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"Russia's Special Military Operation in Ukraine", The Effect of this Announcement on the Performance of Emerging Stock Markets and its Relationship with Economic Growth. A Case for Event Study

"Operación Militar Especial de Rusia en Ucrania", El Efecto de este Anuncio en el Desempeño de los Mercados Accionarios Emergentes y su Relación con el Crecimiento Económico. Un Caso para el Estudio de Eventos

"A Operação Militar Especial da Rússia na Ucrânia", O Efeito deste Anúncio no Desempenho dos Mercados Bolsistas Emergentes e a sua Relação com o Crescimento Económico. Um Caso para Estudo de Evento

AUTHOR

Eduardo Sandoval Álamos[1]
Universidad Tecnológica Metropolitana, Santiago, Chile.
eduardo.sandoval@utem.cl

1. Corresponding author: Departamento de Industria; Facultad de Ingeniería, Instituto Universitario de Investigación y Desarrollo Tecnológico; Universidad Tecnológica Metropolitana, Santiago, Chile. José Pedro Alessandri 1242, Ñuñoa, Región Metropolitana, Chile.

This article estimates the effect that the announcement of a "special military operation in Ukraine" made by the President of Russia had on the performance of emerging stock markets. For the above, the Fama & French 5-factor model is contrasted using 4 different econometric methods. The results indicate that those global investors who opportunely took refuge in the stock markets of China, Colombia, Mexico and Malaysia had a superior stock market performance in economies that jointly showed, during the years 2022 and 2023, positive economic growth rates.

Este artículo estima el efecto que tuvo el anuncio "operación militar especial en Ucrania" realizado por el presidente de Rusia en el desempeño de los mercados accionarios emergentes. Para lo anterior, se contrasta el modelo de 5 factores de Fama y French utilizando 4 métodos econométricos diferentes. Los resultados indican que aquellos inversionistas globales que oportunamente se refugiaron en los mercados accionarios de China, Colombia, México y Malasia tuvieron un desempeño accionario superior en economías que en conjunto mostraron, durante los años 2022 y 2023, tasas de crecimiento económico positivas.

Este artigo estima o efeito que o anúncio de uma "operação militar especial na Ucrânia" feito pelo Presidente da Rússia teve no desempenho dos mercados bolsistas emergentes. Para o efeito, o modelo de 5 fatores de Fama & French é contrastado utilizando 4 métodos econométricos diferentes. Os resultados indicam que os investidores globais que oportunamente se refugiaram nos mercados bolsistas da China, Colômbia, México e Malásia tiveram um desempenho bolsista superior em economias que, em conjunto, apresentaram, durante os anos de 2022 e 2023, taxas de crescimento económico positivas.

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1. Introduction

Event studies and their implementation through dynamic econometric designs are increasingly used in empirical financial research. Its various applications in measuring the effects of corporate decision announcements, changes in regulations and macroeconomic shocks on stock prices and returns are of special interest to both local and global investors for different purposes. However, events that consider the effects of war conflict announcements on stock market performance are relatively scarce in the literature, especially in the case of stock markets involved in the conflict as well as in the world's emerging stock markets.

Keeping the above in mind, this article continues with the line of research reported in Sandoval (2023), which focused just on the case of developed stock markets. This article focuses on a different object of study since it investigates the effect that the announcement of a "special military operation" in Ukraine, made on February 24, 2022 by the president of Russia, Vladimir Putin, had on the performance of emerging stock markets, also including the stock markets that were protagonists of the war, Russia and Ukraine, respectively. The sample thus includes 24 emerging stock markets plus Russia and Ukraine, totaling 26 stock markets in accordance with the classification criteria of Morgan Stanley Capital International, MSCI.

The object of study in this case is interesting, because of emerging stock markets (also including the stock markets of Russia and Ukraine) are frequently more volatile and less integrated with each other, compared to the case of developed stock markets, and therefore the econometric methods applied may eventually yield different results.

As a hypothesis, it is proposed that this type of announcement produces negative abnormal returns (an inferior stock market performance, as a result of a fall in the stock price beyond normal) especially in those stock markets most exposed to the conflict, which in turn would reflect a punishment to the expected free cash flows generated by companies for their investors, due to an expected economic drop activity in the corresponding countries analyzed. This hypothesis is also consistent with the fact that, if some stock markets are relatively less exposed, and thus, relatively more benefited from the announcement, they would present positive abnormal returns (superior stock market performance), which would reflect a better expected performance in their corresponding economies.

In addition to what has already been indicated, in each of the countries in the sample, it is studied whether or not the effects of this announcement are related to their respective ex post economic growth, experienced in both 2022 and 2023 years, in an attempt to corroborate whether the stock market performance (superior/inferior) displayed on the day of the aforementioned announcement, constitutes a correct signal that anticipates or not the performance of the real economy of each country.

Whatever the situation, there would be a direct relationship between stock market performance as a result of the announcement and performance in the real sector of the economy, which is empirically examined in the development of this article.

Keywords
Ukraine, Time-varying, Stock market performance, Economic growth.

Palabras clave
Ucrania, Variable en el tiempo, Desempeño del mercado accionario, Crecimiento económico.

Palavras-chave
Ucrânia, Variação temporal, Desempenho do mercado bolsista, Crescimento económico.

JEL codes
G12; G15

The rest of the article is organized as indicated. The next section presents the literature review, then describes the sample and data, then presents the model and the econometric methods used. Finally, the results and conclusions of the article are shown.

