International Journal of Scientific Research and Engineering Development-– Volume 6 Issue 2, Mar-Apr 2023

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

The Impact of the Russia-Ukraine War: A Comparative Study of 10 Global Indices

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ABSTRACT

This paper aims to study the reactions of 10 global indices to the ongoing war between Russia and Ukraine. We have used daily stock market returns as a sample which covers the period from 24th June 2021 to 31stOct 2022. We used an event study model to detect the impact of war on the selected global indices.

Keywords: global indices, stock market, war, Russia, Ukraine, Event study.

Objectives:

1. To understand the effect of the Russia Ukraine war on global market performance
2. Identify the most affected indices.
3. To identify the percentage of impact on each index.
4. To find out the reason for the major impact on global indices.

Findings:

A noticeable negative shift in stock market performance is visible from the findings reported herein. The Russian and Ukraine stock markets are the ones which took the most hitswhich is a given considering their present involvement in the ongoing war. Compared to the Asian stock markets, the European stock markets have endured more pressure presumably from their proximity to Russia and Ukraine as well as their dependency on both these nations for various commodities.

INTRODUCTION

Russia invaded Ukraine on 24th February 2022, making it the latest chapter to unfold in the Russia-Ukraine War that started as early as 2014. This event marked the biggest refugee crisis that Europe has witnessed since World War II, as the number of Ukrainians fleeing the country reached north of 6.3 million as well as a third of the whole population displaced. Since Russia and Ukraine are 2 of the largest exporters of food products in the world, the war also led to food shortages on a global scale.

In 2014, Russia annexed and attacked Crimea which sparked a regional war between the two countries. With the support of Russia, separatists were able to seize power in a portion of the Donbas region in southeast Ukraine. This region consists of the Luhansk and Donetsk oblasts. In 2021, Russia mobilized nearly 190,000 soldiers and sufficient equipment to establish a major military presence along its border with Ukraine. In a televised speech moments before the invasion, Russian President Vladimir Putin challenged Ukraine's right to statehood and blamedthat the Ukrainian government is being run by “neo-Nazis” who were mistreating

the ethnic Russian minority. He expressed extreme irredentist views towards the entire situation in his speech. On February 21, 2022, Russia recognized the self-proclaimed breakaway quasi-states of Donbas, the Donetsk People's Republic and the Luhansk People's Republic, and the next day, use of force was approved by the Russian Federation Council. The Russian troops quickly followed suit. On February 24, Vladimir Putin announced a "special military operation" to "demilitarize and denazify" Ukraine, officially launching the invasion.

The stock market isa tool that can be used to analyze the performance of the economy. In this context of war, it can be used as an indicator to show the performance of various indices during these turbulent times. A sharp decline of an index after news of the war breaking out indicates a dent in investors' confidence about further repercussions and the uncertainties thereof. A war between two countries, one of which is a superpower, can lead to a lot of instability in the economy. The disruption caused in the normal lives of the citizens and the sanctions which may be imposed against and or by even one of these countries can cause a huge dent in the overall global economy. This is particularly true considering that Ukraine is one of the most gifted countries in terms of natural resource abundance as well as being a major player in the export of agricultural and industrial products.

The objective of this paper is to evaluate stock prices to find an indication of the effect of the disturbances between Russia and Ukraine. Tools like correlation and regression analysis will be used to analyze the relationship between the War and various global stock indices. These tools would provide the relationship between the event and the stock marketsand will additionally define the degree of relationship between these two. Models such as the "traditional valuation model" suggest that stock prices usually reflect expectations about the future of the economy and can therefore be used to predict the economy.

During the course of this paper, we will attempt to answer the following questions. First, is there an effect of the Russia-Ukraine war on the global stock market performance? If yes, to what extenthas each index been affected in percentage? We will calculate this by collecting data from 10 different indices from around the globe and comparing the market performance 5 months before the commencement of the war and 5 months afterward. Second, which are the most affected indices out of these 10, and what are the reasons for this impact? Third, what are the future implications of the current events?

LITERATURE REVIEW

The study titled "The impact of the Ukraine-Russia war on world stock market returns" investigates the reactions of global stock market indices to the conflict between Ukraine and Russia. The researchers found a negative correlation between the conflict and global stock market returns by analyzing daily stock market returns from a sample of 94 countries from January 22 to March 24, 2022. The impact on the European stock market illustrates how the situation in Russia and Ukraine has affected European stock markets. The European stock markets, which have strong trading ties with the Russian economy, generally responded poorly to this crisis due to the increase in political uncertainty, proximity to Russia, and the effects of new sanctions. It was also noted that European stocks experienced a significant negative abnormal return on February 21, 2022, the day that Russia recognized two governments in Ukraine as

autonomous regions. The negative stock price reactions also continued in the following days. The severity of the stock market responses to this crisis varied significantly between industries, countries, and firm sizes.

Hoffmann, Manuel, and Neuenkirch (2014) conducted a similar study to investigate the impact of the pro-Russian conflict on stock returns in Russia and Ukraine from November 21, 2013, to September 29, 2014. They used conflict-related news on the internet as an indicator for the level of de-escalation and found that the conflict was worsening and reducing stock returns in Russia and Ukraine. The pro-Russian conflict in Ukraine was found to account for a total variation of 6.5 percentage points in the Russian and Ukrainian stock markets.

Another research by Jonathan Federle, Gernot Müller, André Meier, and Victor Sehn in 2022 studiesthe response of stock markets to the Russian invasion of Ukraine and analyzes the economic spillovers that a country is exposed to during times of war are significantly influenced by how close it is to the area of conflict. This research paper demonstrates that the stock market's behavior around the beginning of the war exhibits a considerable sensitivity to changes in perceived disaster risk by focusing on the particular situation of the conflict in Ukraine. In this case, geography turns out to be important. During the first few weeks of the war, markets in nearby nations saw a significant proximity penalty in the form of steeply negative returns. Comparatively, distant nations performed significantly better. Trade linkages, which, on average, tend to be closer among countries, can be blamed for roughly half to two-thirds of this effect. The remaining amount most likely reflects risks of military spillover. In fact, neighbors of Ukraine generally saw a greater rise in independent geopolitical risk measures, increased their military aid to Ukraine, saw domestic defense companies significantly outperform the general stock market, and experienced higher perceptions of disaster risk as reflected in currency options. Also, location affects how war affects the economy. These spillovers will undoubtedly have an impact on geopolitics and could even change how the war plays out.

Generally, reactions of stock markets to international crises have been mostly negative, with one notable exception being the reaction to conflict in the Gulf on Wall Street. This suggests thatall international crises do not have the same impact on stock markets, even in a highly interconnected global economy. These differences may reflect the markets' varying sensitivity to the same political event. According to Schneider and Troeger (2006), conflictive events have a stronger influence on stock market volatility compared to cooperative events. The reaction of stock markets to international crises depends largely on the severity of an anticipated or actual international event and the collective expectation that the event will occur. This is demonstrated in the study by Krishnan and Dagar (2022), which found that although the US-China trade war affected the proportion of Chinese exports to the US (due to higher tariff rates), stock volume traded was positive. This positive relationship between exchange rate and volume traded suggests that investors and companies were able to mitigate risk by trading in the stock market, particularly during the COVID-19 pandemic. In contrast, the trade war caused significant changes in international trade in goods and services, resulting in increased trading in the Indian market and high

volatility due to the impact on exchange rates. Trading in both the US and China increased significantly during both the trade war and the pandemic, but the markets were also highly volatile. Similar research by Shi, Wang, and Ke (2021) identified a spillover pattern where breakpoints occurred in the Chinese stock market after the official start of the trade war. On the other hand, a study by Fernandez (2007) specifically focused on conflicts in the Middle East found that structural breakpoints in volatility mainly occurred in the Middle Eastern and emerging Asian stock markets, while the rest of the world experienced volatility clustering as a result of the political instability in the Middle East, known as a Transitory Volatility Increase.

