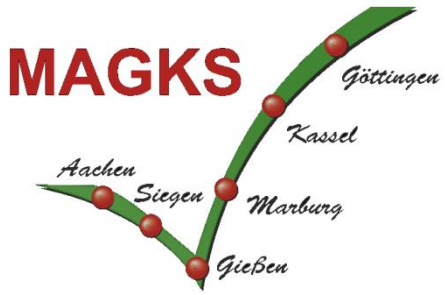

Joint Discussion Paper Series in Economics

by the Universities of

Aachen · Gießen · Göttingen
Kassel · Marburg · Siegen

ISSN 1867-3678

No. 17-2023

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Empirical Effects of Sanctions and Support Measures on Stock Prices and Exchange Rates in the Russia-Ukraine War

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July 8, 2023

Abstract

What are the effects of sanctions and economic support on stock prices and exchange rates in the Russia-Ukraine war? We address this question using a panel-VAR model that incorporates data from 23 countries, besides Russia and Ukraine, spanning the period from 02/01/2022 to 02/24/2023. Our analysis relies on a detailed database to capture the nuances of sanctions and economic support. The results are presented from three distinct perspectives: firstly, in relation to the global economies; secondly, with regard to Russia; and thirdly, concerning Ukraine. The findings reveal that the overall impact of economic support provided to Ukraine is generally limited. In contrast, sanctions imposed by countries have minimal effects on the sanctioning country itself, but they can have significant consequences for the targeted nation. This is particularly evident when financial sanctions are implemented. However, it is important to note that such sanctions also exert effects on the opposing party in the war, Ukraine. Furthermore, if the sanctions originate from G7 or developed countries, the effects on Russia tend to be more pronounced.

Keywords: Sanctions, Support Measures, Stock Prices, Exchange Rates, Panel-VAR

JEL classification: F31, F51, G15, C33

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1 Introduction

On the 24th of February 2022, the Russian Federation initiated its war against Ukraine. Since then, the bloodiest conflict in Europe since World War II has been ongoing. While the Ukrainian people bear the primary burden of the war, there are undoubtedly economic effects as well.

This paper aims to empirically estimate the effects of sanctions imposed due to the war and the support provided to Ukraine on two critical financial variables: stock prices and exchange rates. We utilize a detailed dataset that captures the imposed sanctions and economic support. The dataset provides information on the countries responsible for imposing sanctions or providing support, as well as the type of sanction/support initiated. This allows us to differentiate the policies into eight types of sanctions and three support categories. The sanction categories include: 1. Financial, 2. Individual, 3. Import, 4. Export, 5. Travel Restrictions, 6. Trade Support Russia, 7. Trade Support Ukraine, 8. No Sanction. The economic support categories consist of: 1. Financial, 2. Humanitarian, 3. Military. Additionally, we collect data from 23 countries that have imposed sanctions or provided support, besides the directly involved countries of Russia and Ukraine. This special setup enables us to examine the effects on the country imposing sanctions or providing support, as well as estimate the effects on the two warring countries, Ukraine and Russia.

To estimate these effects, we utilize a panel-VAR model that accounts for the dynamic impacts of sanctions and support measures on stock prices and exchange rates. The panel structure is particularly advantageous in this context, as not all countries have imposed all types of sanctions or taken all forms of support. However, by considering the collective data from all countries, we obtain a substantial number of reliable observations in each sanction and support category.

Furthermore, we conduct robustness checks by dividing the countries into different subgroups and comparing their responses. We examine whether the country imposing the sanction or providing support is a G7 country, the country's development status, and its geographical position.

The results indicate that economic support to Ukraine has generally limited effects on stock prices and exchange rates. This observation also holds true for sanctions when considering the responses within the sanctioning country. However, in the case of the sanctioned country, Russia, sanctions can have a substantial impact, with effectiveness depending crucially on the type of sanction applied. Specifically, we find that financial sanctions lower stock prices in Russia and depreciate its currency. Additionally, we observe significant effects of these types of sanctions on

Ukrainian stocks and the exchange rate. Furthermore, our robustness checks reveal that financial sanctions imposed by G7 or developed countries are more effective than those imposed by other countries.

