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EMERGING MARKETS ECONOMIES SENSITIVITY TO US DOLLAR'S STRENGTH DURING RUSSIA-UKRAINE WAR

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Abstract. This paper aims to study the sensitivity of emerging markets economies (EMEs) to the US Dollar's strength during the Russian-Ukrainian war in the long and the short run, where Autoregressive distributed lag model (ARDL) was used to analyze time series daily data in the period 2020-2023. We studied the impact of the US Dollar's strength on EMEs asset prices: EMEs currencies, EMEs bonds (US Dollar-denominated) and EMEs stocks, including the factor of the Russian-Ukrainian war as a dummy variable, as well as the effects of various economic factors: Federal Funds Rate, the US 10-year bond yield, commodity prices index and gold prices. The results showed that Russian-Ukrainian war has a significant positive impact on US Dollar's strength. In the other hand, both of them have significant negative impacts on EMEs asset prices, with varying degrees, where the aforementioned economic factors have asymmetric impacts. Moreover, EMEs stocks were the most Sensitive to Russian-Ukrainian war, US Dollar's strength and commodity prices, meanwhile EMEs bonds market were the least Sensitive.

Keywords: *ARDL model, asset prices, emerging market economy, russia-ukraine war, us dollar strength.*

Rezumat. Lucrarea își propune să studieze sensibilitatea economiilor de piață emergente (EME) la puterea dolarului american în timpul războiului ruso-ucrainean pe termen lung și scurt, în care modelul de întârziere distribuit autoregressiv (ARDL) a fost utilizat pentru a analiza datele zilnice ale seriilor de timp în perioada 2020-2023. A fost studiat impactul forței dolarului american asupra prețurilor activelor EME: valute EME, obligațiuni EME (denominate în dolari SUA) și acțiuni EME, inclusiv factorul războiului ruso-ucrainean ca variabilă inactivă, precum și efectele diferitor factori economici: rata fondurilor federale, randamentul obligațiunilor americane pe 10 ani, indicele prețurilor mărfurilor și prețul aurului. Rezultatele au arătat că războiul ruso-ucrainean are un impact pozitiv semnificativ asupra puterii dolarului american. Pe de altă parte, ambele au un impact negativ semnificativ asupra prețurilor activelor EME, cu grade diferite, acolo unde factorii economici menționați mai sus au impacturi asimetrice. Mai mult, acțiunile EME au fost cele mai sensibile la războiul ruso-ucrainean, la puterea dolarului american și la prețurile mărfurilor, în timp ce piața de obligațiuni din EME a fost cea mai puțin sensibilă.

Cuvinte cheie: *model ardl, prețuri ale activelor, economie de piață emergentă, războiul ruso-ucrainean, puterea dolarului american.*

1. Introduction

Due to Covid-19 pandemic lockdown restrictions, the global economy has faced massive economic crisis. By the beginning of 2022, the mortality and infections rates have decreased, which led to cancel the pandemic restrictions by most of countries. Thus, the global economy finally started to recover from covid-19 pandemic and there were optimistic predictions for global growth according to the IMF World Economic Outlook. In February of 2022, Russia invaded Ukraine, which raised questions about the impact of the conflict on the world's political and economic order and dimmed all hopes for global growth [1, 2].

The conflict started when Ukraine declared its attention to join NATO, which created a threat to Russia. According to U.S. Department of State Antony Blinken, Russia "continues to take aim at NATO, a defensive, voluntary alliance that protects nearly a billion people across Europe and North America, and at the governing principles of international peace and security that we all have a stake in defending" [3].

The invasion caused massive economical, geopolitical, and humanitarian crisis. According to United Nations High Commissioner for Refugees (UNHCR), more than eight million Ukrainian refugees recorded across Europe, and over eight million others displaced within the country. Moreover, the war led to a mixture of repercussions on the global economy with significant impacts on: the commodity markets, trade, financial flows, Refugees problems and market confidence [4].

Therefore, investors fear and uncertainty related to financial markets risks and volatility have increased due to geopolitical tension. In addition, global economy was primarily impacted by the sharp increase in prices of commodities that are provided by Russia and Ukraine such as energy, wheat, fertilizers and some minerals. The war also intensified price rise pressures of foods that were already piling from the Covid-19 pandemic crisis and worsened poverty rates, food insecurity in several countries [5].

The value of global currencies was significantly depreciated due to the Russia-Ukraine war especially the Russian Ruble [6].Since the US Dollar is considered as the most dominant currency in international transactions and foreign lending, any fluctuations in its value will negatively affect emerging market economies, as cross-border loans represent about 50% of all external liabilities of emerging market countries according to the International Monetary Fund (IMF) and U.S. dollars represent 80% of these loans [7]. In addition, the US dollar Strength leads to a significant contraction in real investment in emerging markets, especially countries with a floating exchange rate regime. There is a negative relationship between emerging markets GDP growth and the US dollar strength, any rise in US Dollar value will lead to falling of US Dollar priced commodities, and weak commodity prices lead to lower real incomes, which reduces domestic demand and real GDP growth in emerging markets [8, 9].