METHODS OF RESEARCH

To execute an event study properly, the event must be defined properly first along with event timeline, and the event window. We used February 24, 2022, as the event date of the Russian-Ukraine war because it has never been formally declared. The event window consists of a total of 10 months (24th June 2021 to 31stOct 2022),which are divided into two time periods which includethe pre-war period andthe post war period. We have used the closing price of all these 10 indices on a daily basis for our analysis and will only consider trading days in our analysis. We have examined these stock indices - SENSEX, CSI 300, DAX, FTSE 100, MOEX, NASDAQ Composite, PFTS, S&P 500, CAC 40, and NIKKEI 25.

Tools to be used to analyze the relationshipbetween the selected 10 global indices and the Russia-Ukraine war are:

- ADF Test
- Johansen System Cointegration Test
- Correlation and Covariance
- Descriptive Statistics

SENSEX

Null Hypothesis: D(SENSEX_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 12 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.464646	0.0000
Test critical values:	1% level	-3.473382	
	5% level	-2.880336	
	10% level	-2.576871	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(SENSEX_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.555111	0.0000
Test critical values:	1% level	-3.471719	
	5% level	-2.879610	
	10% level	-2.576484	

*MacKinnon (1996) one-sided p-values.

CSI 300

Augmented Dickey-Fuller Test Eq
Dependent Variable: D(SENSEX_
Method: Least Squares
Date: 12/12/22 Time: 15:29
Sample (adjusted): 15 167
Included observations: 153 after a

Variable
D(SENSEX_PRE_WAR(-1))
D(SENSEX_PRE_WAR(-1),2)
D(SENSEX_PRE_WAR(-2),2)
D(SENSEX_PRE_WAR(-3),2)
D(SENSEX_PRE_WAR(-4),2)
D(SENSEX_PRE_WAR(-5),2)
D(SENSEX_PRE_WAR(-6),2)
D(SENSEX_PRE_WAR(-7),2)
D(SENSEX_PRE_WAR(-8),2)
D(SENSEX_PRE_WAR(-9),2)
D(SENSEX_PRE_WAR(-10),2)
D(SENSEX_PRE_WAR(-11),2)
D(SENSEX_PRE_WAR(-12),2)
C
R-squared
Adjusted R-squared
S.E. of regression
Sum squared resid
Log likelihood
F-statistic
Prob(F-statistic)

Null Hypothesis: D(CSI_300_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 13 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.604148	0.0000
Test critical values:	1% level	-3.475500	
	5% level	-2.881260	
	10% level	-2.577365	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CSI_300_PRE_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:33
Sample (adjusted): 16 161
Included observations: 146 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CSI_300_PRE_WAR(-1))	-9.578941	1.450443	-6.604148	0.0000
D(CSI_300_PRE_WAR(-1),2)	7.666849	1.413429	5.424291	0.0000
D(CSI_300_PRE_WAR(-2),2)	6.791944	1.346307	5.044871	0.0000
D(CSI_300_PRE_WAR(-3),2)	5.965304	1.258920	4.738429	0.0000
D(CSI_300_PRE_WAR(-4),2)	5.199880	1.159518	4.484519	0.0000
D(CSI_300_PRE_WAR(-5),2)	4.395287	1.046772	4.198898	0.0000
D(CSI_300_PRE_WAR(-6),2)	3.659433	0.925984	3.951941	0.0001
D(CSI_300_PRE_WAR(-7),2)	3.015862	0.795766	3.789886	0.0002
D(CSI_300_PRE_WAR(-8),2)	2.405060	0.663841	3.622948	0.0004
D(CSI_300_PRE_WAR(-9),2)	1.806320	0.536174	3.368909	0.0010
D(CSI_300_PRE_WAR(-10),2)	1.362932	0.413635	3.295009	0.0013
D(CSI_300_PRE_WAR(-11),2)	0.831128	0.294752	2.819753	0.0056
D(CSI_300_PRE_WAR(-12),2)	0.451509	0.181510	2.487513	0.0141
D(CSI_300_PRE_WAR(-13),2)	0.231993	0.083432	2.780605	0.0062
C	-3.12E-06	0.000866	-0.003599	0.9971

R-squared	0.843182	Mean dependent var	-8.62E-06
Adjusted R-squared	0.826423	S.D. dependent var	0.025097
S.E. of regression	0.010456	Akaike info criterion	-6.186189
Sum squared resid	0.014322	Schwarz criterion	-5.879654
Log likelihood	466.5918	Hannan-Quinn criter.	-6.061637
F-statistic	50.31158	Durbin-Watson stat	2.045794
Prob(F-statistic)	0.000000		

Null Hypothesis: D(CSI_300_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on AIC, maxlag=13)

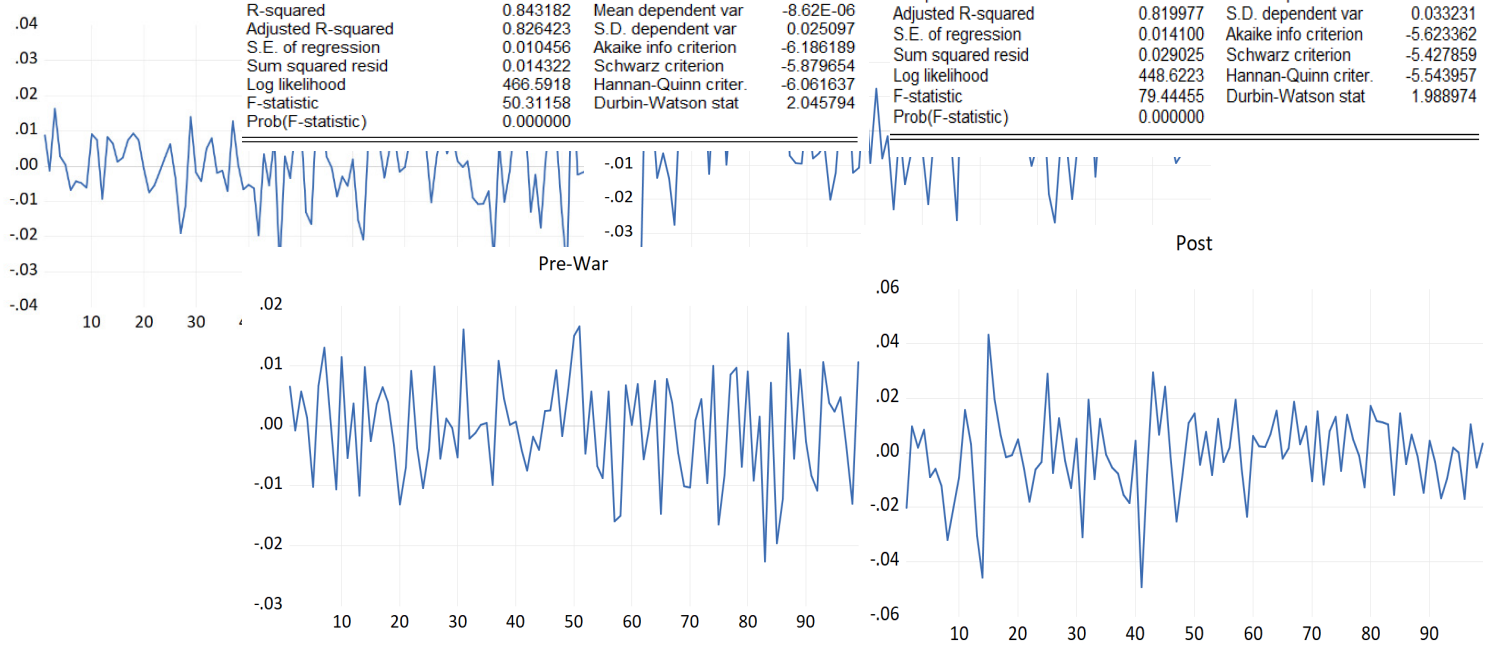
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.125457	0.0000
Test critical values:	1% level	-3.472534	
	5% level	-2.879966	
	10% level	-2.576674	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CSI_300_POST_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:34
Sample (adjusted): 11 166
Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CSI_300_POST_WAR(-1))	-6.884221	0.847241	-8.125457	0.0000
D(CSI_300_POST_WAR(-1),2)	4.912156	0.804354	6.106959	0.0000
D(CSI_300_POST_WAR(-2),2)	3.938519	0.729332	5.400171	0.0000
D(CSI_300_POST_WAR(-3),2)	2.996177	0.632556	4.736618	0.0000
D(CSI_300_POST_WAR(-4),2)	2.149250	0.520690	4.127699	0.0001
D(CSI_300_POST_WAR(-5),2)	1.464760	0.399902	3.662802	0.0003
D(CSI_300_POST_WAR(-6),2)	0.900590	0.282074	3.192739	0.0017
D(CSI_300_POST_WAR(-7),2)	0.460657	0.174331	2.642433	0.0091
D(CSI_300_POST_WAR(-8),2)	0.175009	0.080706	2.168486	0.0317
C	9.24E-05	0.001129	0.081781	0.9349