The remainder of the paper is organized as follows: Section 2 provides a literature review and identifies the additional research gaps addressed by this paper. Section 3 describes the data used, including the generation of data on sanctions and economic support. In Section 4, we outline the panel-VAR model employed, while Section 5 presents the results. The final section, Section 6, concludes the paper and offers some policy advice.

2 Literature review

There is a substantial body of literature on the economics of sanctions and foreign support. Therefore, in this literature review, we will primarily focus on articles directly connected to our research, specifically those investigating the Russia-Ukraine war or examining changes in stock prices and exchange rates resulting from introduced policies.[1] We organize the review in the following manner: we begin with studies examining the stock market or exchange rate responses in the context of the Russia-Ukraine war, followed by articles related to sanctions, and conclude with those investigating the role of economic support measures. To the best of our knowledge, this paper is the first to simultaneously measure all these combinations.

Regarding stock market responses to the Russia-Ukraine war, Ahmed et al. (2022) employ an event-study approach to analyze the effect of the war's onset on European stocks. They consider the date of February 21st, 2022, when the Russian President signed decrees recognizing the independence of two Ukrainian regions, three days prior to the actual invasion. The authors find significant negative abnormal returns on European stocks following this event. Kamal et al. (2023) adopt a similar approach to investigate the Australian stock market, also confirming a negative impact of the war. Yousaf et al. (2022) estimate the effects of the war on stock markets using an event-study methodology for G20 countries and neighboring countries to the war, with the event day set as February 24th, 2022, the start of the invasion. They find declines in European stock markets as a result of this event. Kumari et al. (2023) utilize an event-study design for 25 member countries of the EU, demonstrating heterogeneous effects of the war on stock markets across those countries. Boungou and Yatie (2022) estimate the stock market response of 94

[1] A substantial body of literature focuses on the effectiveness of sanctions. For example, notable works include Baldwin (1999), Bapat et al. (2013), and Ahn and Ludema (2020).

countries using a panel analysis with a war indicator derived from Google Trends. They find that the war led to reduced stock market returns worldwide, particularly during the first two weeks and in countries geographically closer to the war. Federle et al. (2022) observe a proximity penalty during the first four weeks of the war, revealing that countries or firms located 1000 kilometers closer to Ukraine experienced 1.1 percentage points lower returns. Izzeldin et al. (2023), employing a Markov-switching HAR model, investigate stock market volatility globally during the war, comparing it to the responses during the global financial crisis and the COVID pandemic. They find that stock markets' response to the war was more rapid than the other two events, but its intensity was less pronounced.

The effect of the Russia-Ukraine war on exchange rates is examined by Aliu et al. (2023). They employ various time series and cointegration techniques to analyze five exchange rates against the Euro. The study confirms that the depreciation of the Euro against four other leading currencies is partially attributable to the Ruble effect, as Europe was heavily dependent on Russian commodities. Sokhanvar and Bouri (2023) estimate the effects of commodity price shocks resulting from the war on the Canadian Dollar exchange rate against the Euro and the Yen, utilizing a QARDL approach. They find that shocks in wheat and energy prices lead to an appreciation of the Canadian Dollar against the other two currencies.

The empirical literature on economic sanctions received a significant boost with the Russia-Ukraine conflict. While the conflict predates the war itself, sanctions were already imposed on Russia, notably in response to the annexation of Crimea in 2014. Castagneto-Gissey and Nivorozhkin (2016) are among the first to present empirical results regarding the stock market response. They employ a DCC-MGARCH model with stock market data from 19 countries, revealing that the Russian stock market largely decoupled from others due to the sanctions following the Crimea annexation. Hoffmann and Neuenkirch (2017) construct an (de-)escalation index for sanctions among others and demonstrate that both the Russian and Ukrainian stock indices respond negatively to news about sanctions during the Crimea annexation period. Najaf et al. (2023) extend this analysis up to 2022, encompassing data from the actual war period. They confirm the persistently negative relationship between sanctions and stock markets, with a steeper decline observed in the Russian stock market. Andukimov et al. (2017) analyze the effects of sanctions on the Russian stock market by implementing a pre-sanction regime before March 1st, 2014, and a post-sanction regime after that date. They find that stock market volatility increased post-sanctions, although it is not entirely clear whether this can be solely attributed to the sanctions, as other factors also changed between the two periods.

