FTSE MIB (Italy), Shanghai Composite (China), BSE Sensex (India). Data collection includes opening prices for each business day, starting two weeks before the outbreak of war, and ending two weeks after the event. Before proceeding with the actual regression, it is worth observing the behavior of prices before and after February 24, the critical day for the study. The price index graphs are shown in the figure below. Instead, data on the independent variables and regression results will be illustrated in the tables that will follow.

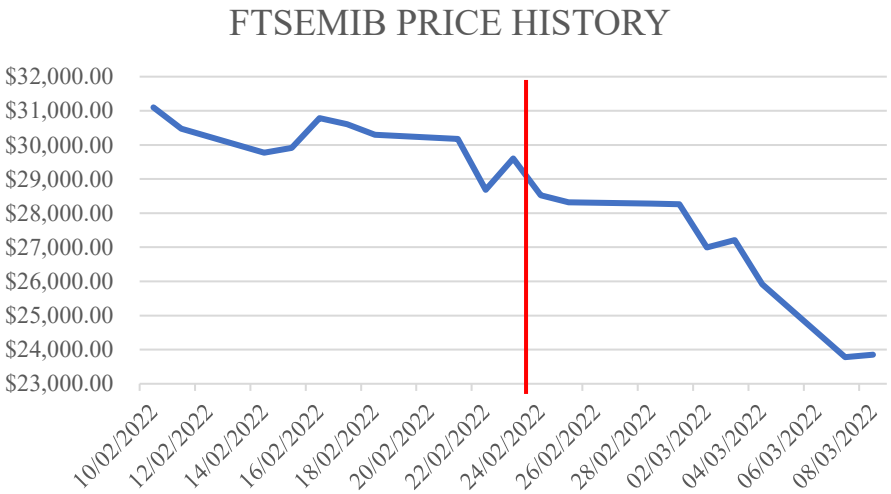
Figure 3.1 – Daily returns of selected stock indices (Feb 10 – Mar 8, 2022)



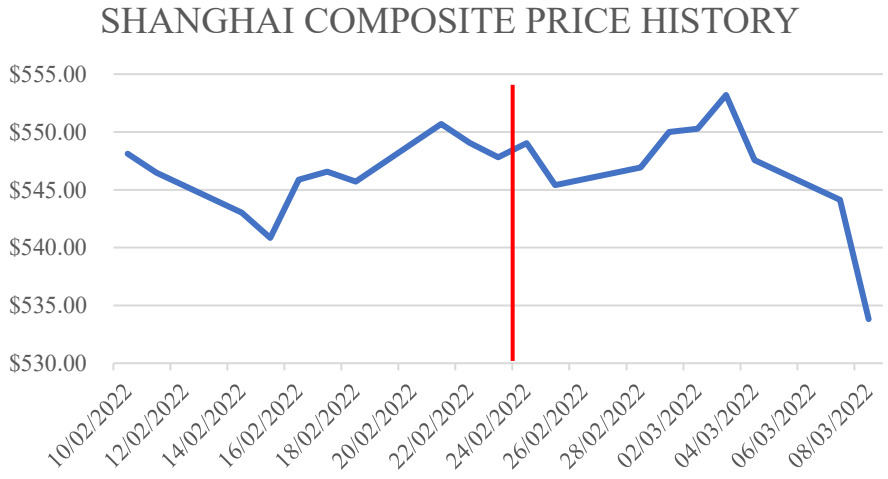
Source: Investopedia, historical data obtained from www.investopedia.com