R-squared	0.830430	Mean dependent var	2.95E-05
Adjusted R-squared	0.819977	S.D. dependent var	0.033231
S.E. of regression	0.014100	Akaike info criterion	-5.623362
Sum squared resid	0.029025	Schwarz criterion	-5.427859
Log likelihood	448.6223	Hannan-Quinn criter.	-5.543957
F-statistic	79.44455	Durbin-Watson stat	1.988974
Prob(F-statistic)	0.000000		



MOEX

Null Hypothesis: D(MOEX_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.80982	0.0000
Test critical values:	1% level	-3.470179	
	5% level	-2.878937	
	10% level	-2.576124	

*MacKinnon (1996) one-sided p

Augmented Dickey-Fuller Test
Dependent Variable: D(MOEX_
Method: Least Squares
Date: 12/12/22 Time: 15:45
Sample (adjusted): 7 171
Included observations: 165 afte

Variable	C
D(MOEX_PRE_WAR(-1))	
D(MOEX_PRE_WAR(-1),2)	
D(MOEX_PRE_WAR(-2),2)	
D(MOEX_PRE_WAR(-3),2)	
D(MOEX_PRE_WAR(-4),2)	
C	

R-squared	
Adjusted R-squared	
S.E. of regression	
Sum squared resid	
Log likelihood	
F-statistic	
Prob(F-statistic)	

Null Hypothesis: D(MOEX_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.300837	0.0000
Test critical values:	1% level	-3.475819	
	5% level	-2.881400	
	10% level	-2.577439	

*MacKinnon (1996) one-sided

Null Hypothesis: D(NASDAQ_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 10 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.960818	0.0000
Test critical values:	1% level	-3.472534	
	5% level	-2.879966	
	10% level	-2.576674	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NASDAQ_PRE_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:48
Sample (adjusted): 13 168
Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NASDAQ_PRE_WAR(-1))	-7.137787	1.025424	-6.960818	0.0000
D(NASDAQ_PRE_WAR(-1),2)	5.234644	0.984157	5.318911	0.0000
D(NASDAQ_PRE_WAR(-2),2)	4.436056	0.918320	4.830620	0.0000
D(NASDAQ_PRE_WAR(-3),2)	3.729278	0.837800	4.451275	0.0000
D(NASDAQ_PRE_WAR(-4),2)	2.922818	0.749332	3.900565	0.0001
D(NASDAQ_PRE_WAR(-5),2)	2.275073	0.640234	3.553505	0.0005
D(NASDAQ_PRE_WAR(-6),2)	1.776704	0.518646	3.425656	0.0008
D(NASDAQ_PRE_WAR(-7),2)	1.419465	0.399580	3.552389	0.0005
D(NASDAQ_PRE_WAR(-8),2)	0.942067	0.297631	3.165222	0.0019
D(NASDAQ_PRE_WAR(-9),2)	0.500073	0.194787	2.567282	0.0113
D(NASDAQ_PRE_WAR(-10)...	0.130986	0.091762	1.427453	0.1556
C	-0.000439	0.001033	-0.424319	0.6720

R-squared	0.828819	Mean dependent var	-4.82E-05
Adjusted R-squared	0.815742	S.D. dependent var	0.030037
S.E. of regression	0.012894	Akaike info criterion	-5.790368
Sum squared resid	0.023939	Schwarz criterion	-5.555763
Log likelihood	463.6487	Hannan-Quinn criter.	-5.695082
F-statistic	63.38300	Durbin-Watson stat	1.975369
Prob(F-statistic)	0.000000		

Null Hypothesis: D(NASDAQ_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on AIC, maxlag=13)

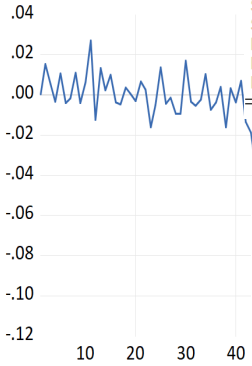
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.589921	0.0000
Test critical values:	1% level	-3.470934	
	5% level	-2.879267	
	10% level	-2.576301	

*MacKinnon (1996) one-sided p-values.

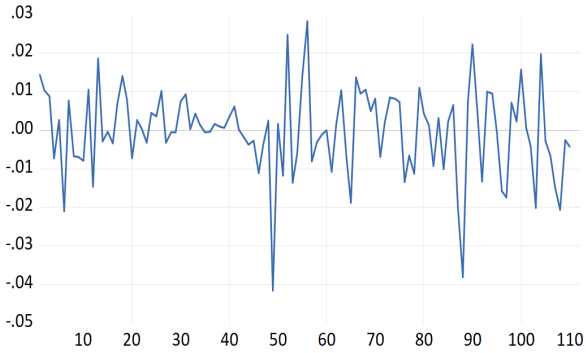
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NASDAQ_POST_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:49
Sample (adjusted): 12 173
Included observations: 162 after adjustments

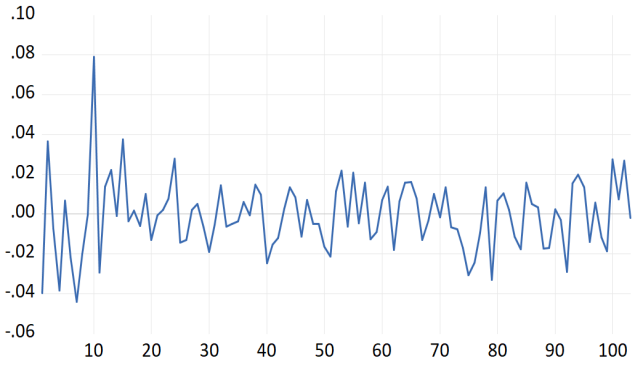
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NASDAQ_POST_WAR(-1))	-6.771918	0.892225	-7.589921	0.0000
D(NASDAQ_POST_WAR(-1),2)	4.844648	0.855271	5.664457	0.0000
D(NASDAQ_POST_WAR(-2),2)	3.979233	0.787283	5.054386	0.0000
D(NASDAQ_POST_WAR(-3),2)	3.168670	0.700519	4.523317	0.0000
D(NASDAQ_POST_WAR(-4),2)	2.470589	0.598914	4.125116	0.0001
D(NASDAQ_POST_WAR(-5),2)	1.845754	0.491561	3.754885	0.0002
D(NASDAQ_POST_WAR(-6),2)	1.289144	0.381625	3.378035	0.0009
D(NASDAQ_POST_WAR(-7),2)	0.838027	0.271312	3.088798	0.0024
D(NASDAQ_POST_WAR(-8),2)	0.425054	0.169591	2.506348	0.0133
D(NASDAQ_POST_WAR(-9),2)	0.210540	0.078847	2.670227	0.0084
C	0.000232	0.001691	0.137270	0.8910