Biglaiser and Lektzian (2020) differentiate between various types of sanctions, categorizing sanctions imposed on 66 countries as financial, import, or export sanctions. They find differing effects among the sanction types. In this paper, we conduct an even more detailed differentiation between sanction groups. Huang and Lu (2022) employ an event panel study for selected event days during the Russia-Ukraine war to estimate the effects on stock markets in countries imposing sanctions on Russia compared to those that do not. They find that sanctions on Russia led to a domestic stock market loss of approximately 0.11 trillion US dollars.

Regarding the effects of sanctions on exchange rates, Sohag et al. (2022) estimate the response of economic policy uncertainty on the Ruble-US Dollar exchange rate from 1998 to 2020. They suggest that part of the uncertainty is related to sanctions imposed on Russia, but do not quantify the specific magnitude. However, they demonstrate that an increase in policy uncertainty (and potentially sanctions) leads to a depreciation in a floating exchange rate regime. Dreger et al. (2015) evaluate the effects of sanctions on the Ruble-US Dollar exchange rate for the sanctions imposed on and from Russia in 2014 and the beginning of 2015. They are the first, to our knowledge, to directly measure each imposed sanction and construct a sanction index. We adopt a similar approach in this paper. In a cointegrated VAR model, they do not find any significant effect of sanctions on the exchange rate. Tyll et al. (2018) examine the same exchange rate as the two previous papers but for the years 2013 to 2016. Through stationarity tests, they confirm that the influence of oil prices on the exchange rate changed after the first set of sanctions were imposed in July 2014. Itskhoki and Mukhin (2022) develop a theoretical model and find that the exchange rate reaction to sanctions critically depends on the type of sanction imposed. Import sanctions tend to appreciate the currencies of the targeted countries, while the reverse is true for export or financial sanctions. In our paper, we will empirically test these results in the case of Russia. Eichengreen et al. (2023) have already examined these relationships for sanctions imposed during World Wars I and II, finding empirical support for the theoretical considerations of Itskhoki and Mukhin (2022) during that period.

The literature on the effects of economic support measures on stock prices is still relatively scarce. One notable exception is the study by Billmeier and Massa (2009). They investigate the role of private remittances on stock market capitalization for 17 Middle East and Central Asia countries between 1995 and 2005. Employing a panel regression approach, they find a positive impact of remittances on the stock market. Issahaku et al. (2017), using a panel of 61 developing countries from 1999 to 2013, demonstrate that stock market development decreases with rising remittances.

The role of economic support measures on exchange rates has mainly been investigated in the context of developing countries. Elbadawi et al. (2008) compare 39 conflict-affected countries with 44 non-conflict countries between 1970 and 2004, showing that post-conflict countries receive larger foreign aid and tend to have overvalued real exchange rates. However, this overvaluation cannot be directly attributed to aid. In a similar analysis focusing on Sub-Saharan African countries, Elbadawi et al. (2012) reinforce these findings in a sample of 83 countries. Lartey et al. (2012) examine the role of remittances in a panel of 109 developing or transition countries, finding that increasing remittances tend to lead to a real exchange rate appreciation. Olexsiv and Mirzoieva (2022) analyze the case of Ukraine, which is of particular interest in our paper, investigating the role of remittances and exchange rates. Through an ARDL and error-correction framework, they show that remittance inflows in Ukraine tend to appreciate the domestic currency.

This paper contributes to the existing literature in several ways: First, it is the first study to simultaneously examine stock market prices and exchange rates. Second, it is the first paper to consider both sanctions and economic support measures simultaneously. Third, it distinguishes between the effects of sanctions on the imposing and target countries. Fourth, it provides a detailed differentiation of sanction groups and economic support measures. Fifth, it is one of the few papers that utilize data from the Russia-Ukraine war.

3 Data

In this section, we provide a detailed description of the data used and its construction. Additionally, we outline the various data settings employed in this paper to assess the potential disparate effects of sanctions and economic support across different countries.

3.1 The construction of the variables

In this paper, we utilize daily data excluding weekends, spanning from February 1st, 2022, to February 24th, 2023. This time frame includes approximately a month before the start of the Russia-Ukraine war, as some sanctions were already announced prior to the invasion. We collect data for 23 countries, besides the two war parties, Russia and Ukraine. The countries included in our analysis are: United States, United Kingdom, Japan, Australia, Canada, Germany, France, Italy, Switzerland, China, South Korea, Norway, Iceland, New Zealand, India, Taiwan, Indonesia, Turkey, Mexico, Brazil, Argentina, South Africa, and Serbia.