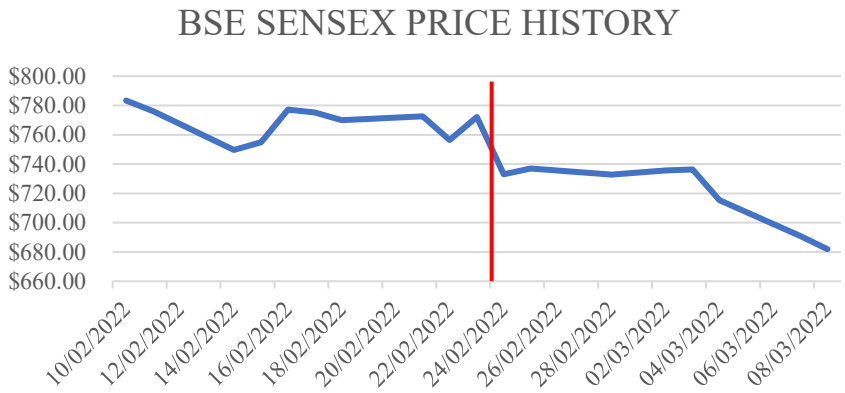
Source: Workspace, historical data obtained from www.workspace.refinitiv.com



Source: Workspace, historical data obtained from www.workspace.refinitiv.com



Source: Workspace, historical data obtained from www.workspace.refinitiv.com



Source: Workspace, historical data obtained from www.workspace.refinitiv.com

Table 3.1 – Daily opening prices of the selected variables used in all regressions: VIX index, on the left; DXY index, on the right (Feb 10 – Mar 8, 2022)

10/02/2022	20.37
11/02/2022	24.39
14/02/2022	29.17
15/02/2022	28.09
16/02/2022	25.19
17/02/2022	24.83
18/02/2022	26.66
22/02/2022	31.8
23/02/2022	28.04
24/02/2022	37.5
25/02/2022	31.68
28/02/2022	32.44
01/03/2022	29.45
02/03/2022	34.2
03/03/2022	30.52
04/03/2022	31.9
07/03/2022	35.88
08/03/2022	36.19

10/02/2022	95.55
11/02/2022	96.08
14/02/2022	96.37
15/02/2022	95.99
16/02/2022	95.7
17/02/2022	95.8
18/02/2022	96.04
22/02/2022	96.03
23/02/2022	96.19
24/02/2022	97.14
25/02/2022	96.61
28/02/2022	96.71
01/03/2022	97.41
02/03/2022	97.39
03/03/2022	97.79
04/03/2022	98.65
07/03/2022	99.29
08/03/2022	99.06

Source: Investopedia, historical data obtained from www.investopedia.com

3.3.1 Impact on S&P 500, USA

Table 3.2 – Regression results for S&P 500 returns

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	18.62
Model	130984.968	3	43661.656	Prob > F	=	0.0000
Residual	35178.2688	15	2345.21792	R-squared	=	0.7883
				Adj R-squared	=	0.7459
Total	166163.237	18	9231.29094	Root MSE	=	48.427

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	28.20982	39.61105	0.71	0.487	-56.21912	112.6388
vix	-21.82883	4.160241	-5.25	0.000	-30.69618	-12.96149
dxy	3.710846	17.85613	0.21	0.838	-34.34859	41.77028
_cons	4636.451	1684.79	2.75	0.015	1045.406	8227.495

From this regression, it can be inferred that 78.83% of the variance of S&P 500 returns is explained by the model. Moreover, Prob > F is 0.0000, and hence it can be concluded that the regression is statistically valid and informative even though the number of observations is not that extensive. Turning to the interpretation of the coefficients, it is evident that the p-value about the "warevent" variable is notably elevated (0.487). This figure supports the proposed thesis, as it has been demonstrated that the event itself does not generate direct effects on U.S. markets. Conversely, the factors associated with and triggered by the war then lead to market fluctuations that are observable in the graph above.