R-squared	0.838007	Mean dependent var	3.97E-05
Adjusted R-squared	0.827279	S.D. dependent var	0.051747
S.E. of regression	0.021506	Akaike info criterion	-4.775492
Sum squared resid	0.069838	Schwarz criterion	-4.565841
Log likelihood	397.8149	Hannan-Quinn criter.	-4.690371
F-statistic	78.11375	Durbin-Watson stat	1.975362
Prob(F-statistic)	0.000000		



NASDAQ





DAX

Null Hypothesis: D(DAX_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on AIC, maxlag=13)

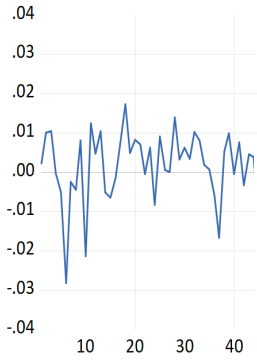
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.972753	0.0000
Test critical values:	1% level	-3.471192	
	5% level	-2.879380	
	10% level	-2.576361	

*MacKinnon (1996) one-sided p

Augmented Dickey-Fuller Test E
Dependent Variable: D(DAX_PF
Method: Least Squares
Date: 12/12/22 Time: 15:43
Sample (adjusted): 12 172
Included observations: 161 after

Variable	Coef
D(DAX_PRE_WAR(-1))	-7.4
D(DAX_PRE_WAR(-1)...	5.5
D(DAX_PRE_WAR(-2)...	4.6
D(DAX_PRE_WAR(-3)...	3.6
D(DAX_PRE_WAR(-4)...	2.8
D(DAX_PRE_WAR(-5)...	2.1
D(DAX_PRE_WAR(-6)...	1.5
D(DAX_PRE_WAR(-7)...	1.0
D(DAX_PRE_WAR(-8)...	0.6
D(DAX_PRE_WAR(-9)...	0.2
C	-0.0

R-squared	0.8
Adjusted R-squared	0.8
S.E. of regression	0.0
Sum squared resid	0.0
Log likelihood	513
F-statistic	74.
Prob(F-statistic)	0.0



Null Hypothesis: D(DAX_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.433419	0.0000
Test critical values:	1% level	-3.469691	
	5% level	-2.878723	
	10% level	-2.576010	

S&P 500

Null Hypothesis: D(S_P_500_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 10 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.170965	0.0000
Test critical values:	1% level	-3.472534	
	5% level	-2.879966	
	10% level	-2.576674	

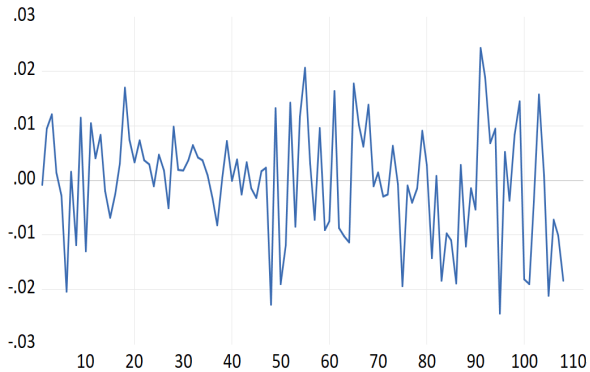
*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(S_P_500_PRE_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:51
Sample (adjusted): 13 168
Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(S_P_500_PRE_WAR(-1))	-7.026460	0.979848	-7.170965	0.0000
D(S_P_500_PRE_WAR(-1),2)	5.156005	0.940847	5.480172	0.0000
D(S_P_500_PRE_WAR(-2),2)	4.395551	0.876861	5.012827	0.0000
D(S_P_500_PRE_WAR(-3),2)	3.718043	0.799243	4.651953	0.0000
D(S_P_500_PRE_WAR(-4),2)	2.967943	0.714052	4.156480	0.0001
D(S_P_500_PRE_WAR(-5),2)	2.295915	0.609677	3.765790	0.0002
D(S_P_500_PRE_WAR(-6),2)	1.788156	0.494047	3.619403	0.0004
D(S_P_500_PRE_WAR(-7),2)	1.426622	0.383658	3.718471	0.0003
D(S_P_500_PRE_WAR(-8),2)	0.956132	0.286651	3.335524	0.0011
D(S_P_500_PRE_WAR(-9),2)	0.529495	0.188003	2.816412	0.0055
D(S_P_500_PRE_WAR(-10),2)	0.196626	0.089299	2.201886	0.0293
C	-0.000360	0.000764	-0.471043	0.6383

R-squared	0.820383	Mean dependent var	-8.34E-06
Adjusted R-squared	0.806662	S.D. dependent var	0.021665
S.E. of regression	0.009526	Akaike info criterion	-6.395782
Sum squared resid	0.013067	Schwarz criterion	-6.161178
Log likelihood	510.8710	Hannan-Quinn criter.	-6.300496
F-statistic	59.79142	Durbin-Watson stat	1.987294
Prob(F-statistic)	0.000000		

PRE-WAR



Null Hypothesis: D(S_P_500_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.238845	0.0000
Test critical values:	1% level	-3.470934	
	5% level	-2.879267	
	10% level	-2.576301	

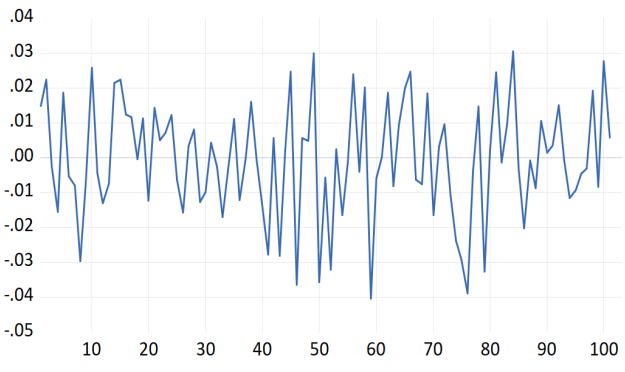
*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(S_P_500_POST_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:51
Sample (adjusted): 12 173
Included observations: 162 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(S_P_500_POST_WAR(-1))	-6.259111	0.864656	-7.238845	0.0000
D(S_P_500_POST_WAR(-1...	4.372509	0.829014	5.274347	0.0000
D(S_P_500_POST_WAR(-2...	3.551895	0.763520	4.651998	0.0000
D(S_P_500_POST_WAR(-3...	2.809572	0.679589	4.134222	0.0001
D(S_P_500_POST_WAR(-4...	2.186248	0.582784	3.751389	0.0003
D(S_P_500_POST_WAR(-5...	1.612950	0.480368	3.357736	0.0010
D(S_P_500_POST_WAR(-6...	1.115804	0.375155	2.974246	0.0034
D(S_P_500_POST_WAR(-7...	0.711082	0.268385	2.649487	0.0089
D(S_P_500_POST_WAR(-8...	0.358666	0.167905	2.136131	0.0343
D(S_P_500_POST_WAR(-9...	0.196131	0.078903	2.485727	0.0140
C	0.000264	0.001311	0.201184	0.8408

R-squared	0.826953	Mean dependent var	-1.29E-05
Adjusted R-squared	0.815493	S.D. dependent var	0.038818
S.E. of regression	0.016674	Akaike info criterion	-5.284442
Sum squared resid	0.041982	Schwarz criterion	-5.074790
Log likelihood	439.0398	Hannan-Quinn criter.	-5.199320
F-statistic	72.15935	Durbin-Watson stat	1.965934
Prob(F-statistic)	0.000000		

POST



NIKKEI 225

Null Hypothesis: D(NIKKEI_225_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 10 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.575020	0.0000
Test critical values:	1% level	-3.474265	
	5% level	-2.880722	
	10% level	-2.577077	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(NIKKEI_225_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 10 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.282174	0.0000
Test critical values:	1% level	-3.472534	
	5% level	-2.879966	
	10% level	-2.576674	

*MacKinnon (1996) one-sided p-values.