There are four categories of variables used in this paper. First, the dependent variables consist of stock prices and exchange rates. Second, we incorporate a fundamental variable that is well-known to influence both financial variables. Third, we include measures of imposed sanctions on Russia. Fourth, we consider measures of economic support provided to Ukraine. We will describe each of these four categories in detail.

Regarding the financial variables used as dependent variables, we calculate daily growth rates of the leading stock index in each country to represent stock prices. As for the exchange rate, we deviate from most of the literature by focusing on the nominal effective exchange rate (NEER) in its broad definition, which covers 64 economies as provided by the Bank for International Settlements (BIS). However, the BIS database does not include an exchange rate for Ukraine. Therefore, we use the nominal effective exchange rate provided by the European Central Bank (ECB). It is important to note that the ECB exchange rate data is only available up until the end of 2022. Consequently, the sample size needs to be adjusted when using the Ukrainian effective exchange rate as a dependent variable. Similar to stock prices, the exchange rates are entered into our model as daily growth rates.

Both stock prices and exchange rates are influenced by fundamental variables. However, in this paper, our focus is on the effects of sanctions and economic support. Therefore, we do not include all relevant fundamental variables in our model as that would result in an overly complex estimation. Nevertheless, we incorporate a measure of interest rates as a fundamental variable. Specifically, we collect daily data on central bank policy rates from the websites of the respective national central banks. It is worth mentioning that the policy rates of Germany, France, and Italy are the same as these countries belong to the Eurosystem, and the European Central Bank (ECB) sets policy rates uniformly for all member countries. Policy rates capture most of the relevant fundamental information, as central banks typically consider factors such as inflation rates or economic growth when setting these rates, following the principles of the Taylor rule (Taylor, 1993).

The main contribution of this paper lies in the granular application of the sanctions imposed during the war. To achieve this, we utilize the sanctions timeline provided by the Peterson Institute for International Economics.[2] This timeline categorizes sanction events into five dimensions: financial, individual, import, export, and travel. Additionally, the timeline includes data on trade support for Russia or Ukraine, as well as announcements of countries to implement no sanctions. We em-

[2]The database can be found under the following link: https://www.piie.com/blogs/realtime-economics/russias-war-ukraine-sanctions-timeline

ploy the total of these eight different categories from this timeline in our estimations. It is important to note that the timeline covers data for all 25 countries included in our study.[3] The events within the different categories exhibit substantial variation. Thus, we attempted to categorize them into an index. Our categorization assigns a weight of 1 to each new general sanction announced, a weight of 0.75 to sanctions targeting specific groups (e.g., individual banks or individuals), and a weight of 0.5 to sanctions that involve prolongation or expansion to other countries (e.g., Belarus). [4] The data on sanctions are entered into the estimation model as daily changes.

In terms of economic support measures, we employ data from the Ukraine Support Tracker provided by Trebesch et al. (2023). This database captures support to Ukraine from 40 different countries and the European Union (EU), which, in our case, is represented by the percentage contributions of Germany, France, and Italy. The database covers 16 out of the 23 countries included in our sample. Unfortunately, data are not available for Iceland, Indonesia, Mexico, Brazil, Argentina, South Africa, and Serbia. For these countries, we assume that no economic support was provided, which seems reasonable given that, except for Iceland, none of these countries imposed sanctions on Russia. The database classifies economic support into three dimensions: financial, humanitarian, and military. We will analyze each dimension separately. The data are primarily reported in the donor countries' national currencies but are also converted to Euros to facilitate comparability among countries. In our analysis, we use the Euro values. However, when estimating the model for donor countries, the Euro values are deflated by the countries' Euro GDP in 2021 to represent the percentage of economic activity allocated to Ukraine, which is no longer available to the donor country. Conversely, when considering the receiving country, the Euro values (in millions of Euros) represent the amount of support received by Ukraine. To maintain consistency with the measurement of

[3]Moreover, the timeline data includes information for the European Union (EU), Singapore, Liechtenstein, Finland, and Sweden. However, these countries (or groups of countries) have been excluded from our analysis for various reasons. The EU data are excluded because three EU countries, namely Germany, France, and Italy, are already included in the analysis. Therefore, EU sanctions are reflected in the data for these three countries, in addition to any potential additional sanctions imposed by each country individually. Singapore is excluded due to the unavailability of an effective exchange rate. Liechtenstein is excluded because the country does not have its own currency. Sweden and Finland are excluded because, in reality, they did not impose any sanctions, apart from the common EU sanctions. However, they are mentioned in the timeline due to their association with the North Atlantic Treaty Organization (NATO) in May 2022.