In contrast, it can be noticed that the p-value of the "vix" variable is remarkably low, indicating a strong significance of the regressor. Thus, the coefficient resulting from the analysis indicates that for each additional unit in the VIX index, there is an average drop of 21.8 points in the S&P 500 index return. The results are evident: an escalation in investor fear and an increase in market volatility exerts a negative influence on returns. Finally, for reasons previously elucidated, it is concluded that the dollar index (DXY) had no substantial influence on the regression. Therefore, fluctuations in the dollar value did not impact on the performance of the index. However, subsequent regressions will demonstrate a completely different pattern. The underlying causes may vary. There may be collinearity with other regressors. Another possibility is that the period analyzed was insufficiently long. Alternatively, the financial instrument observed may simply be less sensitive to changes in the dollar since it is an asset denominated in dollars. This is also

the reason why an appreciation of the dollar typically decreases the returns of European stocks, since a great portion of investment will be directed to the US.

It can be concluded that market volatility, which is still triggered by the event itself, is the only market force that is statistically significant for the model. This suggests that the performance of the S&P 500 index is primarily driven by the perceived risk and uncertainty, rather than the war itself or dollar fluctuations.

3.3.2 Impact on DAX, Germany

Table 3.3 – Regression results for DAX returns

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	144.26
Model	26350366.8	3	8783455.6	Prob > F	=	0.0000
Residual	913263.664	15	60884.2443	R-squared	=	0.9665
				Adj R-squared	=	0.9598
Total	27263630.5	18	1514646.14	Root MSE	=	246.75

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	-159.9316	201.826	-0.79	0.440	-590.1136	270.2504
vix	-102.2128	21.19724	-4.82	0.000	-147.3937	-57.03197
dxy	-755.0458	90.98046	-8.30	0.000	-948.966	-561.1255
_cons	92354.18	8584.333	10.76	0.000	74057.11	110651.3

The model presented in this case is extremely statistically valid and greatly informative. Matter of fact, 96.7% of the DAX variance is explained by the model (R-squared = 0.9665) and Prob > F is again zero. Moreover, the regression conducted on the DAX index also confirms the hypothesis that the war itself is not directly correlated with the return of the financial assets. Indeed, the p-value (0.440) is again remarkably high, which makes the variable almost insignificant. On the other hand, the other two market forces, the VIX index and the US dollar index, play a crucial role. Their significance is consolidated by negligible p-value. Plus, the negative coefficient of “vix” regressors indicates that whenever the volatility increases by one unit, DAX loses 102 points on average. This represents the strong reaction of investors to the period of great uncertainty brought by the event. Heavier is the negative correlation between the dollar index and DAX returns, because a unit increase in the former leads to a drop of 755.05 points in the latter. This is a result that makes sense, because a more valuable dollar penalizes exports and foreign capital for the reasons elucidated in the first chapter, section 7.

3.3.3 Impact on FTSE MIB, Italy

Table 3.4 – Regression results for FTSE MIB returns

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	154.67
Model	83027017.1	3	27675672.4	Prob > F	=	0.0000
Residual	2684038.81	15	178935.921	R-squared	=	0.9687
				Adj R-squared	=	0.9624
Total	85711055.9	18	4761725.33	Root MSE	=	423.01

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	74.63134	345.9979	0.22	0.832	-662.8457	812.1084
vix	-129.9108	36.33923	-3.57	0.003	-207.3661	-52.4556
dxy	-1694.049	155.9712	-10.86	0.000	-2026.493	-1361.604
_cons	196149.4	14716.44	13.33	0.000	164782	227516.8

The model is once again very robust and with an excellent fit, regardless of the small number of observations. The regression yields a result virtually identical to those noted in the previous one. The "warevent" variable turns out to be insignificant again, suggesting an indirect effect on returns. The same negative correlation between the VIX index and dollar index is observed, and the variables remain statistically significant. The motivations are the same. What differs is the magnitude of the effect, which is captured by the coefficients. It emerges that for a unit increase in the VIX and DXY, the stock falls by 129.91 and 1694.049 points respectively, and thus a really strong negative correlation is witnessed.