PFTS

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NIKKEI_225
Method: Least Squares
Date: 12/12/22 Time: 15:47
Sample (adjusted): 13 162
Included observations: 150 after adj

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NIKKEI_225_PRE_WAR(-1))	0.842037	-6.282174	0.0000	
D(NIKKEI_225_PRE_WAR(-1),2)	0.812218	4.255668	0.0000	
D(NIKKEI_225_PRE_WAR(-2),2)	0.761252	3.726325	0.0003	
D(NIKKEI_225_PRE_WAR(-3),2)				
D(NIKKEI_225_PRE_WAR(-4),2)				
D(NIKKEI_225_PRE_WAR(-5),2)				
D(NIKKEI_225_PRE_WAR(-6),2)				
D(NIKKEI_225_PRE_WAR(-7),2)				
D(NIKKEI_225_PRE_WAR(-8),2)				
D(NIKKEI_225_PRE_WAR(-9),2)				
D(NIKKEI_225_PRE_WAR(-10...				
C				

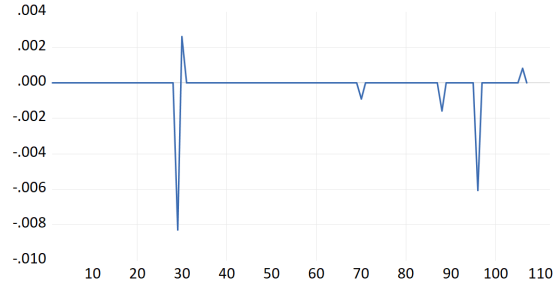
R-squared		Mean dependent var	
Adjusted R-squared		S.D. dependent var	
S.E. of regression		Akaike info criterion	
Sum squared resid		Schwarz criterion	
Log likelihood		Hannan-Quinn criter.	
F-statistic		Durbin-Watson stat	
Prob(F-statistic)			

Null Hypothesis: D(PFTS_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.406891	0.0000
Test critical values:	1% level	-3.471719	
	5% level	-2.879610	
	10% level	-2.576484	

*MacKinnon (1996) one-sided p-values.

PRE-WAR



Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PFTS_PRE_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:50
Sample (adjusted): 9 167
Included observations: 159 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PFTS_PRE_WAR(-1))	-5.677225	0.603518	-9.406891	0.0000
D(PFTS_PRE_WAR(-1...	3.629556	0.560969	6.470151	0.0000
D(PFTS_PRE_WAR(-2...	2.674949	0.484404	5.522142	0.0000
D(PFTS_PRE_WAR(-3...	1.828091	0.384798	4.750780	0.0000
D(PFTS_PRE_WAR(-4...	1.121883	0.275871	4.066700	0.0001
D(PFTS_PRE_WAR(-5...	0.617104	0.169096	3.649426	0.0004
D(PFTS_PRE_WAR(-6...	0.244807	0.075075	3.260824	0.0014
C	2.43E-05	8.02E-05	0.302875	0.7624

R-squared	0.856092	Mean dependent var	-5.20E-06
Adjusted R-squared	0.849421	S.D. dependent var	0.002604
S.E. of regression	0.001010	Akaike info criterion	-10.90814
Sum squared resid	0.000154	Schwarz criterion	-10.75373
Log likelihood	875.1974	Hannan-Quinn criter.	-10.84544
F-statistic	128.3258	Durbin-Watson stat	2.062050
Prob(F-statistic)	0.000000		

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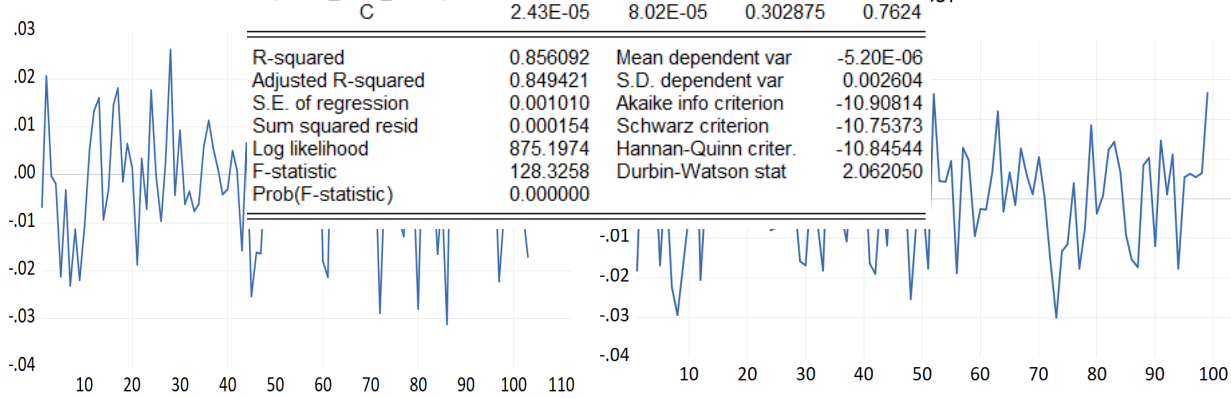


PFTS_POST_WAR – not available as all the values are equal to 0.

FTSE

Null Hypothesis: D(FTSE_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.605791	0.0000
Test critical values:	1% level	-3.471719	
	5% level	-2.879610	
	10% level	-2.576484	

*MacKinnon (1996) one-sided p

Augmented Dickey-Fuller Test E
Dependent Variable: D(FTSE_F
Method: Least Squares
Date: 12/12/22 Time: 15:54
Sample (adjusted): 12 170
Included observations: 159 after

Variable	Co
D(FTSE_PRE_WAR(-1))	-7.
D(FTSE_PRE_WAR(-1...	5.
D(FTSE_PRE_WAR(-2...	4.
D(FTSE_PRE_WAR(-3...	3.
D(FTSE_PRE_WAR(-4...	2.
D(FTSE_PRE_WAR(-5...	2.
D(FTSE_PRE_WAR(-6...	1.
D(FTSE_PRE_WAR(-7...	0.
D(FTSE_PRE_WAR(-8...	0.
D(FTSE_PRE_WAR(-9...	0.
C	-9.

R-squared	0.
Adjusted R-squared	0.
S.E. of regression	0.
Sum squared resid	0.
Log likelihood	54
F-statistic	7
Prob(F-statistic)	0.