2. Literature Review

A review of event studies in Finance is presented in El Ghoul et al., (2022) and briefly reported in Sandoval (2023). In this sense, the latter indicates that "less than 12% of the event studies reported in El Ghoul et al. (2022), only four (0.57%) are related to election events or political risks and practically none are related to announcements of any military intervention in any country.

A recent search (2023-2024) in alternative sources of academic articles yielded the following publications related to studies that account for the impact of the war between Russia and Ukraine on the returns of emerging stock markets.

Khan, T.; et al. (2023) examine the herd behavior of Indian stock market investors during the intense geopolitical tensions between Russia and Ukraine in 2022. Multifractal Trendless Fluctuation Analysis (MFDFA) was used to calculate the fifth-order Hurst exponent that detects herding behavior. The empirical results of their study revealed the presence of profound herding behavior during the escalation window of the geopolitical event between Russia and Ukraine, demonstrating the interconnection of global events and financial markets, highlighting the need for policymakers to consider the possible social and economic consequences of geopolitical events.

Keleş, E., (2023) examines the role that some financial factors played in the resilience of businesses in Turkey during the Russia-Ukraine war. The results of the event study show a significant negative reaction, which began before the official announcement of war and grew over time. Complementary analyzes reveal that the negative effect decreases for larger and more profitable companies, but increases for companies with a high market capitalization, high level of cash and debt. The author concludes that this study contributes to exploring Turkey as a unique emerging market environment due to its important geopolitical position, strategic trade, and trade partnership with the European Union and Russia.

Kwaku, S., (2023) examines the asymmetric interdependence between geopolitical risk (GPR) and the stock markets of the seven major emerging countries (E7) (Mexico, Russia, Turkey, India, China, Indonesia and Brazil) in the current geopolitical conflict between Russia and Ukraine. The results show heterogeneous and asymmetric responses offered by E7 stocks to geopolitical risk, allowing emerging market stocks to be suitable for diversification and downside hedging strategies against geopolitical risk-induced shocks.

Küçükçolak, R.; et al. (2024) examine, using event study methodology, the effect of the Russia-Ukraine crisis on energy companies listed on the stock exchanges of European and Asian countries that import oil and natural gas from Russia, as well as from the US. In the first window period, the analysis carried out on a country-by-country basis, the conflict caused an extreme reaction in the European and Asian stock markets showing positive abnormal returns. However, energy companies in the U.S stock market maintained normal returns. In the second window period, due to Russia's prior announcement on natural gas sales in rubles, the stocks under study showed only normal returns, ensuring the efficiency of their stock markets.

These studies, among others, published in the last two years although they are related to the impacts of the Russia-Ukraine conflict in the indicated emerging stock markets, on the other hand, they do not consider a broad nor an exhaustive sample of emerging stock markets in the world, as well as a dynamic econometric methodology that captures how systematic risk coefficients can change over time or whether volatility clustering can be present with greater frequency around the announcement of a war conflict.

This article, on the contrary, contributes to the literature through the comparison of four types of econometric methods or specifications based on deviations from the five-factor model of Fama and French (2015) applied to an exhaustive sample of emerging stock markets, according to the MSCI criteria. The above with the objective of first validating whether the model by using methods that allow systematic risk coefficients that change over time and/or heteroscedastic in nature, fit the data better. The five-factor model of Fama and French is used since it has shown superiority in goodness of fit compared to alternative valuation models., Sandoval (2023). Secondly, this article aims to quantify the effect of the announcement of Russia's special military operation in Ukraine on the stock performance of emerging markets, also including the protagonists of the conflict. The first method (method 1) assumes fixed coefficients and homoscedastic residual variance, the second (method 2) assumes fixed coefficients and heteroscedastic residual variance, which is governed by a Garch (1,1) process. The third (method 3) assumes systematic risk coefficients (betas) that change in time through a process with mean reversion and homoscedastic residual variance and the fourth (method 4) assumes systematic risk coefficients (betas) that change in time through a process with mean reversion and heteroskedastic residual variance, governed by a Garch (1,1) process.

The time-varying specifications with heteroscedastic residual variance have recently been documented with significant advantages compared to those that consider parameters fixed over time, when using daily data, see Ortas et al., (2015) and Sandoval (2023). The above thanks to the fact that they allow leptokurtosis to be controlled, thus reducing the influence of atypical observations in the parameter estimation process. Furthermore, by conditioning the time varying models to the presence of residual heteroscedasticity, they allow for better control of the presence of the phenomenon of volatility clustering present in the financial series, especially in periods of crisis. These methods generally present better indicators of goodness of fit compared to conventional methods that assume fixed parameters and homoscedasticity, recurrently used in event studies.