[4]Please note that this categorization does not significantly influence our results. We tested alternative categorizations, such as assigning equal weights to all announcements, and found that the results remained nearly unchanged. Additional results based on these alternative categorizations are available upon request.

other variables, the economic support variables are entered into the estimation as daily changes.

Table 1 provides an overview of the countries included in our panel and the number of sanctions and economic support events covered. We account for a total of 1040 events across various categories, with approximately 75% attributed to sanctions. Developed countries are the primary imposers of sanctions, while most developing countries have not imposed any sanctions on Russia and have even actively declared their non-involvement. This finding is consistent with the distribution of economic support events for Ukraine, with developed countries being the primary donors in all three categories. However, some developing countries, such as China and Turkey, also provide varying degrees of support. It is important to note that data for many developing countries are unavailable, although it is possible that some of these countries have provided support to Ukraine.

Table 2 presents the descriptive statistics and panel unit root tests for the variables used in our analysis. While stock prices, exchange rates, and interest rates can theoretically take on unrestricted values, the sanction measures are restricted to the range between 0 and 1 by construction. However, this restriction does not apply to the support measures. In Table 2, we report statistics for the GDP-deflated support measures. The Euro values used for the estimation model for Russia and Ukraine are available upon request. It is worth noting that all the variables used in our analysis appear to be stationary, as indicated by the panel unit root tests.

3.2 Different data settings

As mentioned earlier, our analysis aims to evaluate the impact of sanctions and economic support on stock prices and exchange rates from three different perspectives. First, we examine the global effects of these measures. Therefore, we estimate the effects on countries that impose sanctions on Russia or provide support to Ukraine. In most cases, we would expect a negative response, as imposing sanctions limits economic opportunities for firms, leading to lower stock prices. However, the reverse could also be true if sanctions effectively hinder competitors from accessing domestic or global markets. It has been shown in previous studies, such as Itskhoki and Mukhin (2022) or Eichengreen et al. (2023), that different types of sanctions may have different effects. Regarding economic support, we would anticipate a negative impact in the donor country, as the money or resources allocated to Ukraine could not be utilized for domestic purposes.

Second, we examine the effects on Russia as the sanctioned country in this war. It is evident that sanctions imposed on Russia are expected to have a negative impact

on Russian stock prices. However, similar to the previous perspective, the reverse effect could also occur. The response of the exchange rate to international sanctions depends on the type of sanction applied, as discussed in the literature. Additionally, when estimating the effects for Russia, we consider the sanctions imposed by Russia on other countries. Therefore, we explicitly include these sanctions in our analysis, assuming they have similar effects to those initiated by other countries. It is important to note that we also incorporate economic support measures in the estimation for Russia. Although Russia does not benefit from this support as the funds and resources are directed to Ukraine, it can have negative effects on the Russian stock market or exchange rate, such as the possibility of a longer war or the likelihood of Russia losing the war increases.

Third, we estimate the effects on Ukrainian stock prices and exchange rates. Even though the sanctions primarily target Russia, they can still have an influence on Ukraine by cutting off resources to the opponent and thus increasing the likelihood of a Ukrainian victory. Moreover, Ukraine has imposed its own sanctions, and we will investigate whether these have any effects. Finally, we consider the economic support given to Ukraine. We anticipate that financial aid, for example, will boost stock prices as money flows into the country, thereby increasing domestic demand. The reaction to humanitarian or military support is less clear, as it may crowd out domestic production. In line with the literature, we assume that the domestic currency will appreciate with increasing foreign support.