Thus, the US Dollar is widely acknowledged as the primary currency for global reserve, international trade, investment, and global financial flows. As such, US Dollar's strength has negative effect on GDP, investment, financial sector and sovereign risk in emerging markets economies [10].

Given the importance to understanding the impact of geopolitical uncertainty (Russian-Ukraine War) on emerging market economies (EME) and the US dollar, this study aims to examine the reaction of the US Dollar Strength to the Russian-Ukraine war and how they affect EMEs asset prices: EMEs currencies, EMEs bonds (US Dollar-denominated) and

EMEs stocks, including the role of various economic factors such as: commodity prices, gold prices, Federal Funds Rate and the US 10-year bond yield, in the long and the short run.

The paper is organized as follows: The second section devoted to literature review, the third section explains the methodologies used, dataset and auxiliary calculations, whereas the fourth section provides the discussion of the econometric results and the final section is the Conclusion.

2. Literature Review:

In term of international finance, it has been conducted a great deal of research on emerging market economies, particularly in regards to how are these markets vulnerable to shocks from the outside world, such as uncertainty related to US economy behavior and global geopolitical conflicts. According to [11], when economic uncertainty in the US increases, GDP drops globally along with it. Furthermore, there is a significant portion of the activity reduction in advanced nations caused by the exchange rate system and financial instability, however, the reactions are higher in EMEs countries when trade openness and financial system instability are both high and are unaffected by the exchange rate regime.

The study of [12], displayed in their study that while individual components' effects vary depending on the market categorization, the overall political risk factor has an impact on stock returns in established, developing, and frontier economies. Government action is a substantial source of political risk that is common to all three market groups; the main distinction is the possibility of war as shown in ethnic tensions, government stability is the final factor that makes frontier stock markets particularly vulnerable to political risk. The study performed by [13], demonstrate that shocks to global geopolitical risk have a significant impact on the business cycle for emerging economies. These shocks are connected to significant economic contractions, between 13% and 22% of output volatility is often accounted by global geopolitical risk shocks. However, the specific share for each EMEs country varies greatly.

The Russia-Ukraine War is considered as the most recent geopolitical risk that led to major global Consequences, where it has resulted a massive humanitarian loss, opportunity cost of military investment and a disruption of local and global economies [14]. The war has also added more worries about a significant slowdown in global growth, an increase in prices and debts and a rise in poverty. Additionally, there were economic influences on financial markets, trade, migration and investment confidence; through three primary channels: an increase in commodity prices, financial sanctions and supply chains interruptions [15]. In his study, [16] showed that between February and August 2022, imports from Ukraine became 47.3% less than the usual, and the trade rerouting caused by the Russia-Ukraine conflict benefited Russian exports of mineral oil and gas to Europe and Asia more than any other country. Furthermore, he demonstrated the existence of a significant variation among product groups and geographic regions, and that the trade adjustments mostly occur through increases in import prices.

Nations that depend on food imports from Russia and Ukraine, especially those in the Middle East and North Africa (MENA) area, were particularly affected by the war's immediate and extensive cascading effect on global food security. In addition, the timing of the war was unfortunate for the world's food markets as they already had high food prices due to supply chain disruptions brought on by the COVID-19 pandemic, high global demand and poor harvests in certain areas [17, 18]. The crisis's detrimental impacts are proven with more than

27 million people being driven into poverty and extra 22 million people into hunger, while increased food costs have a greater impact on hunger and food quality, furthermore, increasing energy and fertilizer prices have a greater impact on agricultural industries and poverty [19].

The study conducted by [20], suggested that the volatility of the agricultural, metal, and energy markets is greatly increased by the escalation of the Russia-Ukraine conflict. The conflict has an impact on these markets through both economic and financial channels, the higher the global market share of Russia exported commodities, the higher volatility of commodity markets. According to [21], commodity prices have a significant impact on stock markets all over the world, their change can be considered as the biggest since the 2008 financial crisis, which directly affected the gold and oil markets and stronger trade ties with Russia and Ukraine led to more decrease in the stock market value indexes [22]. But, according to [23] though the Russian-Ukrainian war impact was smaller than Global Financial Crisis (GFC) and the Covid-19, the immediate response of the world stock markets demonstrates that investors perceived the invasion as bigger news.

The studies of [24, 25], discovered the existence of a considerable negative impact of war on most stock markets as they became inefficient, particularly on the Russian market, where the conflict has a large negative impact on the G20's European and Asian regions. The stock markets return in invasion day are adversely correlated with economic globalization as measured by GDP-scaled commerce, where the war impact was greater on more globalized economies [26].