3. Sample and Data

The sample in this article considers 26 stock markets in total, 24 of them emerging plus Russia and Ukraine, according to the classification and information of IMI stock indices that are available at MSCI (www.msci.com). From these, the corresponding daily stock returns, in USD, are obtained for the period from December 1, 2021 to May 19, 2022. This period covers sixty business days of stock returns before and sixty business days after the day of announcement on February 24, 2022. This window is wide enough so that models that consider time-varying and heteroscedastic parameters in their residual variance can converge adequately. The IMI stock indices of each country reflect the stock performance of a market portfolio representative of 99% of the adjusted free float market capitalization of large, medium and small companies in each stock market, respectively. The 26 stock markets plus the 2 IMI stock indices for developed and emerging markets (orthogonal in their returns to the previous one) used as benchmarking, respectively, are listed in **Table 2**. It is important to note that MSCI classifies emerging markets based on 3 criteria: Economic development, Size and liquidity requirements and Market accessibility criteria. Daily yields in USD on US Treasury bonds (with 1 month maturity) are used as the risk-free rate. In relation to the five risk factors of Fama and French (2015), these were obtained on a daily basis, along with the risk-free rate, for developed markets from the Keneth French website:

https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Table 2. - Descriptive Statistics.

MSCI IMI Stock Indices	*Average*	*Standard Deviation*	*Skewness*	*Kurtosis*	*JB*	*ADF*
Brazil	0.14%	1.76%	-0.4350	2.96	3.82	-8.75***
Chile	0.10%	2.08%	-0.7793	6.02	58.13***	-9.98***
China	-0.21%	2.45%	1.6466	12.82	541.30***	-8.64***
Colombia	0.00%	1.66%	-0.5199	5.17	29.10***	-9.01***
Czech Rep	0.15%	1.99%	-0.8246	7.76	128.16***	-11.58***
Egypt	-0.22%	1.47%	-1.6491	9.35	258.04***	-10.25***
Greece	-0.03%	1.98%	-0.0467	6.27	53.80***	-12.56***
Hungary	-0.31%	3.56%	-0.8451	9.13	204.03***	-3.87***
India	-0.09%	1.47%	-0.7158	4.91	28.79***	-10.29***
Indonesia	0.02%	1.00%	-1.9202	12.52	531.26***	-13.12***
Korea	-0.15%	1.39%	0.0287	3.11	0.08	-10.76***
Kuwait	0.11%	0.75%	-0.5107	6.90	81.96***	-8.78***
Malaysia	-0.04%	0.78%	-0.3550	2.93	2.57	-9.90***
Mexico	0.09%	1.31%	0.1921	2.62	1.48	-9.56***
Peru	0.11%	2.08%	0.0579	3.88	3.93	-10.00***
Philippines	-0.06%	1.32%	-0.5647	3.85	10.07***	-12.03***
Poland	-0.21%	2.73%	-0.3954	12.56	464.21***	-11.62***
Qatar	0.06%	0.99%	-0.4638	8.91	180.69***	-10.90***
Saudi Arabia	0.11%	0.94%	-1.0974	6.58	88.90***	-9.46***

South Africa	0.00%	1.60%	-0.0536	3.42	0.94	-9.41***
Taiwan	-0.14%	1.24%	-0.2145	4.07	6.71**	-9.87***
Thailand	0.00%	1.00%	-0.5181	4.30	13.98***	-10.51***
Turkey	0.12%	3.92%	2.9576	28.68	3502.08***	-13.15***
United Arab Emirates	0.06%	1.40%	-0.1287	13.71	579.06***	-9.71***
Russia	-1.28%	7.86%	-1.4829	11.89	252.55***	-12.11***
Ukraine	-1.17%	7.80%	-0.4655	16.33	513.34***	-3.37**
Developed Markets	-0.14%	1.08%	0.2117	2.67	0.83	-10.01***
Emerging Markets	0.00%	0.93%	-1.3865	7.65	84.32***	-11.12***

**** Significant at 1%*
*** Significant at 5%*
** Significant at 10%*

Table 2 shows the descriptive statistics of the daily excess returns of the 28 stock indices. 24 of them are associated with IMI stock indices elaborated by MSCI for emerging stock markets, 2 for Russia and Ukraine, plus 2 for developed and emerging countries, as groups, respectively. Column JB reports the values associated with the Jarque-Bera normality test. The ADF column reports the values of the augmented Dickey-Fuller unit root test. The lags for this test were determined based on the Schwarz Criterion. Source: Own elaboration based on the outputs of EViews 12.0.

Table 2 shows the basic descriptive statistics for the daily excess returns of the 26 MSCI IMI stock indices under study, from December 2, 2021 to May 19, 2022 (121 data), that is, 60 data before and 60 data after the announcement day of February 24, 2022. The highest average daily excess return is achieved by the MSCI IMI index of Czechoslovakia (+0.15%) followed by Brazil (+0.14%). On the other hand, the worst excess daily average returns are achieved by Russia (-1.28%) and Ukraine (-1.17%), respectively. Regarding risk, measured by the standard deviation of daily excess returns, the lowest risk is achieved by the MSCI IMI index of Kuwait (0.75%) while the highest risk is captured by the MSCI IMI index of Russia (7.86%). Twenty-one of the twenty-six series (81%) of excess daily returns associated with the MSCI IMI indices reported in **Table 2** show a negative bias, while five (19%) present a positive bias, that is, they present a distribution which is concentrated on negative and positive excess returns, respectively. Furthermore, 23 of the 26 series exhibit leptokurtosis with more pointed distributions and thicker tails compared to the normal distribution. When examining the results of the Jarque-Bera test, the rejection of the null hypothesis of normality is confirmed in 20 of the 26 series under study. The ADF test, for its part, confirms at 5% of statistical significance the rejection of the null hypothesis of unit root, thus making all excess returns series stationary. Leptokurtosis and the high presence of non-normality in the excess returns of the 26 series analyzed, anticipate that the models with time-varying parameters, accompanied by those that assume heteroscedasticity in the residual variance, will eventually present better indicators for the criteria of information or in the data goodness of fit. This will be reported later in the results of this article.