3.3.4 Impact on Shanghai Composite, China

Table 3.5 – Regression results for Shanghai Composite returns

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	3.52
Model	132.311367	3	44.1037891	Prob > F	=	0.0413
Residual	188.070611	15	12.5380408	R-squared	=	0.4130
				Adj R-squared	=	0.2956
Total	320.381979	18	17.7989988	Root MSE	=	3.5409

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	7.376466	2.896273	2.55	0.022	1.203205	13.54973
vix	-.2429669	.3041878	-0.80	0.437	-.8913279	.405394
dxy	-3.623235	1.305601	-2.78	0.014	-6.406058	-.8404119
_cons	900.5493	123.1882	7.31	0.000	637.98	1163.119

In this scenario, the results obtained are different from those seen so far. In fact, the model

remains valid (Prob > F is still below 0.05). However, it is notably less robust than those analyzed before. This outcome was predictable because the Chinese market is not typically synchronized with the Western ones. This is also the reason why, for the first time, a very high p-value is observed for the "vix" variable, which thus becomes an insignificant variable for the model. Surprisingly, the event itself has been shown to have a positive and significant effect. The geographical and political detachment from the European war could have led to the attraction of foreign investors, who moved their investment to a less volatile market. The only result that remains unaffected is the negative relationship between asset returns and the dollar index, always represented by the fact that a stronger dollar shifts global capital into US-denominated assets.

3.3.5 Impact on BSE Sensex, India

Table 3.6 – Regression results for BSE Sensex returns

Source	SS	df	MS	Number of obs	=	18
				F(3, 14)	=	90.13
Model	14234.749	3	4744.91635	Prob > F	=	0.0000
Residual	737.062962	14	52.6473544	R-squared	=	0.9508
				Adj R-squared	=	0.9402
Total	14971.812	17	880.694824	Root MSE	=	7.2558

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	-1.764349	6.609604	-0.27	0.793	-15.94054	12.41184
vix	-2.510922	.6495937	-3.87	0.002	-3.904162	-1.117682
dxy	-17.86096	2.721111	-6.56	0.000	-23.69717	-12.02476
_cons	2549.312	257.8377	9.89	0.000	1996.305	3102.319

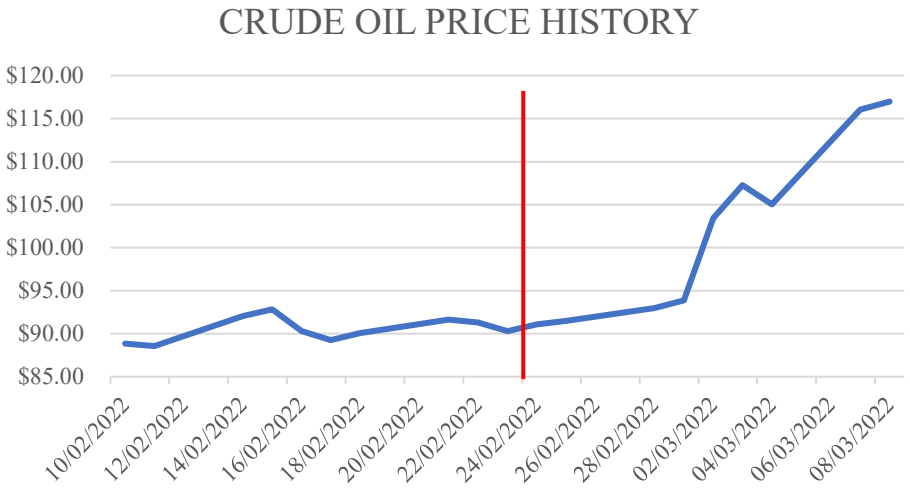
The last regression concerning stock markets presents the same outcomes observed initially, and the model's robustness was confirmed. The event itself remains a factor that is not directly related to the performance of the Indian stock market, which is once again negatively correlated with the VIX and DXY. This suggests that despite a considerable geographic distance, the Indian stock market is well integrated and incorporated into the global financial system, in contrast to the situation observed in China. In fact, India enjoys greater economic freedoms than its Chinese counterpart, despite being a developing and emerging market.