Null Hypothesis: D(FTSE_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.896586	0.0000
Test critical values:	1% level	-3.470934	
	5% level	-2.879267	
	10% level	-2.576301	

Null Hypothesis: D(CAC_40_PRE_WAR) has a unit root
Exogenous: Constant
Lag Length: 13 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.140137	0.0000
Test critical values:	1% level	-3.471719	
	5% level	-2.879610	
	10% level	-2.576484	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAC_40_PRE_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:53
Sample (adjusted): 16 174
Included observations: 159 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CAC_40_PRE_WAR(-1))	-9.448278	1.538773	-6.140137	0.0000
D(CAC_40_PRE_WAR(-1),2)	7.511670	1.506980	4.984587	0.0000
D(CAC_40_PRE_WAR(-2),2)	6.557381	1.450937	4.519411	0.0000
D(CAC_40_PRE_WAR(-3),2)	5.557394	1.371228	4.052859	0.0001
D(CAC_40_PRE_WAR(-4),2)	4.716480	1.264468	3.730011	0.0003
D(CAC_40_PRE_WAR(-5),2)	3.903138	1.142909	3.415092	0.0008
D(CAC_40_PRE_WAR(-6),2)	3.221625	1.009863	3.190160	0.0017
D(CAC_40_PRE_WAR(-7),2)	2.532102	0.867334	2.919409	0.0041
D(CAC_40_PRE_WAR(-8),2)	1.996267	0.722854	2.761644	0.0065
D(CAC_40_PRE_WAR(-9),2)	1.473603	0.576860	2.554522	0.0117
D(CAC_40_PRE_WAR(-10),2)	1.053419	0.434930	2.422039	0.0167
D(CAC_40_PRE_WAR(-11),2)	0.798587	0.297537	2.683997	0.0081
D(CAC_40_PRE_WAR(-12),2)	0.510630	0.180782	2.824560	0.0054
D(CAC_40_PRE_WAR(-13),2)	0.224881	0.083382	2.697008	0.0078
C	-0.000163	0.000853	-0.191155	0.8487

R-squared	0.842009	Mean dependent var	5.65E-05
Adjusted R-squared	0.826649	S.D. dependent var	0.025827
S.E. of regression	0.010753	Akaike info criterion	-6.137633
Sum squared resid	0.016651	Schwarz criterion	-5.848114
Log likelihood	502.9418	Hannan-Quinn criter.	-6.020063
F-statistic	54.81763	Durbin-Watson stat	2.026486
Prob(F-statistic)	0.000000		

Null Hypothesis: D(CAC_40_POST_WAR) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on AIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.005530	0.0000
Test critical values:	1% level	-3.469691	
	5% level	-2.878723	
	10% level	-2.576010	

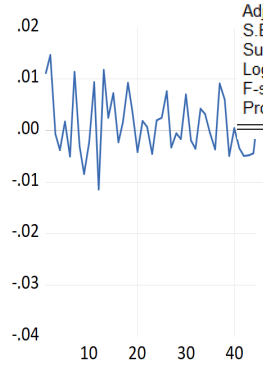
*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAC_40_POST_WAR,2)
Method: Least Squares
Date: 12/12/22 Time: 15:53
Sample (adjusted): 10 176
Included observations: 167 after adjustments

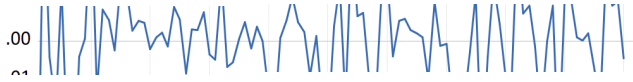
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CAC_40_POST_WAR(-1))	-4.880497	0.609641	-8.005530	0.0000
D(CAC_40_POST_WAR(-1),2)	3.017119	0.567386	5.317581	0.0000
D(CAC_40_POST_WAR(-2),2)	2.314865	0.503008	4.602042	0.0000
D(CAC_40_POST_WAR(-3),2)	1.674053	0.427249	3.918215	0.0001
D(CAC_40_POST_WAR(-4),2)	1.141979	0.338865	3.370013	0.0009
D(CAC_40_POST_WAR(-5),2)	0.801126	0.246163	3.254457	0.0014
D(CAC_40_POST_WAR(-6),2)	0.406591	0.155643	2.612323	0.0099
D(CAC_40_POST_WAR(-7),2)	0.088072	0.073020	1.206131	0.2296
C	0.000481	0.001166	0.412274	0.6807

R-squared	0.821468	Mean dependent var	-9.29E-05
Adjusted R-squared	0.812428	S.D. dependent var	0.034701
S.E. of regression	0.015029	Akaike info criterion	-5.505294
Sum squared resid	0.035687	Schwarz criterion	-5.337259
Log likelihood	468.6921	Hannan-Quinn criter.	-5.437092
F-statistic	90.87421	Durbin-Watson stat	1.951380
Prob(F-statistic)	0.000000		

CAC 40



PRE-WAR



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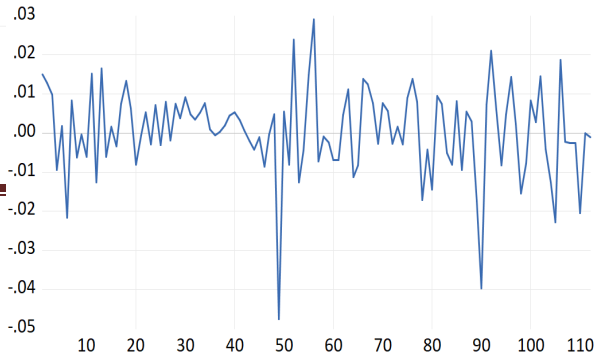

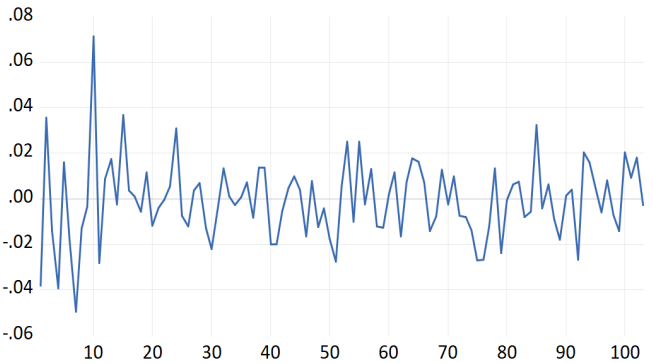

ISSN : 2581-7175

Cointegration test Pre-War

Included observations: 150 after adjustments
Trend assumption: Linear deterministic trend
Series: CAC_40 CSI_300 DAX FTSE_100 MOEX NASDAQ NIKKEI_225 PFTS S_P500 SENSEX
Lags interval (in first differences): 1 to 10

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.485208	354.0434	239.2354	0.0000
At most 1 *	0.385609	254.4445	197.3709	0.0000
At most 2 *	0.294021	181.3759	159.5297	0.0019
At most 3 *	0.206337	129.1505	125.6154	0.0299
At most 4	0.172245	94.48609	95.75366	0.0610
At most 5	0.138335	66.13041	69.81889	0.0950
At most 6	0.102747	43.79718	47.85613	0.1143
At most 7	0.089109	27.53450	29.79707	0.0892
At most 8	0.054958	13.53472	15.49471	0.0966
At most 9 *	0.033144	5.055882	3.841465	0.0245

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.485208	99.59887	64.50472	0.0000
At most 1 *	0.385609	73.06862	58.43354	0.0011
At most 2	0.294021	52.22542	52.36261	0.0516
At most 3	0.206337	34.66439	46.23142	0.4814
At most 4	0.172245	28.35568	40.07757	0.5366
At most 5	0.138335	22.33322	33.87687	0.5818
At most 6	0.102747	16.26268	27.58434	0.6434
At most 7	0.089109	13.99979	21.13162	0.3650
At most 8	0.054958	8.478835	14.26460	0.3321
At most 9 *	0.033144	5.055882	3.841465	0.0245

Cointegration test Post-War

Included observations: 145 after adjustments
Trend assumption: No deterministic trend
Series: CAC_40 CSI_300 DAX FTSE_100 MOEX NASDAQ NIKKEI_225 S_P500 SENSEX
Lags interval (in first differences): 1 to 9

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.573251	355.8523	179.5098	0.0000
At most 1 *	0.406496	232.3763	143.6691	0.0000
At most 2 *	0.288374	156.7282	111.7805	0.0000
At most 3 *	0.223843	107.3988	83.93712	0.0004
At most 4 *	0.193276	70.65579	60.06141	0.0049
At most 5	0.100028	39.51357	40.17493	0.0582
At most 6	0.075378	24.23171	24.27596	0.0506
At most 7 *	0.055610	12.86800	12.32090	0.0404
At most 8 *	0.031037	4.571731	4.129906	0.0386