4. Econometric Models and Methods

This section presents the model and the econometric methods to be used in the article. The model to be used has its foundations in the Fama and French (2015) five-factor model (hereinafter FF), which has typically been together with the CAPM of Sharpe (1964), used in the study of events, assuming parameters fixed and constant residual variance. This model, in its empirical version, is used to estimate deviations in market equilibrium excess returns, using daily frequency data. Four different econometric methods or specifications are applied as estimation methods; 2 of these are based on ordinary least squares with fixed parameters (assuming homoskedasticity and heteroskedasticity, respectively in the residual variance) and alternatively, as innovations, to compare goodness of fit, 2 state-space methods with systematic risk parameters that change in the time (time-varying) (assuming homoskedasticity and heteroskedasticity in the residual variance, respectively), the latter led by a general heteroskedastic conditional autoregressive process Garch (1,1). The four methods are detailed below:

Method 1: Based on FF model, it considers fixed parameters and homoscedastic residual variance, estimation method, ordinary least squares.

$$R_{jt} - R_{ft} = \alpha_{j1}d_1 + \alpha_{j2}d_2 + \beta_{j1}(R_{dmt} - R_{ft}) + \beta_{j2}(R_{emt} - R_{ft}) + \beta_{j3}SMB_t + \beta_{j4}HML_{t_t} + \beta_{j5}RMW_t + \beta_{j6}CMA_t + e_{jt} \quad (1)$$

Method 2: Based on the FF model, it considers fixed parameters and heteroskedastic residual variance, under a Garch (1,1) process, estimation method, ordinary least squares.

$$R_{jt} - R_{ft} = \alpha_{j1}'d_1 + \alpha_{j2}'d_2 + \beta_{j1}'(R_{dmt} - R_{ft}) + \beta_{j2}'(R_{emt} - R_{ft}) + \beta_{j3}'SMB_t + \beta_{j4}'HML_{t_t} + \beta_{j5}'RMW_t + \beta_{j6}'CMA_t + u_{jt} \quad (2)$$

$$\sigma^2_{ujt} = \omega_j + \chi_j\mu^2_{j,t-1} + \gamma_j\sigma^2_{ujt-1} \quad (3)$$

$$\text{con } \omega_j,\ \chi_j, \gamma_j \geq 0 \text{ y } (\chi_j + \gamma_j) < 1$$

Method 3: Based on FF model, it considers parameters (time-varying for developed and emerging market betas, each of them following a process with mean reversion) and homoscedastic residual variance, estimation method, state-space.

$$R_{jt} - R_{ft} = \alpha_{j1}''d_1 + \alpha_{j2}''d_2 + \beta_{j1t}''(R_{dt} - R_{ft}) + \beta_{j2t}''(R_{emt} - R_{ft}) + \beta_{j3}''SMB_t + \beta_{j4}''HML_{t_t} + \beta_{j5}''RMW_t + \beta_{j6}''CMA_t + z_{jt} \quad (4)$$

$$\beta_{j1t''} = \bar{\beta}_{j1''} + \phi_{j1''}(\beta_{j1t-1''} - \bar{\beta}_{j1''}) + \tau_{j1t} \quad (5)$$

$$\beta_{j2t''} = \bar{\beta}_{j2''} + \phi_{j2''}(\beta_{j2t-1''} - \bar{\beta}_{j2''}) + k_{j2t} \quad (6)$$

Method 4: Based on FF model, it considers parameters (time-varying for developed and emerging market betas, each of them following a process with mean reversion) and heteroskedastic residual variance, following a Garch (1,1) process, estimation method, state -space.

$$R_{jt} - R_{ft} = \alpha_{j1}'''d_1 + \alpha_{j2}'''d_2 + \beta_{j1t}'''(R_{dmt} - R_{ft}) + \beta_{j2t}'''(R_{emt} - R_{ft}) + \beta_{j3}'''SMB_t + \beta_{j4}'''HML_{t_t} + \beta_{j5}'''RMW_t + \beta_{j6}'''CMA_t + r_{jt} \quad (7)$$

$$\beta_{j1t'''} = \bar{\beta}_{j1'''} + \phi_{j1'''}(\beta_{j1t-1'''} - \bar{\beta}_{j1'''}) + s_{j1t} \quad (8)$$

$$\beta_{j2t'''} = \bar{\beta}_{j2'''} + \phi_{j2'''}(\beta_{j2t-1'''} - \bar{\beta}_{j2'''}) + v_{j2t} \quad (9)$$

$$\sigma^2_{rjt} = \omega_{j'} + \chi_{j'}\mu^2_{j,t-1} + \gamma_{j'}\sigma^2_{ujt-1} \quad (10)$$

$$\text{con } \omega_{j'},\ \chi_{j'}, \gamma_j \geq 0 \text{ y } (\chi_{j'} + \gamma_{j'}) < 1$$

where;

R_{jt} - R_{ft} = Excess return R_{jt} relative to the risk-free rate R_{ft} for the emerging stock market j on day t. j = 1, ...,26. t = Covers the period from December 2, 2021 to May 19, 2022, with daily data, in methods 1, 2, 3 and 4, respectively.