3.4 Impact on Commodity Markets

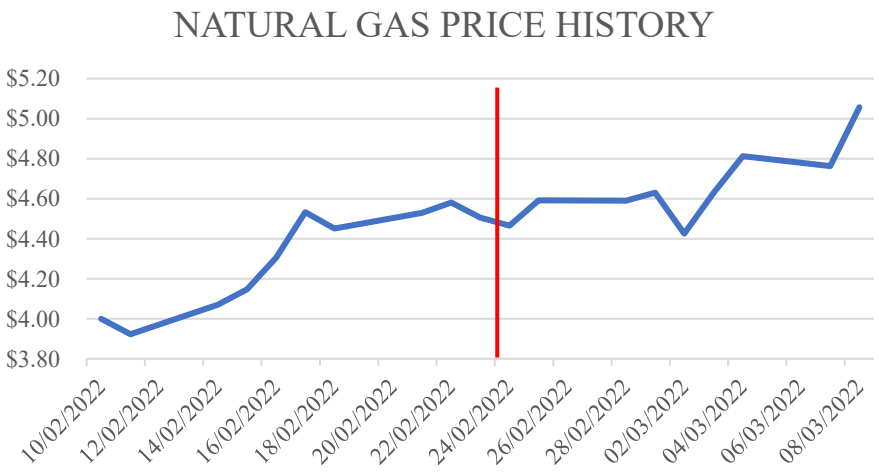
The quantitative analysis then proceeds to examine the impact of the Russia-Ukraine war on the prices of the three commodities under consideration: Crude Oil, Natural Gas, and

Gold. The rationale underlying this analysis is straightforward. Indeed, raw materials and energy assets respond differently to global crises than equity indices. The regressions conducted will be the same, and it will then be determined whether the pattern previously observed is replicated in this different financial market segment or if there are any discrepancies. As a first step, graphs summarizing the performance of commodity prices during the same period will be shown. Subsequent to this, the regression results will be displayed in tables, which will then be interpreted.

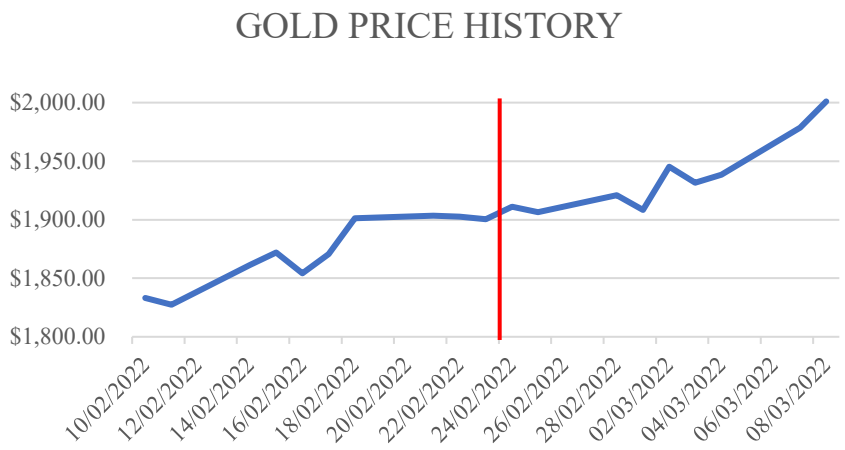
Figure 3.2 – Daily opening prices of selected commodities (Feb 10 – Mar 8, 2022)



Source: Investopedia, historical data obtained from www.investopedia.com



Source: Investopedia, historical data obtained from www.investopedia.com



Source: Investopedia, historical data obtained from www.investopedia.com

3.4.1 Impact on Crude Oil

Table 3.7 – Regression results for Crude Oil WTI Futures prices

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	62.73
Model	1372.96835	3	457.656116	Prob > F	=	0.0000
Residual	109.434513	15	7.29563421	R-squared	=	0.9262
				Adj R-squared	=	0.9114
Total	1482.40286	18	82.3557145	Root MSE	=	2.701