The study performed by [27], look for how the Russia-Ukraine war affected the topological characteristics of the global bond market, they found that the war has a significant impact on developed and developing economies government bonds markets. While utilizing the Euro as the official currency, the networks of relationships between the markets for EU government bonds are intimately linked to one another. Additionally, the effects of the Russia-Ukraine conflict on foreign exchange rates using five different Euro exchange rates, their findings showed that the Russian Ruble had a significant impact on the devaluation of the Euro. In addition, all of the foreign exchange rates showed a long-run cointegration, only the relationships between Euro against Russian Ruble, US Dollar and Chinese Yuan were significant in the short run [28].

The study conducted by [29], examined how the Russian invasion of Ukraine affected various asset classes' hedging capabilities, they found that the different asset classes displayed varied levels of risk sensitivity, in terms of both size and timescale. For multi-week timeframes, bonds and stocks showed high coherence, although, currencies were affected in shorter time frames. The assets that held their value the longest against changes in the war geopolitical risk, included: real estate, gold, silver, Swiss francs, and green bonds; therefore, they may be the best protection against geopolitical risk.

To the best of our knowledge, no study has covered the impact of the Russia-Ukraine war on US Dollar's strength, while most of previous studies have examined its impact either on global asset prices or on EMEs asset prices individually. This study aims to fill this gap by analyzing the impact of the Russia-Ukraine war on both US Dollar's strength and EMEs asset prices: EMEs currencies, EMEs bonds (US Dollar-denominated) and EMEs stocks; as well as finding which of these EMEs asset prices are more sensitive to US Dollar strength and the Russia-Ukraine war, in the long-run and the short-run. Therefore, the study depended on explanatory variables such as: Federal funds rate and the US 10-year bond yield due to

significant effects of US quantitative easing on EMEs [30], commodity prices index since Russia and Ukraine are considered as major commodities exporters [31], gold prices because gold is commonly recognized as a safeguard against US Dollar fluctuations and it is proven to be more stable than the US Dollar during global economy uncertainty [32].

3. Methodology

This section presents the data collected and the econometric model of the study estimated using Auto Regressive Distributed Lag (ARDL) approach.

3.1 Data

This study used daily data of EMEs assets prices indexes, US Dollar Index, Federal Funds Rate and the US 10-year bond yield, commodity prices, gold prices, collected from investing.com website, besides the Russian-Ukrainian war factor as a dummy variable, in the period between 02 January 2020 and 01 June 2023 with 861 Observations, as displayed in Table 1 and 2.

Table 1

Variables description

variable	index
US Dollar's strength	US Dollar Index
EMEs currencies	MSCI Intl Emerging Market Currency
EMEs bonds	iShares J.P. Morgan USD Emerging Markets Bond ETF
EMEs stokes	MSCI Emerging Markets (MSCIEF)
US Federal funds	Federal Funds Rate
US bonds	US 10-Year Bond Yield
Commodity prices	Bloomberg Commodity (BCOM)
Gold prices	Gold futures

Source: Research Findings.

Table 2

Descriptive statistics

Variable	Max	Min	Mean	St. Dev
US Dollar's strength	114.11	89.44	97.92	6.04
EMEs currencies	1755.59	1547.33	1675.53	54.96
EMEs bonds	117.01	77.09	102.16	11.91
EMEs stocks	1444.93	758.2	1123.2	158.93
US Federal funds	5.08	0.04	1.03	1.51
US bonds	4.25	0.52	1.91	1.08
Commodity prices	136.6	59.47	94.89	20.68
Gold	2069.4	1477.9	1804.33	104.08

Source: Research Findings.

3.2. Econometric Modeling

This study employs Auto Regressive Distributed Lag (ARDL) model [33] to examine long-run cointegration correlations between the model variables and to detect the short-run dynamic by removing features from the error correction model (ECM). Eq. (1), Eq. (2), Eq. (3) and Eq. (4) represent the ARDL models:

$$\Delta DS_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i}\Delta DS_{t-i} + \sum_{i=1}^{p} \beta_{2i}\Delta F_{t-i} + \sum_{i=1}^{p} \beta_{3i}\Delta Y_{t-i} + \sum_{i=1}^{p} \beta_{4i}\Delta CP_{t-i} + \sum_{i=1}^{p} \beta_{5i}\Delta G_{t-i} + \sum_{i=1}^{p} \beta_{6i}\Delta RUW_{t-i} + \delta_1 DS_{t-1} + \delta_1 F_{t-1} + \delta_1 Y_{t-1} + \delta_1 CP_{t-1} + \delta_1 G_{t-1} + \delta_1 RUW_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta EMC_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i}\Delta EMC_{t-i} + + \sum_{i=1}^{p} \beta_{2i}\Delta DS_{t-i} + \sum_{i=1}^{p} \beta_{3i}\Delta F_{t-i} + + \sum_{i=1}^{p} \beta_{4i}\Delta Y_{t-i} + \sum_{i=1}^{p} \beta_{5i}\Delta CP_{t-i} + \sum_{i=1}^{p} \beta_{6i}\Delta G_{t-i} + \sum_{i=1}^{p} \beta_{7i}\Delta RUW_{t-i} + \delta_1 EMC_{t-1} + \delta_2 DS_{t-1} + \delta_3 F_{t-1} + \delta_4 Y_{t-1} + \delta_5 CP_{t-1} + \delta_6 G_{t-1} + \delta_7 RUW_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta EMB_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i}\Delta EMB_{t-i} + + \sum_{i=1}^{p} \beta_{2i}\Delta DS_{t-i} + \sum_{i=1}^{p} \beta_{3i}\Delta F_{t-i} + + \sum_{i=1}^{p} \beta_{4i}\Delta Y_{t-i} + \sum_{i=1}^{p} \beta_{5i}\Delta CP_{t-i} + \sum_{i=1}^{p} \beta_{6i}\Delta G_{t-i} + \sum_{i=1}^{p} \beta_{7i}\Delta RUW_{t-i} + \delta_1 EMB_{t-1} + \delta_2 DS_{t-1} + \delta_3 F_{t-1} + \delta_4 Y_{t-1} + \delta_5 CP_{t-1} + \delta_6 G_{t-1} + \delta_7 RUW_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta EMS_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i}\Delta EMS_{t-i} + + \sum_{i=1}^{p} \beta_{2i}\Delta DS_{t-i} + \sum_{i=1}^{p} \beta_{3i}\Delta F_{t-i} + + \sum_{i=1}^{p} \beta_{4i}\Delta Y_{t-i} + \sum_{i=1}^{p} \beta_{5i}\Delta CP_{t-i} + \sum_{i=1}^{p} \beta_{6i}\Delta G_{t-i} + \sum_{i=1}^{p} \beta_{7i}\Delta RUW_{t-i} + \delta_1 EMS_{t-1} + \delta_2 DS_{t-1} + \delta_3 F_{t-1} + \delta_4 Y_{t-1} + \delta_5 CP_{t-1} + \delta_6 G_{t-1} + \delta_7 RUW_{t-1} + \varepsilon_t \quad (4)$$

Where: Δ: the first-order differential operator, α_0 : constant, p: number of lags, $\beta_1 + \beta_2 + .. + \beta_5$: the short-run dynamics, $\delta_1 + \delta_2 + .. + \delta_5$: the long-run dynamics, p: the number of lags, ε_t: the standard error term, DS: US Dollar's strength, EMC: EMEs currencies, EMB: EMEs bonds, EMS: EMEs stocks, F: Federal Funds Rate, Y: US 10-Year bond yield, CP: Commodity prices, G: Gold prices and RUW: Russian-Ukrainian war.

The ARDL bound test [34] approach was applied to investigate co-integration between the variables by comparing the F-statistic to the critical bound values, Depending on the following hypotheses:

H0: There is no co-integration ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$)

H1: There is a co-integration ($\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq 0$)

The null hypothesis of no co-integration will be rejected if the estimated F-statistics is greater than the two sets of higher critical values, which are divided into upper critical value[I(1)] and lower critical value[I(0)]. If not, it will be accepted.

Then, cumulative sum of the residuals (CUSUM) and cumulative sum of squares of residuals (CUSUMQ) tests [35] were used to evaluate the parameter stability and verify the quality of fit of the ARDL model. Furthermore, Toda and Yamamoto test (Granger causality/ block erogeneity Wald test) [36] was used to examine the causative relationship among the variables, which applies

a Vector Auto-Regression (VAR) approach at the level and adds the maximum integration order(m) of all the model's variables to the appropriate VAR order (k). As shown in Eq. (5) and Eq. (6) below:

$$Y_t = \alpha_1 + \sum_{i=1}^{m} \beta_{1i} Y_{t-i} + + \sum_{i=1}^{k} \beta_{2i} Y_{t-i} + \sum_{i=1}^{m} \theta_{1i} X_{t-i} + + \sum_{i=1}^{k} \theta_{2i} X_{t-i} + \mu_t \quad (5)$$

$$X_t = \alpha_2 + \sum_{i=1}^{m} \theta_{1i} X_{t-i} + + \sum_{i=1}^{k} \theta_{2i} X_{t-i} + \sum_{i=1}^{m} \gamma_{1i} Y_{t-i} + + \sum_{i=1}^{k} \gamma_{2i} Y_{t-i} + \mu_t \quad (6)$$

Where: Y: the dependent variable, X: independent variable, α_1 and α_2: constant, θ_1 , θ_2, $\gamma_1$and γ_2: the short-run dynamics and μ_t: the white error term.

4. Results and Discussion

This section covers the main findings of the Auto Regressive Distributed Lag (ARDL) modeling procedures.