α_{j1}, $\alpha_{j1'}$, $\alpha_{j1''}$, $\alpha_{j1'''}$ = Average abnormal return of the emerging stock market j considering the days before and after the announcement day (February 24, 2022) in methods 1, 2, 3 and 4, respectively.

d_1 = Binary variable, takes value 1 in the days before and after the day of the announcement (February 24, 2022) and 0 on the day of the announcement.

α_{j2}, $\alpha_{j2'}$, $\alpha_{j2''}$, $\alpha_{j2'''}$ = Abnormal return of emerging stock market j on the announcement day (February 24, 2022) in methods 1, 2, 3 and 4, respectively.

d_2 = Binary variable, takes value 1 on the day of the announcement (February 24, 2022) and 0 on the days before and after February 24, 2022.

β_{j1}, $\beta_{j1'}$ = Coefficient 1 of systematic risk for emerging stock market j. It captures the sensitivity of excess returns of emerging stock market j to excess returns of the MSCI IMI developed markets equity index, in methods 1 and 2, respectively.

β_{j2}, $\beta_{j2'}$ = Coefficient 2 of systematic risk for emerging stock market j. It captures the sensitivity of the excess returns of emerging stock market j to the excess returns of the MSCI Emerging Markets Equity Index IMI (excess returns which are orthogonal to the excess returns of the MSCI IMI Developed Markets Equity Index), in the methods 1 and 2, respectively.

$\beta_{j1t''}$, $\beta_{j1t'''}$ = Coefficient 1 of systematic risk for emerging stock market j on day t. It captures the sensitivity of the excess returns of emerging stock market j to the excess returns of the MSCI IMI developed markets equity index, on day t, in methods 3 and 4, respectively. $\beta_{j1t''}$, $\beta_{j1t'''}$ follow a process with mean reversion given by equation (5) and (8), respectively.

$\beta_{j2t''}$, $\beta_{j2t'''}$ = Coefficient 2 of systematic risk for emerging stock market j on day t. It captures the sensitivity of the excess returns of emerging stock market j to the excess returns of the MSCI Emerging Markets Equity Index IMI (excess returns orthogonal to the excess returns of the MSCI IMI Developed Markets Equity Index), on the day t, in methods 3 and 4, respectively. $\beta_{j2t''}$, $\beta_{j2t'''}$ follow a process with mean reversion given by equation (6) and (9), respectively.

$(R_{dmt} - R_{ft})$ = Excess return R_{dmt} relative to the free-risk rate R_{ft} of the MSCI IMI developed markets equity index on day t.

$(R_{emt} - R_{ft})$ = Excess return R_{emt} relative to the risk-free rate R_{ft} of the emerging market equity index, by construction orthogonal to the excess returns of the MSCI IMI developed market equity index on day t.

$\beta_{j3}, \beta_{j3'}, \beta_{j3''}, \beta_{j3'''}$ = Risk coefficient associated with the factor SMB_t, for the emerging stock market j. It captures the sensitivity of the excess returns of the emerging stock market j to the movements of the factor SMB_t. This factor is related to the difference between the returns of portfolios of small and large market capitalization companies, in methods 1, 2, 3 and 4, respectively.

$\beta_{j4}, \beta_{j4'}, \beta_{j4''}, \beta_{j4'''}$ = Risk coefficient associated with the factor HML_t, for the emerging stock market j. It captures the sensitivity of the excess returns of the emerging stock market j to the movements of the factor HML_t. This factor is related to the difference between the returns of portfolios of companies with a high and low book value/market value ratio of shares, in methods 1, 2, 3 and 4, respectively.

$\beta_{j5}, \beta_{j5'}, \beta_{j5''}, \beta_{j5'''}$ = Risk coefficient associated with the factor RMW_t, for the emerging stock market j. It captures the sensitivity of the excess returns of the emerging stock market j to the movements of the RMW_t. This factor is related to the difference between the returns of portfolios of companies that are robust and weak in profitability, in methods 1, 2, 3 and 4, respectively.

$\beta_{j6}, \beta_{j6'}, \beta_{j6''}, \beta_{j6'''}$ = Risk coefficient associated with the factor CMA_t, for the emerging stock market j. It captures the sensitivity of the excess returns of the emerging stock market j to the movements of the CMA_t factor. This factor is related to the difference between the portfolio returns of conservative and aggressive companies in their real investment policy, in methods 1, 2, 3 and 4, respectively.

ε_jt = Error term of method 1 for the emerging stock market j on day t. The errors are assumed to have a normal distribution, a mean value of zero and homoscedastic variance.

μ_{jt} = Error term of method 2 for the emerging stock market j on day t. The errors are assumed to have a normal distribution, a mean value of zero and heteroscedastic variance, which follows a GARCH (1,1) process described by equation (3).

z_{jt} = Error term of method 3 for the emerging stock market j on day t. The errors are assumed to have a normal distribution, a mean value of zero and homoscedastic variance.

r_{jt} = Error term of method 4 for the emerging stock market j on day t. The errors are assumed to have a normal distribution, a mean value of zero and heteroskedastic variance, which follows a GARCH (1,1) process described by equation (10).

$\tau_{j1t}, k_{j2t}, s_{j1t}, v_{j2t}$ = Error term in equations (5), (6), (8) and (9), respectively. The errors are assumed to have a normal distribution, a mean value of zero and homoscedastic variance.