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	-3.0923	2.209308	-1.40	0.182	-7.801328	1.616728
vix	.0296711	.2320377	0.13	0.900	-.4649055	.5242476
dxy	9.600159	.9959263	9.64	0.000	7.477393	11.72293
_cons	-831.5204	93.96922	-8.85	0.000	-1031.811	-631.2297

Given the high value of R-squared (0.9262) and Prob > F equal to zero, the regression once again is considered robust and statistically valid. Moreover, the result that is always confirmed is the statistical insignificance of the "warevent" variable. It is evident that the war between Russia and Ukraine did not exert a direct impact on the price of crude oil, which exhibited an increase after the outbreak. On the other hand, the other results demonstrate a completely divergent pattern compared to those observed in the stock market to a large extent. In fact, it is apparent that the VIX returns to having a negligible impact, considering that its p-value is notably high (0.900). This result should be interpreted. One potential explanation for this dynamic is that the price of commodities and energy assets is not based on the general level of investor discouragement. Rather, it is contingent upon other economic variables, driven by demand and supply mechanisms, and the related shocks caused by such events (sanctions, decline in supply, etc.).

It is also a surprise that an increase in the Dollar index (DXY) has a beneficial impact on crude oil prices. Whenever the DXY increases by 1 point, the price of the commodity rises by 9.60$, on average. Plus, the variable is deemed to be entirely valid (p-value of zero). Theoretically, an appreciation of the dollar should result in a decrease in the price of oil when all other factors are kept constant. However, this relationship does not hold in practice. A potential underlying factor is a disproportionate increase in demand, accompanied by a general decline in supply. This phenomenon can be attributed to the imposition of Russian sanctions and the particularly sensitive and tense geopolitical environment. These factors together have been so strong that they have driven up the price of the commodity anyway, despite a rise in the value of the US dollar.

3.4.2 Impact on Natural Gas

Table 3.8 – Regression results for Natural Gas Futures prices

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	7.42
Model	.874138413	3	.291379471	Prob > F	=	0.0028
Residual	.589015401	15	.039267693	R-squared	=	0.5974
				Adj R-squared	=	0.5169
Total	1.46315381	18	.081286323	Root MSE	=	.19816

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	.0285996	.1620848	0.18	0.862	-.3168761	.3740752
vix	.0152928	.0170233	0.90	0.383	-.0209916	.0515772
dxy	.1510391	.0730657	2.07	0.056	-.0046967	.3067749
_cons	-10.59528	6.894008	-1.54	0.145	-25.28951	4.098956

In this case, it is observed that the regression is less conclusive than the previous ones, with an R-squared of 0.5974 and Prob > F of 0.0028. However, the model remains useful and interpretable. As in often cases, the "warevent" variable has been found to be statistically insignificant. At the same time, it is noted that the interpretation of the VIX index remains unaltered from the previous iteration. Once again, the p-value is elevated. This indicates that natural gas is also unaffected by the relevant market instability during that period. The price of this commodity tends to follow market logic related to supply and demand. This assumption is further supported by the relationship between the price of gas and the dollar index. In fact, the correlation remains positive, but the "dxy" variable's significance is only marginal this time (p-value = 0.05). As previously mentioned, an appreciation of the dollar should result in a decline in gas prices. However,

the strong demand for the energy commodity during the war period caused the price to rise, regardless of the dollar's purchasing power.