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.573251	123.4760	54.96577	0.0000
At most 1 *	0.406496	75.64807	48.87720	0.0000
At most 2 *	0.288374	49.32940	42.77219	0.0082
At most 3 *	0.223843	36.74302	36.63019	0.0485
At most 4 *	0.193276	31.14222	30.43961	0.0408
At most 5	0.100028	15.28186	24.15921	0.4836
At most 6	0.075378	11.36371	17.79730	0.3526
At most 7	0.055610	8.296264	11.22480	0.1564
At most 8 *	0.031037	4.571731	4.129906	0.0386

Descriptive Statistics & Analysis

Pre-War

	CAC_40	DAX	FTSE_100	CSI_300	SENSEX	PFTS	NIKKEI_225	NASDAQ	MOEX	S_P500
Mean	0.000810	0.000134	0.001063	-0.000388	0.000122	-0.000144	-0.000758	-5.81E-05	-0.000972	0.000567
Median	0.001875	0.001329	0.000772	0.000193	0.000528	0.000000	-0.000548	0.001962	-6.63E-05	0.001569
Maximum	0.029073	0.028162	0.016333	0.016566	0.017629	0.002611	0.026110	0.034081	0.035490	0.024348
Minimum	-0.047505	-0.041522	-0.036433	-0.022622	-0.028709	-0.008289	-0.031136	-0.037366	-0.064996	-0.024391
Std. Dev.	0.011201	0.011017	0.008308	0.008588	0.009739	0.001077	0.012816	0.013944	0.017363	0.009900
Skewness	-1.101324	-0.787969	-1.013210	-0.200527	-0.538649	-6.000070	-0.130326	-0.304401	-0.911819	-0.273561
Kurtosis	6.820758	5.341968	6.630421	2.415851	3.059578	43.65662	2.583879	3.142724	5.060882	2.986937
Jarque-Bera	80.23065	32.86963	71.30614	2.071056	4.802003	7412.478	0.994522	1.612920	31.23818	1.235489
Probability	0.000000	0.000000	0.000000	0.355039	0.090627	0.000000	0.608194	0.446436	0.000000	0.539159
Sum	0.080183	0.013247	0.105207	-0.038458	0.012075	-0.014247	-0.074996	-0.005750	-0.096241	0.056136
Sum Sq. Dev.	0.012295	0.011896	0.006764	0.007228	0.009295	0.000114	0.016096	0.019054	0.029544	0.009604
Observations	99	99	99	99	99	99	99	99	99	99

Post-War

	CAC_40	CSI_300	DAX	FTSE_100	S_P500	SENSEX	MOEX	NASDAQ	NIKKEI_225	PFTS
Mean	-0.001399	-0.000354	-0.001000	-0.000388	-0.001277	-0.000902	-0.003469	-0.001749	0.000120	0.000000
Median	-0.002336	0.000446	-0.001291	0.000952	-0.000957	-0.002303	-0.003504	-0.001527	0.001465	0.000000
Maximum	0.071252	0.043242	0.079213	0.039138	0.029862	0.029060	0.200358	0.038171	0.039360	0.000000
Minimum	-0.049654	-0.049421	-0.044083	-0.038783	-0.040395	-0.047214	-0.332806	-0.049917	-0.030076	0.000000
Std. Dev.	0.018216	0.015983	0.018597	0.013608	0.017111	0.013969	0.049016	0.022983	0.014283	0.000000
Skewness	0.539538	-0.449676	0.731541	-0.159239	-0.357484	-0.257810	-2.813112	-0.189224	0.185955	NA
Kurtosis	5.345781	3.986161	6.226107	4.040290	2.537420	3.399332	29.45570	2.167267	2.928449	NA
Jarque-Bera	22.77923	6.086276	42.87363	4.044073	2.477627	1.453208	2499.492	2.858610	0.490073	NA
Probability	0.000011	0.047685	0.000000	0.132386	0.289728	0.483548	0.000000	0.239475	0.782676	NA
Sum	-0.114744	-0.029026	-0.082011	-0.031831	-0.104740	-0.073996	-0.284450	-0.143452	0.009849	0.000000
Sum Sq. Dev.	0.026877	0.020693	0.028014	0.014999	0.023716	0.015805	0.194610	0.042785	0.016525	0.000000
Observations	82	82	82	82	82	82	82	82	82	82

Covariance

Pre-War

										Covariance
	CAC_40	CSI_300	S_P500	SENSEX	PFTS	NASDAQ	NIKKEI_225	MOEX	FTSE_100	DAX
CAC_40	0.000124	-1.04E-05	2.09E-05	3.48E-06	-9.58E-07	3.19E-05	2.46E-05	-1.86E-05	3.95E-05	5.37E-05
CSI_300	-1.04E-05	7.30E-05	-4.34E-06	4.57E-06	-2.80E-07	-3.38E-06	-5.08E-06	-1.23E-05	4.94E-06	-7.42E-06
S_P500	2.09E-05	-4.34E-06	9.70E-05	1.78E-05	-1.69E-07	0.000128	-5.57E-06	4.27E-05	9.46E-06	1.80E-05
SENSEX	3.48E-06	4.57E-06	1.78E-05	9.39E-05	-2.34E-07	2.74E-05	-1.27E-05	2.12E-05	1.61E-05	7.81E-06
PFTS	-9.58E-07	-2.80E-07	-1.69E-07	-2.34E-07	1.15E-06	-7.10E-07	-1.01E-07	3.22E-06	3.54E-07	1.75E-06
NASDAQ	3.19E-05	-3.38E-06	0.000128	2.74E-05	-7.10E-07	0.000192	-6.10E-06	4.60E-05	1.45E-05	1.87E-05
NIKKEI...	2.46E-05	-5.08E-06	-5.57E-06	-1.27E-05	-1.01E-07	-6.10E-06	0.000163	-3.36E-05	7.44E-06	1.67E-05
MOEX	-1.86E-05	-1.23E-05	4.27E-05	2.12E-05	3.22E-06	4.60E-05	-3.36E-05	0.000298	9.53E-06	5.82E-05
FTSE_...	3.95E-05	4.94E-06	9.46E-06	1.61E-05	3.54E-07	1.45E-05	7.44E-06	9.53E-06	6.83E-05	5.28E-05
DAX	5.37E-05	-7.42E-06	1.80E-05	7.81E-06	1.75E-06	1.87E-05	1.67E-05	5.82E-05	5.28E-05	0.000120

Post-War

Covariance

	CAC_40	CSI_300	DAX	FTSE_100	MOEX	NASDAQ	NIKKEI_225	PFTS	S_P500	SENSEX
CAC_40	0.000328	3.98E-05	0.000327	0.000144	0.000270	0.000186	5.21E-05	0.000000	0.000148	7.77E-05
CSI_300	3.98E-05	0.000252	3.75E-05	3.45E-05	4.19E-05	1.86E-05	7.47E-05	0.000000	2.13E-05	1.93E-05
DAX	0.000327	3.75E-05	0.000342	0.000145	0.000281	0.000184	4.35E-05	0.000000	0.000147	7.77E-05
FTSE_...	0.000144	3.45E-05	0.000145	0.000183	0.000253	3.02E-05	3.18E-05	0.000000	3.59E-05	7.75E-05
MOEX	0.000270	4.19E-05	0.000281	0.000253	0.002373	-0.000121	5.23E-05	0.000000	-2.21E-05	0.000290
NASDAQ	0.000186	1.86E-05	0.000184	3.02E-05	-0.000121	0.000522	2.45E-05	0.000000	0.000375	-2.04E-05
NIKKEI...	5.21E-05	7.47E-05	4.35E-05	3.18E-05	5.23E-05	2.45E-05	0.000202	0.000000	2.73E-05	3.34E-05
PFTS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S_P500	0.000148	2.13E-05	0.000147	3.59E-05	-2.21E-05	0.000375	2.73E-05	0.000000	0.000289	-1.90E-06
SENSEX	7.77E-05	1.93E-05	7.77E-05	7.75E-05	0.000290	-2.04E-05	3.34E-05	0.000000	-1.90E-06	0.000193