The unknown parameters of method 3 and 4, respectively, are estimated by maximizing the following maximum likelihood function, Harvey (1990).

$$\log L_j\left(\theta_j\right) = -\frac{T}{2}\log(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\log f_{j,t}\left(\theta_j\right) - \frac{1}{2}\sum_{t=1}^{T}\frac{v_{j,t}^2(\theta_j)}{f_{j,t}(\theta_j)} \quad (11)$$

where;

θ_j is the hyper parameter vector while $v_{j,t}(\theta_j)$ are the predictive residuals of each model, respectively, and the variance of these is estimated using a recursive Kalman filter algorithm. The initial values for the hyper parameter vector are set according to Wells (1996), in which the initial value of 0.1 stands out for the coefficients $\phi_{j1''}$ y $\phi_{j2''}$ $\phi_{j1'''}$ y $\phi_{j2'''}$, respectively, which capture how quickly the market beta coefficients (time-varying) return to their mean. In addition, an initial value of e^{-1} is set for the variance of residuals in equations of methods 3 and 4, respectively. When it is performed a sensitivity analysis of these values, the results do not change significantly.

On the other hand, in the financial econometric literature, as described by Sandoval and Molina (2022), it is "well recognized that the daily series of returns on risky financial assets present the phenomenon of volatility clustering, which becomes more noticeable and significant in periods of crisis." These phenomena are adequately captured in GARCH models [Bollerslev et al., (1992)]. Given the above, unlike static models with homoscedasticity for the residual variance, it is more realistic to assume that the residuals of the observed equation, follow a conditionally heteroscedastic behavior in accordance with a GARCH (1,1) process. The parameters of the GARCH (1,1) processes contemplated in equation (10) are estimated under an iterative process that consists of first estimating the vector of hyper parameters assuming homoscedasticity (method 3), then it is required the generation of the predictive residuals, in order to model their conditional variance according to the GARCH process (1,1) in the observed equation (7), and finally the state-space system is re-estimated.

Our main parameter to analyze, after obtaining the results of the estimates, is α_{j2}, $\alpha_{j2'}$, $\alpha_{j2''}$, $\alpha_{j2'''}$, which estimates the performance shown by a given emerging stock market *j* [superior (+), normal (0) or inferior (-)] on the announcement day (February 24, 2022), under the methods 1, 2, 3 and 4, respectively, and once the effects of Fama and French's 5 factors have been controlled along with some other abnormal return on average in the days before or after the day of the announcement. It is important to note that in all methods, in fact 6 factors were used because in addition to the excess returns of the MSCI IMI stock index for developed markets, the orthogonal excess returns (to the previous one) of the MSCI IMI stock index for emerging markets was also considered in order to capture the pure effect of both stock indices used as benchmarking in the econometric estimates.

5. Results

In this section, in **Table 3**, the results are presented in summary form, concentrating interest on the information criteria (goodness of fit) in addition to the parameter α_2 and its statistical significance, for methods 1, 2, 3 or 4 (the best among them in terms of information criteria) presented in the previous section and that were estimated based on the econometric methods already indicated.

Table 3. - Summary results with model estimation using ordinary least squares and state-space econometric methods.

Stock Emerging Market (Best Method)	*Variáveis dependentes*			*Quantity of IC over the second best method*	*Abnormal return on date of announcement α_2*
	Akaike	*Schwarz*	*Hannan-Quinn*		
1. Brazil (Method 1)	-5.6314	-5.4465	-5.5563	3/3 Method 2	-0.36%
2. Chile (Method 1)	-5.1662	-4.9813	-5.0911	3/3 Method 2	+0.94%
3. China (Method 3)	-6.5573	-6.2569	-6.4353	3/3 Method 2	+3.26% ***
4. Colombia (Method 2)	-5.5669	-5.3127	-5.4637	2/3 Method 4	+1.18% *
5. Czech Republic (Method 4)	-5.6313	-5.3541	-5.5187	2/3 Method 2	-5.39% ***
6. Egypt (Method 2)	-5.8778	-5.6326	-5.7745	3/3 Method 4	-2.66% ***
7. Greece (Method 2)	-5.8441	-5.5939	-5.7449	3/3 Method 4	-5.63% ***
8. Hungary (Método2)	-4.6866	-4.4324	-4.5834	3/3 Method 4	-15.73%+ ***
9. India (Method 1)	-6.4054	-6.2206	-6.3304	2/3 Method 3	-2.80% ***
10. Indonesia (Method 3)	-6.6590	-6.3586	-6.5370	3/3 Method 4	+0.31%
11. Korea (Method 1)	-6.6918	-6.5071	-6.6169	3/3 Method 2	+0.82%
12. Kuwait (Method 4)	-7.4565	-7.1792	-7.3437	3/3 Method 2	+0.75% *
13. Malaysia (Method 1)	-7.4025	-7.2177	-7.3275	3/3 Method 2	+0.71%
14. Mexico (Method 4)	-6.6669	-6.3897	-6.5543	3/3 Method 1	+1.13% ***
15. Peru (Method 4)	-5.7418	-5.4645	-5.6292	3/3 Method 2	-0.07%
16. Philippine (Method 4)	-6.0356	-5.7583	-5.9230	3/3 Method 1	-0.26%
17. Poland (Method 4)	-5.4234	-5.1461	-5.3108	3/3 Method 2	-10.54% ***
18. Qatar (Method 2)	-6.7338	-6.4796	-6.6305	3/3 Method 4	+1.92%
19. Saudi Arabia (Method 1)	-6.5667	-6.3818	-6.4917	2/3 Method 2	-0.35%
20. South Africa (Method 1)	-6.0383	-5.8535	-5.9632	3/3 Method 2	+0.29%
21. Taiwan (Method 4)	-6.8831	-6.6058	-6.7705	3/3 Method 2	+0.45%
22. Thailand (Method 1)	-6.9846	-6.7998	-6.9095	2/3 Method 4	-0.36%
23. Turkey (Method 2)	-4.4926	-4.2384	-4.3894	3/3 Method 4	-9.63% ***
24. United Arab Emirates (Method 2)	-6.0829	-5.8287	-5.9797	3/3 Method 4	-0.45%
25. Russia (Method 4)	-3.8864	-3.4978	-3.7322	3/3 Method 2	-31.74% ***
26. Ukraine (Method 2)	-3.7201	-3.4659	-3.6169	3/3 Method 4	-29.51% ***