3.4.3 Impact on Gold

Table 3.9 – Regression results for Gold Futures prices

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	30.98
Model	31279.1725	3	10426.3908	Prob > F	=	0.0000
Residual	5048.01254	15	336.534169	R-squared	=	0.8610
				Adj R-squared	=	0.8332
Total	36327.185	18	2018.17695	Root MSE	=	18.345

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	-4.767767	15.00511	-0.32	0.755	-36.75041	27.21488
vix	4.402316	1.575947	2.79	0.014	1.043265	7.761366
dxy	26.85638	6.764104	3.97	0.001	12.43903	41.27372
_cons	-821.3111	638.2175	-1.29	0.218	-2181.639	539.0173

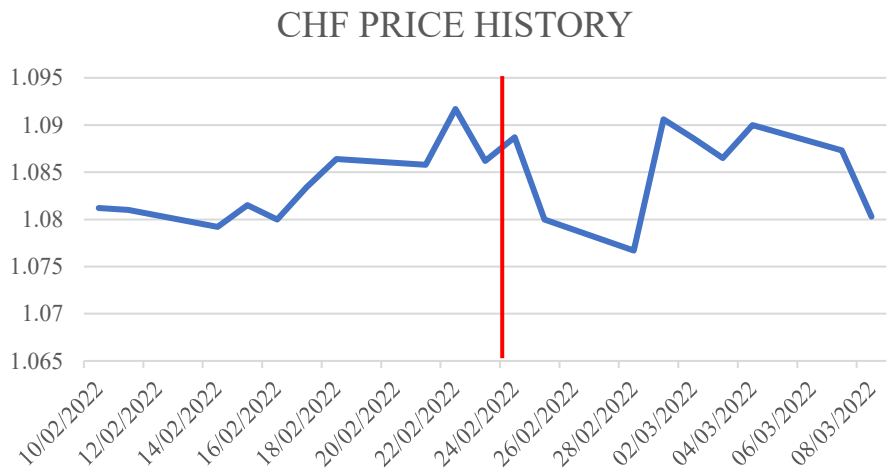
The regression returns to excellent explanatory power, with 86.10% of the variance explained by the model and a Prob > F equal to zero. Needless to say, it is not the occurrence of the event that generates fluctuations in gold prices, but what the event causes (strong fear, unstable and volatile markets, etc.). However, the "vix" variable recovers statistical significance (p-value of 0.014), a result that is not coincidental. Indeed, gold is typically regarded as a safe-haven asset by numerous investors. This model serves to confirm gold's status as a reliable financial asset in times of economic uncertainty. In periods of high market volatility, investors' fear and uncertainty grow. Individuals seek refuge in assets considered secure and stable, in order to allocate their savings to such instruments, and gold is one of them. This explains the positive relationship between the two variables. The coefficient tells us that for every unit increase in the VIX index, the gold price experiences an average increment of $4.40.

However, a surprising finding is the positive relationship with the dollar index. Usually, when the dollar appreciates, the price of gold should experience a decrease, because it becomes more expensive for those buying it in other currencies. But here we observe the opposite pattern. The rationale, however, may be trivial. Indeed, the dollar is considered a safe-haven asset. Therefore, in periods of global crisis or shocks, the augmented demand for US dollars and gold inevitably leads to an increase in the value of both assets. The correlation becomes then positive, and the coefficient indicates that when the dollar index grows by one unit, the price of gold rises by $26.86 on average.

3.5 Impact on Foreign Exchange Market (FOREX)

The final part of the quantitative analysis examines the impact of the selected event on the value of the Swiss Franc (CHF). The choice of this currency is not random. The Franc is regarded as one of the most stable currencies worldwide. Therefore, it is often considered a secure investment destination, as it typically remains unaffected by global geopolitical crises, partly attributable to Switzerland's political neutrality. To begin, let us visualize the CHF/USD exchange rate during the period studied. Having observed that, the following step will be interpreting the standard regression, which will be illustrated in the table below.