4.1. Stationarity test

Table 3 finding shows that all variables are stationary in the first difference (level of significance of 1%), except for G and Y that are stationary in the level (level of significance of 5% and 10% respectively), which means rejecting the null hypothesis (unit root) [37], which confirms suitability of the ARDL model for the study.

Table 3

Unit root test results

	Level			First difference		
Variable	**T&I**	**Intercept**	**None**	**T&I**	**Intercept**	**None**
DS	-1.57032	-1.08497	0.23542	-26.9910***	-27.0057***	-27.0194***
EMC	-1.259201	-1.181657	0.205789	-27.1881***	-27.2046***	-27.2188***
EMB	-2.134774	-1.196146	-1.035634	-9.47278***	-9.47693***	-9.43482***
EME	-1.204737	-1.064944	-0.489872	-26.2773***	-26.2837***	-26.2966***
F	-1.181327	1.708958	2.346977	-29.2181***	-28.7188***	-28.6399***
Y	-3.325920*	-0.230876	0.644602	-28.3152***	-28.2690***	-28.2577***
P	-1.697057	-0.845783	0.583883	-26.2125***	-26.2285***	-26.2270***
G	-3.002485	-2.91220**	0.737549	-28.8332***	-28.8513***	-28.8424***

Note: T&I: Trend and Intercept; ***, **, and *: the level of significance of 1%, 5% and 10% respectively.

4.2. Co-integration test

Table 4 presents the co-integration of long-run relationship according to [34] bounds co-integration test, the results reject the null hypothesis and show a co-integration of all variables at the 1% level.

Table 4

ARDL bounds test

Variable	**F-statistic**	**Significance**	**I0 Bound**	**I1 Bound**
ΔDS	120.7815***	10%	2.08	3
		05%	2.39	3.38
		01%	3.06	4.15
ΔEMC	140.3527***	10%	1.92	2.89
		05%	2.17	3.21
		01%	2.73	3.9
ΔEMB	142.9297***	10%	1.99	2.94
		05%	2.27	3.28
		01%	2.88	3.99

Continuation Table 4

ΔEMS	48.89799***	10%	1.99	2.94
		05%	2.27	3.28
		01%	2.88	3.99

Note: ***, **, and *: the level of significance of 1%, 5% and 10% respectively.

4.3. ARDL model findings

Table 5 presents the long-run regression results of the ARDL model, where Table 6 summarizes the short-run. The R-squared shows that the model explains 60.7%, 60.1%, 61.7% and 57.1% of the variables: US Dollar strength, EMEs currencies, EMEs bonds and EMEs stocks respectively.

Table 5

ARDL Long-run coefficients

Variables	ΔDS	ΔEMC	ΔEMB	ΔEMS
DS		-0.003200 [-0.061566]	0.023930** [2.134471]	0.073740 [0.425205]
F	0.010410 [0.650275]	0.007726 [0.032486]	-0.120921** [-2.356957]	-1.416031* [-1.780119]
Y	-0.075856 [-1.458811]	0.567415 [1.036976]	0.295236** [2.495640]	3.547210* [1.946501]
P	0.003521 [1.602232]	-0.010590 [-0.596087]	-0.008532** [-2.221376]	-0.143791** [-2.429050]
G	-0.000203 [-1.185119]	0.004140** [2.339633]	0.001089*** [2.874681]	0.011371* [1.930268]
RUW	0.016196 [0.207974]	-1.182855 [-1.330500]	-0.322986* [-1.663860]	-0.643043 [-0.213204]
C	154.5688*** [13.01483]	-6.806157 [-0.899146]	-3.857267** [-2.366948]	-19.34095 [-0.766260]

Note: [ ]: t-Statistic; ***, **, and *: the level of significance of 1%, 5% and 10% respectively, Δ: the first-order differential operator, DS: US Dollar's strength, EMC: EMEs currencies, EMB: EMEs bonds, EMS: EMEs stocks, F: Federal Funds Rate, Y: US 10-Year bond yield, CP: Commodity prices, G: Gold prices and RUW: Russian-Ukrainian war.

The results show that the Russia-Ukraine war has a negative significant long-run impact on EMEs bonds with -0.32 coefficient (5% level of significance), in addition, EMEs currencies, EMEs bonds and EMEs stocks are all negatively impacted by the Russia-Ukraine war in the short-run with coefficients of: -12.01 and, -1.585, -45.31 respectively, this supports the results of previous literatures [24-28]. Where Dollar's strength was positively impacted with 1.127 coefficient.

EMEs bonds was positively impacted by US Dollar's strength in the long-run, which confirms [38] finding. In line with pre-war studies [10, 39], US Dollar's strength has a negative short-run impact on EMEs assets prices, implying that one (1) unit increase in US Dollar index will reduce EMEs bonds by -0.393721 in the short-run and rise it by 0.023 in the long-run. Moreover, in the short-run will reduce EMEs currencies and EMEs stocks by -3.78 and -6.47 respectively.