*** Significant at 1%
** Significant at 5%
* Significant at 10%

Table 3 shows the summarized results after the estimation of the four methods indicated in section IV, using econometric specifications of least squares (methods 1 and 2) and state-space (methods 3 and 4) for the excess returns over the risk-free rate of each of the 26 stock indices under study. The Akaike, Schwarz and Hannan-Quinn column shows the resulting values of the information criteria (goodness of fit) of the best method estimated among them. The column, amount of IC over the second best estimated method, shows the number of information criteria, among the 3 criteria, that the best method, reported in the first column, exceeds the second best estimated method. The last column presents the abnormal return on the day of the announcement (February 24, 2022). This presents the value and statistical significance of the alpha 2 coefficient of the best method indicated in the first column of Table 3.

The first column of Table 3 shows the 26 stock markets studied along with the best estimation method for each particular stock market among the four estimates that were presented in section IV. Method 1, 2, 3 and 4 outperform the rest of the methods in 8, 8, 2 and 8 stock markets, respectively. Thus, the most dynamic methods (methods 2, 3 and 4) that assume either heteroskedasticity or time varying systematic risk coefficients, are 18 times better than Method 1, which strictly assumes fixed coefficients and homoscedasticity.

These results align with recent findings in the financial literature [see Ortas et al., (2015), Santos et al., (2019), Sandoval and Molina (2022) and Sandoval (2023)] where models with time-varying parameters and/or with heteroscedastic residual variance fit the data better and more frequently than models with fixed and homoscedastic parameters, by allowing the former better control leptokurtosis and the volatility clustering phenomena present in financial series, especially significant during periods of crisis. However, some differences are detected from the results found by Sandoval (2023) for the case of developed stock markets. In these, method 4 turns out to be the best in the case of 20 out of 23 stock markets (87%) while method 1 turns out to be the best only in the case of the remaining 3 markets (13%). This evidence differs in the case of the emerging stock markets (also including Russia and Ukraine) studied in this article, where method 4 turns out to be the best in the case of 8 of 26 stock markets (31%), while method 1 also turns out to be the best, with the same frequency (31%). These results suggest that the behavior of developed stock markets adjusts relatively better, compared to emerging stock markets, to the dynamics of systematic risk parameters that change over time together with a heteroskedastic residual variance governed by a Garch process (1 ,1), during the estimation period of parameters based on Fama and French's model. This may be reflecting the greater degree of integration that the developed stock markets exhibit among themselves, which in this type of war events are infected in a similar dynamic way. On the other hand, this seems not to be the case of emerging stock markets, which, being more segmented, react differently.

Regarding the effects of the February 24, 2022 announcement, column 6 presents the abnormal return on the day of the announcement made by the President of Russia, Vladimir Putin. Fifteen of the twenty-six stock markets present a negative abnormal return (9 significant at the 1% level) and eleven present a positive abnormal return (4 significant at the 1% and 10% levels, respectively), thus totaling 13 stock markets significantly affected in statistical terms.

The above is clear evidence that the negative effects, resulting from the announcement of February 24, 2022, exceeded the positive ones, generally in emerging stock markets with the addition of Russia and Ukraine. Nine of the thirteen markets (70%) were negatively and statistically significantly affected and only four of the thirteen (30%) were positively affected. The four markets relatively most negatively affected were: Russia (-31.74%), Ukraine (-29.51%), Hungary (-15.73%) and Poland (-10.54%) and the four markets relatively most affected positively were: China (+3.26%), Colombia (+1.18%), Mexico (+1.13%) and Kuwait (+0.75%).

In a complementary manner, as indicated in section I of this article, it is interesting to analyze whether or not there is a direct relationship between the abnormal return associated with the announcement day of February 24, 2022 and the ex-post economic growth shown during the last two years after the announcement in each of the stock markets/emerging countries, plus Russia and Ukraine, included in the sample of this article. As shown in Table 4, the stock markets/countries where a direct relationship is exhibited during both 2022 and 2023 years, respectively, are: China, Colombia, Mexico and Malaysia with positive abnormal returns of 3.26%, 1.18%, 1.13% and 0.71% accompanied by also a positive economic growth during the 2022 year of 3.0%, 7.3%, 3.9% and 8.7%, respectively. During the year of 2023 these countries kept their positive economic growth, showing rates of 5.0%, 1,4%, 3,2% and 4,0%, respectively. In these 4 markets/countries, the hypothesis is validated that the stock markets correctly anticipated the effects of the real economy in their stock performance, after the announcement on February 24, 2022. The other markets/countries do not exhibit a direct relationship after considering the last two years of economic performance. They show, instead, either an inverse or neutral relationship. The most striking cases are Poland and Turkey, which on the one hand show negative abnormal returns of -10.54% and -9.63% and on the other hand, economic growth rates of 4.6% and 5.1%, respectively, in 2022, and 0.6% and 4%, respectively, in 2023.