Since we employ a panel-VAR model, as explained in the next section, the estimated coefficients are assumed to be identical across all countries. Therefore, we obtain one set of impulse response functions that summarize the information from all stock prices or exchange rates. Hence, we cannot differentiate the effects across countries. However, to account for potential differences in the cross-section, we conduct three robustness checks, including sample splits based on country groups. The first split is whether the country is a G7 or non-G7 country. This split is applied because we have observed that the G7 countries are the ones imposing the most sanctions on Russia and providing the most economic support to Ukraine. The second split is based on whether the country is classified as developed or developing according to the United Nations (2020) classification. Developed countries in this classification include the United States, United Kingdom, Japan, Australia, Canada, Germany, France, Italy, Switzerland, Norway, Iceland, and New Zealand. Developing countries include China, South Korea, India, Taiwan, Indonesia, Turkey, Mexico, Brazil, Argentina, and South Africa. Serbia is excluded here as it is classified as a transition country. The third split is based on the geographical origin of

the country, specifically the continent where it is located. We create three groups: European countries, American countries, or Asian and Australian countries. It may be suspected that the effects for and from European countries may be larger due to their closer proximity to the war and their previous economic relations with Russia and Ukraine before the war began.[5]

4 Model

Our analysis is based on an estimated panel-VAR model. The cross-sectional dimension covers the countries investigated, excluding Russia and Ukraine, denoted as $i = 1, ..., N$, while the time dimension is $t = s + 1, ..., T$. The VAR structure captures the endogenous feedback between the interest rate, sanctions imposed, economic support given, and either stock prices or exchange rates. The estimated model is represented as follows:

$$\mathbf{A}\mathbf{y}_{it} = \mathbf{d}_i + \mathbf{F}_1\mathbf{y}_{it-1} + ... + \mathbf{F}_s\mathbf{y}_{it-q} + \varepsilon_{it}, \tag{1}$$

where q denotes the number of lags, $\mathbf{y}_{it}$ is an $n \times 1$ vector containing the endogenous variables, and $\mathbf{d}i$ is an $n \times 1$ vector representing country fixed-effects. The matrices $\mathbf{A}$ and $\mathbf{F_1}, ..., \mathbf{F_q}$ are $n \times n$ matrices containing the VAR coefficients. The structural shocks, which drive all the endogenous variables, are collected in $\boldsymbol{\varepsilon}_{it}$, following a normal distribution with mean zero and covariance matrix $\boldsymbol{\Sigma}\boldsymbol{\Sigma}'$.

In our VAR model estimation, we employ a 13×1 vector of endogenous variables:

$$\mathbf{y}_{it} = [\mathbf{Sanction_{it}} \quad \mathbf{Support_{it}} \quad Interest_{it} \quad x_{it}]' \tag{2}$$

where $\mathbf{Sanction_{it}}$ represents an 8×1 vector of the applied sanction types, $\mathbf{Support_{it}}$ includes the three economic support measures as a 3×1 vector, and x_{it} corresponds to either stock prices or the exchange rate.

For estimations regarding Russia or Ukraine, the vector is expanded to a 21×1 vector to incorporate the sanctions imposed by Russia or Ukraine:

$$\mathbf{y}_{it} = [\mathbf{Sanction_{it}} \quad \mathbf{Sanction_{zt}} \quad \mathbf{Support_{it}} \quad Interest_{it} \quad x_{zt}]' \tag{3}$$

[5]Furthermore, we attempted to differentiate countries based on the "unfriendly country list" proposed by the Russian Federation. However, it became apparent that this classification essentially grouped countries into two categories: those that have imposed sanctions on Russia (considered unfriendly countries) and those that have not (considered friendly countries). Consequently, comparing the reactions to sanctions between these two groups is not feasible, as the latter group simply has not implemented any sanctions.

where the index z represents either Russia or Ukraine. We include $q = 10$ lags of the endogenous variables. Despite the large dimension of the dataset across time and countries, the number of variables and parameters to be estimated should not raise concerns.

We assume that $\mathbf{A}$ is lower-triangular, resulting in the reduced-form model:

$$\mathbf{y}_{it} = \mathbf{c}_i + \mathbf{B}_1 \mathbf{y}_{it-1} + ... + \mathbf{B}_s \mathbf{y}_{it-s} + \mathbf{A}^{-1} \mathbf{\Sigma} \varepsilon_{it}, \tag{4}$$

where $\boldsymbol{\varepsilon}_{it} \sim N(0, \mathbf{I}_k)$, $\mathbf{c}_i = \mathbf{A}^{-1}\mathbf{d}_i$, $\mathbf{B}_j = \mathbf{A}^{-1}\mathbf{F}_j$, and $\mathbf{\Sigma}$ is an $n \times n$ matrix with standard deviations on the main diagonal.