Figure 3.3 – Daily CHF/USD exchange rate (Feb 10 – Mar 8, 2022)



Source: Investopedia, historical data obtained from www.investopedia.com

Table 3.10 – Regression results for CHF prices

Source	SS	df	MS	Number of obs	=	19
				F(3, 15)	=	0.55
Model	.000035327	3	.000011776	Prob > F	=	0.6533
Residual	.000318864	15	.000021258	R-squared	=	0.0997
				Adj R-squared	=	-0.0803
Total	.000354192	18	.000019677	Root MSE	=	.00461

return	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
warevent	.000022	.0037712	0.01	0.995	-.0080162	.0080601
vix	.0003878	.0003961	0.98	0.343	-.0004564	.0012321
dxy	-.000589	.0017	-0.35	0.734	-.0042125	.0030345
_cons	1.129872	.1604026	7.04	0.000	.7879823	1.471763

For the first time, we are faced with an inconclusive regression that is ambiguous and very difficult to interpret. Only 9.97% of the variance of the franc is explained by the

model. Plus, the Prob > F is extremely high. Therefore, the results possess minimal econometric relevance and are challenging to comprehend. In addition, none of the variables turns out to be statistically significant, further weakening the model. Although this may all be perceived negatively, it is actually consistent with what might be expected. This outcome aligns with the inherent nature of the Swiss Franc as a safe-haven asset. Indeed, it does not exhibit the same response as stocks and commodities during periods of heavy instability, such as the war in Ukraine itself. Instead, it maintains a remarkable degree of stability that goes beyond investor fear, US market volatility, and the dollar value. The reasons for the franc's high reliability, which is evident in the graph above, have previously been elucidated on numerous occasions in this work. Therefore, the results of the regression only prove once again what was already inferred: the Swiss franc is an exceptionally stable currency and an asset in which to take refuge in times of global/geopolitical crises.

Conclusion

The empirical work carried out in this paper has demonstrated robust and consistent patterns on how the various asset classes respond to shocks associated with geopolitical crises, in particular those related to the Russia–Ukraine war. Although the war dummy was not significant in most of the regressions, this result reinforces the main argument: the event is not the determining factor for market responses, but the consequences that such an event generates. This includes rising volatility, risk aversion, and shifts in global capital flows.

For what concerns stock markets, Western equity indices (S&P 500, DAX, and FTSE MIB) and the Indian equity index faced substantial declines primarily driven by a peak in the VIX index and by a dollar appreciation. Nevertheless, there were differences in the reaction of Chinese indices. Paradoxically, it appears that Shanghai Composite responded positively to the event, which is likely justified by the fact that this country is to some extent detached from Western markets. On the commodity market, the response moved in different directions: Oil prices rose following the war, and gold prices did the same both during and after the war, confirming their role as hedging tools. Gold in particular had a powerful positive relationship with volatility, which further strengthened its reputation as a safe haven asset. Lastly, the Swiss Franc has been remarkable in its stability, and the results indicate how impervious it has been to market panics and uncertainty it has been.

These points add up to several key takeaways. First, the VIX remained both the single most important explanatory variable and, by far, the most significant one in importance. This leads to the conclusion that investor fear is the primary driver of price dynamics. Secondly, it has been observed that gold and the Swiss Franc maintained their historical roles as safe harbors, whereas regular stocks were more vulnerable. Lastly, the Dollar Index demonstrated different effects, but perhaps that was to be expected given its dual role as a risk and global safe haven gauge.

From an investor and policymaker perspective, the implications are clear. During periods of geopolitical instability, portfolio diversification into uncorrelated asset classes, particularly those that have historically been more immune to shocks, is a necessity. The

results also imply that studying the measures of volatility and market sentiment is a better signal for asset allocation, compared with examining the geopolitical event itself.

For future studies, this approach may be extended to investigate the financial consequences related to other crises, like the COVID-19 crisis or Middle East tensions, to see if they respect similar dynamics. In addition, a more in-depth study of cross-market interdependencies, behavioral finance factors, and speed of investor reaction would contribute to better understanding of market sensitivities under stress.

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