Correlation

Pre-War

Correlation

	CAC_40	CSI_300	DAX	FTSE_100	MOEX	NASDAQ	NIKKEI_225	S_P500	SENSEX	PFTS
CAC_40	1.000000	-0.108789	0.439432	0.429203	-0.096645	0.206075	0.172904	0.190025	0.032219	-0.080227
CSI_300	-0.108789	1.000000	-0.079230	0.070012	-0.083229	-0.028537	-0.046633	-0.051576	0.055175	-0.030599
DAX	0.439432	-0.079230	1.000000	0.582197	0.307181	0.122693	0.119491	0.167175	0.073562	0.149120
FTSE_...	0.429203	0.070012	0.582197	1.000000	0.066750	0.126325	0.070565	0.116233	0.200812	0.039965
MOEX	-0.096645	-0.083229	0.307181	0.066750	1.000000	0.191767	-0.152329	0.250909	0.126527	0.173877
NASDAQ	0.206075	-0.028537	0.122693	0.126325	0.191767	1.000000	-0.034476	0.938170	0.203534	-0.047777
NIKKEI...	0.172904	-0.046633	0.119491	0.070565	-0.152329	-0.034476	1.000000	-0.044333	-0.103018	-0.007412
S_P500	0.190025	-0.051576	0.167175	0.116233	0.250909	0.938170	-0.044333	1.000000	0.186305	-0.016018
SENSEX	0.032219	0.055175	0.073562	0.200812	0.126527	0.203534	-0.103018	0.186305	1.000000	-0.022536
PFTS	-0.080227	-0.030599	0.149120	0.039965	0.173877	-0.047777	-0.007412	-0.016018	-0.022536	1.000000

Post-War

Correlation

	CAC_40	CSI_300	DAX	FTSE_100	MOEX	NASDAQ	NIKKEI_225	PFTS	S_P500	SENSEX
CAC_40	1.000000	0.138223	0.975726	0.589261	0.305636	0.450071	0.202561	NA	0.480826	0.309266
CSI_300	0.138223	1.000000	0.127623	0.160766	0.054162	0.051297	0.331236	NA	0.078782	0.087575
DAX	0.975726	0.127623	1.000000	0.578833	0.312615	0.434851	0.165827	NA	0.466463	0.302811
FTSE_...	0.589261	0.160766	0.578833	1.000000	0.383359	0.097872	0.165493	NA	0.155946	0.412858
MOEX	0.305636	0.054162	0.312615	0.383359	1.000000	-0.109178	0.075631	NA	-0.026712	0.428753
NASDAQ	0.450071	0.051297	0.434851	0.097872	-0.109178	1.000000	0.075587	NA	0.964534	-0.064412
NIKKEI...	0.202561	0.331236	0.165827	0.165493	0.075631	0.075587	1.000000	NA	0.112963	0.169263
PFTS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S_P500	0.480826	0.078782	0.466463	0.155946	-0.026712	0.964534	0.112963	NA	1.000000	-0.008039
SENSEX	0.309266	0.087575	0.302811	0.412858	0.428753	-0.064412	0.169263	NA	-0.008039	1.000000

INTERPRETATION

The present study has used Augmented Dickey-Fuller (ADF) test to conduct tests for unit root in 10 global indices namely SENSEX, CSI 300, DAX, FTSE 100, MOEX, NASDAQ Composite, PFTS, S&P 500, CAC 40, and NIKKEI 225. It helps to identify the stationarity of the data series of all the 10 global indices of two time periods i.e. pre-war period and the post-war period.

Analysis of the Pre-War Period

All the data series were stationary at the I(1)level and its difference and intercept level as shown in Fig. 1.1 that data is stationary at the first level in the ADF test. The null hypothesis is (p-1) = 0 it possesses a unit root and is therefore rejected in each of the cases. In the first index SENSEX the null hypothesis in PRE_WAR has a unit root which is rejected at 1% level which implies the series is stationary. Its p value is 0.000. When p value is greater than 0.05 null hypothesis is accepted. If it is not, then null hypothesis is rejected. Here the null hypothesis is rejected.Likewise, in POST_WAR has a unit root test which is rejected in 1% level itself which implies the series is stationary.Null hypothesis in every PRE_WAR and in POST_WAR have unit root test which is rejected at 1% level. So the entire series are stationary.

In all the cases p-value of the pre-war period for all the 10 global indices is significant at a 5% level using differences with the intercept model. The P value of the ADF test is 0.000 which is less than 5% thus implying that the data is stationary. The coefficient value is negative in all cases. It suggested that the model is fit.

Fig. 1.1

INDEX	Calculated Value	P value
SENSEX	-6.465	0.000
CSI 300	-6.604	0.000
DAX	-7.973	0.000
FTSE 100	-7.606	0.000
MOEX	-11.810	0.000
NASDAQ	-6.961	0.000
PFTs	-9.407	0.000
S&P 500	-7.171	0.000
CAC 40	-6.140	0.000
NIKKEI 225	-6.575	0.000

Analysis of the Post-War Period

All the data series were stationary at the I(1)level and its difference and intercept level as shown in Fig. 1.2 that data is stationary at the first level in the ADF test. The null hypothesis is (p-1) = 0 it possesses a unit root and is rejected in all the cases. In all the cases p-value of the post-war period for all the 10 global indices is significant at a 5% level using differences with the intercept model. The P value of the ADF test is 0.000 which is less than 5% thus implying that the data is stationary. The coefficient value is negative in all cases. It suggested that the model is fit.

Fig. 1.2

INDEX	Calculated Value	P value
SENSEX	-7.555	0.000
CSI 300	-8.125	0.000
DAX	-8.433	0.000

FTSE 100	-7.897	0.000
MOEX	-7.301	0.000
NASDAQ	-7.590	0.000
PFTs	N/A	0.000
S&P 500	-7.239	0.000
CAC 40	-8.006	0.000
NIKKEI 225	-6.282	0.000

Cointegration test

Following the confirmation that each series is stationary at first difference, the Johansen cointegration test was conducted at the selected lag level to check for the existence of a long-term equilibrium between the various stock market indices. If the series are cointegrated, it means they have a common random trend, and any deviations from the long-term equilibrium may lead to short-term adjustments of the series to restore the equilibrium. Comparing trace and eigenvalue statistics to the critical values at 5% suggests that trace test indicates 4 cointegrating eqn(s) and max-eigenvalue tests indicate 2 cointegrating eqn(s) for Pre-War and Trace test indicates 5 cointegrating eqn(s) and Max-eigenvalue test indicates 5 cointegrating eqn(s) for Post-War.

CONCLUSIONS

This study examines how the conflict between Ukraine and Russia has affected the movement of 10 global stock market indices. The daily stock return data of 10 global indices over the period starting from 24th June 2021 to 31stOct 2022 shows significant negative effects of the Russia-Ukraine war on these global stock indices. During the first few weeks of the war, markets in neighboring nations saw a significant proximity penalty in the form of steeply negative returns. Comparatively, faraway nations performed significantly better. We anticipated that the European stock market, which is an important trading partner for Russia's economy, would react poorly to this issue because of the country's closeness, rising political unrest, and the effects of any sanctions.

We observed that the event of February 24, 2022, had an immediate, significant negative influence on the global indices, followed by an immediate, significant positive impact. PFTs was an exception to this, even if the overall impact on the international stock markets was unfavorable. Our research also shows that a prolonged war will have a negative impact on the global economy.

Since our research was conducted at the start of the ongoing Russia-Ukraine conflict, it is possible that it does not fully reflect the outcome of the crisis. We recommend that future researchers thoroughly investigate the repercussions of this event comprehensively.

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