US 10-year bond yield has a positive significant impact on EMEs bonds in the long-run which means that the continuity in US Dollar's strength and US 10-year bond yield rise, led

to increase in EMEs bonds. Meanwhile, in the short-run EMEs Bond was negatively impacted by US 10-year bond yield, similar to [40] pre-war study, on the contrary, EMEs currencies, EMEs stocks and US Dollar's strength was positively impacted by US 10-year bond yield.

Federal Funds Rate has a negative long-run impact on EMEs bonds and EMEs stocks moreover, it has a negative impact on EMEs currencies and US Dollar's strength in the short-run, as [30, 41] asserted similar effects in the pre-war period.

The gold prices have a positive impact on EMEs asset prices in the long-run, which clarifies the asymmetric impact of gold prices on EMEs stocks [42]. Moreover, the gold prices have a negative short-run impact on US Dollar's strength, same as [43], and positive impact on EMEs bonds.

Commodity prices have a negative impact on US Dollar's strength, same as the pre-war [44] finding, while they have a positive impact on EMEs asset prices in the short-run, in addition, they have a negative impact on EMEs bonds and EMEs stocks in the long-run.

Overall, EMEs stocks were more impacted by the Russia-Ukraine war than EMEs currencies and EMEs bonds respectively, which contradicts [29] study results. Same as for US Dollar's strength and commodity prices, where they have more impact on EMEs stocks than EMEs currencies and EMEs bonds respectively.

Table 6

ARDL Short-run coefficients

Variables	**ΔDS**	**ΔEMC**	**ΔEMB**	**ΔEMS**
ΔDS		-3.784451*** [-12.86990]	-0.393721*** [-5.732936]	-6.472111*** [-6.862521]
ΔDS(-1)	0.974781*** [145.9178]	-3.740072*** [-12.52205]		-5.352578*** [-5.955563]
ΔF	0.622223*** [2.858677]	-0.286398 [-0.153248]	0.552210 [1.363929]	
ΔF(-1)	-0.744575** [-2.465758]	-4.671478** [-2.516459]		
ΔY	1.523571*** [6.107598]	10.65567*** [4.899386]	-3.551244*** [-7.295184]	39.98758*** [5.827321]
ΔY(-1)	0.763755*** [3.242033]			
ΔP	-0.070464 [-5.173589]	0.600247*** [5.260809]	0.122355*** [4.636605]	2.202177*** [6.029893]
ΔP(-1)	-0.026369** [-2.145286]			
ΔG	-0.006473*** [-7.535253]		0.001383 [0.820450]	
ΔG(-1)			0.003376** [2.326768]	
ΔRUW	0.293697 [0.703404]	-1.636264 [-0.446511]	-1.654087** [-2.081588]	-28.94058** [-2.433979]
ΔRUW(-1)	1.127497*** [2.710611]	-12.31864*** [-3.352066]	-1.585499 ** [-1.993756]	-45.31346*** [-3.802603]
CointEq(-1)	-0.025219*** [-4.860060]	-1.177941*** [-35.45028]	-1.157517*** [-34.10490]	-1.023880*** [-30.54824]
R^2	0.606839	0.601228	0.616797	0.571369

Note: [ ]: t-Statistic; ***, **, and *: the level of significance of 1%, 5% and 10% respectively, Δ: the first-order differential operator, DS: US Dollar's strength, EMC: EMEs currencies, EMB: EMEs bonds, EMS: EMEs stocks, F: Federal Funds Rate, Y: US 10-Year bond yield, CP: Commodity prices, G: Gold prices and RUW: Russian-Ukrainian war.

4.4. The stability tests

Figure 1 and Figure 2 present the CUSUM and CUSUMSQ graphs respectively (by means of 5% critical lines), where these graphs show the stability of the variables across the model period. The CUSUMs all of the US Dollar's strength, EMEs currencies, EMEs bonds and EMEs stocks are contained inside the 5% important critical lines. Although the CUSUMSQ of EMEs bonds and stocks have not been presented throughout the entire model period, The CUSUMSQ graphs for the US Dollar's strength and EMEs currencies are within the 5% significance critical lines. However, according to [45], the stability could be proven at least by either CUSUM or CUSUMSQ, which supports the parameter stability of the model variables.