Table 4. - Abnormal return in % on February 24, 2022 and economic growth in 2022 and 2023, respectively, for the 26 emerging stock markets/countries (includes Russia and Ukraine).

Emerging Stock Market/ Country	*Abnormal return on the date of announcement % α_2*	*Economic growth rate In 2022*	*Economic growth rate In 2023*
1. Brazil	-0.36%	+2.9%	+3.10%
2. Chile	+0.94%	+2.4%	-0.50%
3. China	+3.26% ***	+3.0%	+5.00%
4. Colombia	+1.18% *	+7.3%	+1.40%
5. Czech Republic	-5.39% ***	+2.3%	+0.20%
6. Egypt	-2.66% ***	+6.7%	+4.20%
7. Greece	-5.63% ***	+5.9%	+2.50%
8. Hungary	-15.73% ***	+4.6%	-0.30%
9. India	-2.80% ***	+7.2%	+6.30%
10. Indonesia	+0.31%	+5.3%	+5.00%
11. Korea	+0.82%	+2.6%	+1.40%
12. Kuwait	+0.75% *	+8.9%	-0.60%
13. Malaysia	+0.71%	+8.7%	+4.00%
14. Mexico	+1.13% ***	+3.9%	+3.20%
15. Peru	-0.07%	+2.7%	+1.10%
16. Philippine	-0.26%	+7.6%	+5.30%
17. Poland	-10.54% ***	+5.1%	+0.60%
18. Qatar	+1.92%	+4.9%	+2.40%
19. Saudi Arabia	-0.35%	+8.7%	+0.80%
20. South Africa	+0.29%	+1.9%	+0.90%
21. Taiwan	+0.45%	+2.4%	+0.80%
22. Thailand	-0.36%	+2.6%	+2.70%
23. Turkey	-9.63% ***	+5.5%	+4.00%
24. United Arab Emirates	-0.45%	+7.9%	+3.40%
25. Russia	-31.74% ***	-2.1%	+2.20%
26. Ukraine	-29.51% ***	-29.1%	+2.00%

*** Significant at 1%
** Significant at 5%
* Significant at 10%

Table 4 shows in the first column the emerging stock markets/countries (also includes Russia and Ukraine) under study. The second column shows the abnormal return in %, with its respective statistical significance, on the day of the announcement (February 24, 2022). The third and fourth columns show the economic growth rate of each country in years 2022 and 2023, respectively, according to the source: IMF, October 2023 World Economic Outlook. Note: For India, data and forecasts are presented on a fiscal year basis, with FY 2022/23 (starting in April 2022) shown in the 2022 column. India's growth projections are 6.5 percent in 2023 and 5.7 percent in 2024 based on calendar year.

6. Conclusions

This article studies the effect of the announcement (made on February 24, 2022 by the president of Russia, Vladimir Putin, in which he communicates a “special military operation” in Ukraine) on the performance of the emerging stock markets of the world, also including the stock markets directly involved in the war conflict, Russia and Ukraine. In a complementary manner, it is studied whether or not the effects of this announcement on the performance of the aforementioned stock markets are related to the respective economic growth experienced in both 2022 and 2023 years on their respective countries in the sample.

As a hypothesis, a direct relationship is proposed between stock market performance as a result of the announcement and economic growth rate, which is empirically examined in the development of this article.

In methodological terms, the results show a predominance of models with time-varying parameters and/or with heteroscedastic residual variance, which fit better to the dynamics of the data, allowing better control of leptokurtosis and volatility clustering phenomena that occur in financial series, especially in periods of crisis.

Regarding the effects of the announcement on February 24, 2022, the results show clear evidence that the negative effects resulting from the announcement outweighed the positive ones in general in the performance of the stock markets examined. Nine of thirteen stock markets were negatively affected, in terms of statistical significance, and only four of thirteen were positively affected. The three markets relatively most negatively affected were Russia, Ukraine and Hungary and the three relatively most positively affected were China, Colombia and Mexico.

In addition, the results show that the stock markets/countries where a direct relationship is exhibited between stock market performance, around the announcement, and economic growth in both 2022 and 2023 years, are: China, Colombia, Mexico and Malaysia with positive abnormal returns and positive economic growth. In these four stock markets/countries, the hypothesis is validated that the stock markets correctly anticipated, in their stock performance, the effects on the real economy, after the announcement of February 24, 2022.

The results allow us to conclude that only some of the examined stock markets correctly anticipated, in their stock market performance (around the announcement of February 24, 2022), what really would occur in their respective economies in both 2022 and 2023 years. In others stock markets it didn't happen. This opens other channels of research to search for a possible answer.

The results finally indicate that those global investors who opportunely (before the announcement of Russia's special military operation in Ukraine) took refuge in the stock markets of China, Colombia, Mexico and Malaysia had a superior stock performance in economies with positive economic growth.

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