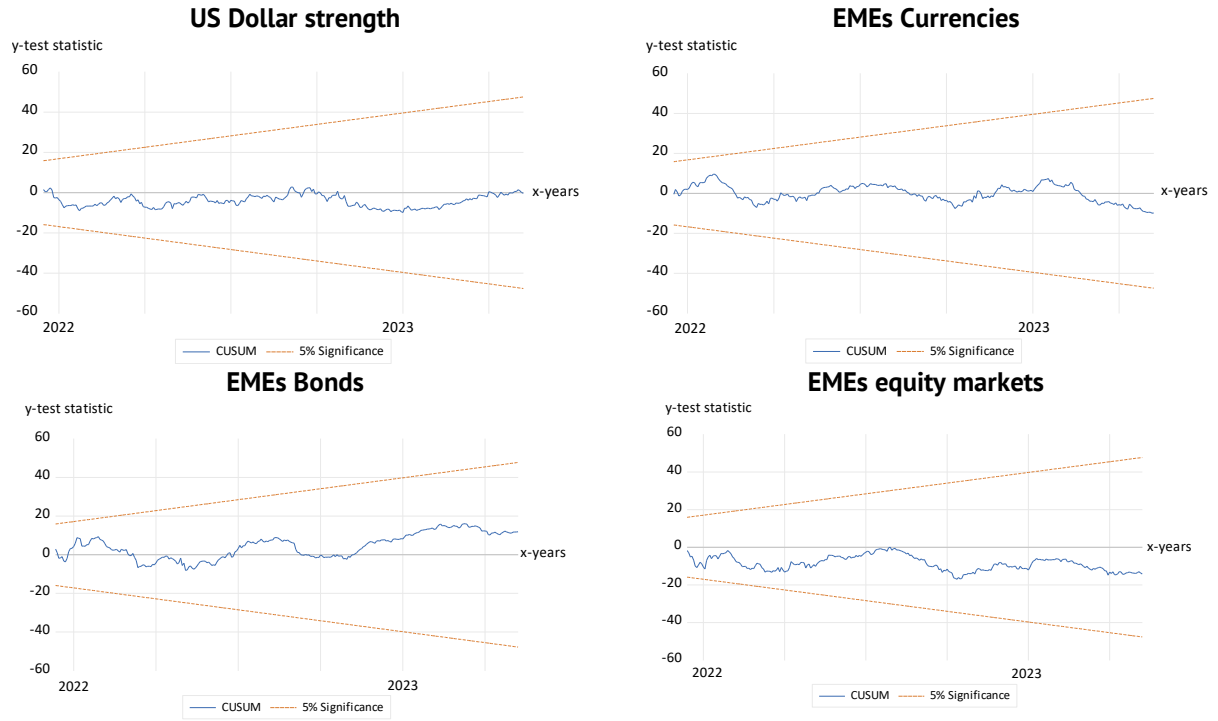
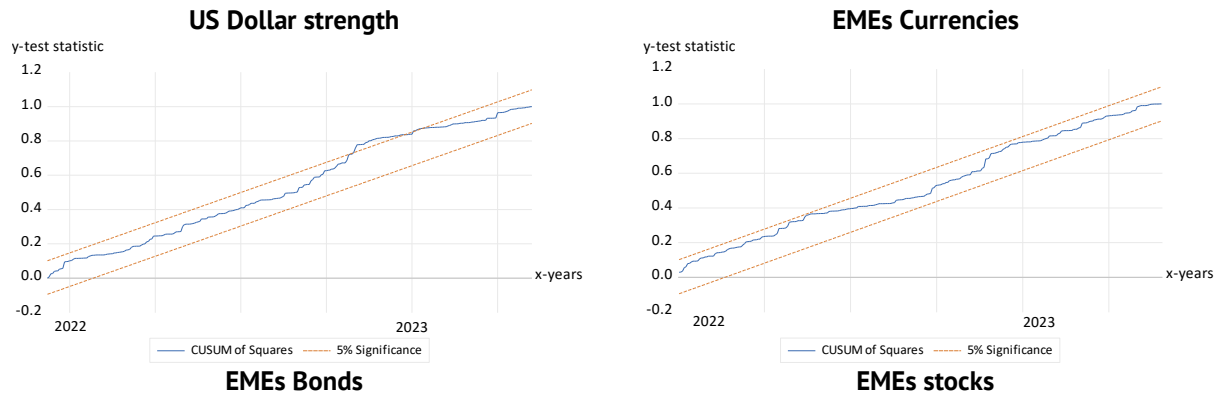


Figure 1. CUSUM test graphs.
Source: Elaborated by the authors depending on EViews 12 outputs.



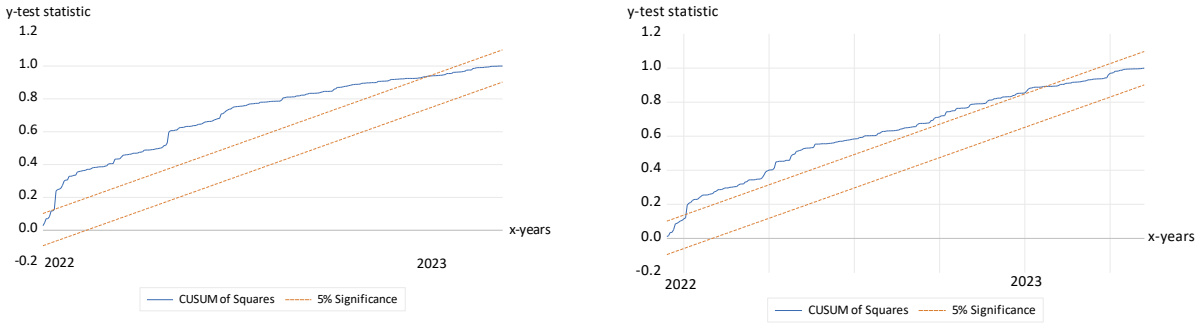


Figure 2. CUSUMSQ test graphs.

Source: Elaborated by the authors depending on EViews 12 outputs.

4.5. Toda and Yamamoto Tests

Table 7 shows the results of Toda and Yamamoto test, where there is unidirectional causality between the Russia-Ukraine war and EMEs currencies, EMEs bonds, EMEs stocks and commodity prices. Moreover, US Dollar's strength has unidirectional causality with EMEs currencies, EMEs stocks, federal funds rate and commodity prices, in addition, it has bidirectional causality with EMEs bonds, US 10-year bond yield and gold prices. Additionally, commodity prices have unidirectional causality with EMEs asset prices, federal funds rate and gold prices, also bidirectional causality with federal funds rate and US 10-year bond yield. There is bidirectional causality between federal funds rate and US 10-year bond yield.

Table 7

Toda and Yamamoto Tests

Variable	DS	EMC	EMB	EME	F	Y	P	G	RUW
DS		0.000***	0.060*	0.000***	0.011**	0.605	0.026**	0.093*	0.636
EMC	0.953		0.656	0.039**	0.607	0.303	0.025**	0.813	0.451
EMB	0.000***	0.000***		0.000***	0.100*	0.000***	0.252	0.010***	0.890
EME	0.450	0.726	0.133		0.550	0.061*	0.056*	0.165	0.508
F	0.893	0.290	0.089*	0.442		0.003***	0.040**	0.963	0.908
Y	0.040***	0.7495	0.001***	0.073*	0.001***		0.007***	0.255	0.318
P	0.289	0.0978*	0.082*	0.810	0.219	0.027**		0.024**	0.705
G	0.025**	0.065*	0.026**	0.298	0.029**	0.148	0.434		0.144
RUW	0.344	0.000***	0.039**	0.001***	0.865	0.898	0.050**	0.187	

Note: ***, **, and *: the level of significance of 1%, 5% and 10% respectively, Δ: the first-order differential operator, DS: US Dollar's strength, EMC: EMEs currencies, EMB: EMEs bonds, EMS: EMEs stocks, F: Federal Funds Rate, Y: US 10-Year bond yield, CP: Commodity prices, G: Gold prices and RUW: Russian-Ukrainian.

5. Conclusions

In order to determine how the Russia-Ukraine war has impacted the US Dollar's strength, and how they both impacted emerging markets economies (EMEs) in the long-run and the short-run. Then, we used Autoregressive Distributed Lag model (ARDL) to analyze the sensitivity of EMEs currencies, EMEs bonds (US Dollar-denominated) and EMEs stocks, to the US Dollar Index and the Russia-Ukraine war, as well the effects of various economic factors: Federal Funds Rate, the US 10-year bond yield, commodity prices index and gold prices

The finding of this study suggests that in the short-run: the Russia-Ukraine war has a negative impact on EMEs asset prices and a positive impact on US Dollar's strength. In addition, EMEs currencies, EMEs bonds and EMEs stocks, are all negatively impacted by US Dollar's strength. US 10-year bond yield has a positive impact on US Dollar's strength, EMEs currencies and EMEs stocks, where it has a negative impact on EMEs bond. Federal funds rate

has a negative impact on US Dollar's strength and EMEs currencies. EMEs asset prices was positively impacted by commodity prices, while US Dollar's strength was negatively impacted. The gold prices have a positive impact on EMEs bonds and a negative impact on US Dollar's strength.

While in the long-run: the Russia-Ukraine war has a negative impact on EMEs bonds. EMEs bonds was positively impacted by US Dollar's strength and US 10-year bond yield, while they are negatively impacted besides EMEs stocks by federal funds rate. Commodity prices have a positive impact on EMEs asset prices, on contrary; they have a negative impact on US Dollar's strength. The gold prices have negative impact on EMEs bonds and EMEs stocks. Moreover, EMEs stocks was more sensitive to the Russia-Ukraine war, US Dollar's strength and commodity prices than EMEs currencies and even more than EMEs bonds.

Overall, these results have significant implications for investors and regulators in emerging markets, where geopolitical conflicts (the Russia-Ukraine war) for example, have an impact on emerging market economies, then, policymakers should be aware of this impact and take the necessary precautions to reduce the risks associated. Investors in emerging markets should also be aware of these risks and should adjust their investment strategies accordingly.

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