This identification implies a restriction on the contemporaneous interaction of the endogenous variables. Specifically, we assume that stock prices or exchange rates respond simultaneously to all other variables in the system, considering their instantaneous reaction to news. All other variables are assumed to respond to stock prices or exchange rates, but with at least a one-day delay. This assumption seems reasonable since the applied sanctions and support measures should be mostly independent of stock price or exchange rate changes. Monetary policies, including interest rates, may respond to exchange rate or stock price fluctuations, but a lag of one day is a reasonable assumption considering the decision-making processes within central bank committees.[6]

5 Results

In this section, we will present the results of our panel-VAR estimations regarding stock prices or exchange rates. We will focus on the accumulated impulse response functions to a one standard deviation shock over the next ten business days, as it is observed that most of the adjustment occurs within this time frame. Additionally, we will report the 90% confidence intervals. Specifically, we will display the impulse response functions relating to stock prices or exchange rates, while the impulse response functions for other variables are available upon request from the authors. Following the structure outlined in section 3.1, we will begin by examining the global effects, followed by the effects on Russia, and finally, the effects on Ukraine.

[6] We also checked for alternative orderings, such as changing the positions of sanctions and economic support measures. However, the results remained broadly unchanged in all cases.

5.1 Global results

We will now examine the global effects of sanctions and support for the sanctioning and supporting countries. Figure 1 illustrates the overall reactions in stock markets. The impact of sanctioning Russia appears to be relatively limited. Only travel sanctions show a significant negative effect, possibly due to the prohibition for wealthy Russian oligarchs to consume goods and services abroad. Conversely, import sanctions seem to have a temporary positive effect on stock markets, potentially because banned Russian products can be substituted by domestic production. All other types of sanctions, including non-sanctions, appear to be insignificant. This holds true for all three categories of economic support for Ukraine as well, which could be seen as positive news for Ukraine since support does not seem to lower production or stock market prices in the donor countries. Finally, rising interest rates tend to decrease stock prices, as suggested by theory, but the estimates remain insignificant throughout.

In Figure 2, we divide the countries into G7 and non-G7 countries. From the results, it becomes evident that the negative effect of travel sanctions on stock prices is driven solely by travel sanctions in G7 countries, while there is no significant response in non-G7 countries. The same pattern applies to the positive impact of import sanctions. Furthermore, there is divergence in the response to humanitarian support for Ukraine. While stock markets in G7 countries tend to exhibit negative effects, non-G7 stock markets show positive effects, if any. This is concerning for Ukraine, as G7 countries are the largest donors of humanitarian support.

When we split the sample into developed and developing countries, as shown in Figure 3, the results are twofold. On one hand, the responses are clear-cut because only one group applies the sanctions or support measures, aligning with the overall results. This is the case for individual sanctions, import sanctions, travel sanctions, Ukrainian trade support, Ukrainian financial support, Russian trade support, and no sanctions, as these are implemented by either developed or developing countries exclusively. On the other hand, when both groups apply sanctions and economic support measures, no significant differences are found. This is mainly due to the relatively large confidence intervals for developing countries, as they have implemented fewer sanctions and support measures.

Regarding geographical differences in the response of stock prices to sanctions and economic support, as depicted in Figure 4, we were unable to identify any significant differences. It appears that stock market reactions are independent of the continent in which the country is situated.

Now turning to the response of exchange rates to sanctions and economic sup-

port, we present the overall results in Figure 5. Here, we do not observe any significant effects, indicating that nominal effective exchange rates are not influenced by the imposed sanctions or given economic support. This may be due to the fact that sanctions are primarily targeted at one country (Russia) and possibly accompanied countries like Belarus, while the effective exchange rate encompasses many more bilateral exchange rates that remain largely unaffected by the war or may even experience substituting effects from the sanctions through rebalancing international goods and capital flows. In terms of economic support measures, the lack of response in exchange rates can be explained by the relatively small size of support compared to other international capital flows for the donor countries. Therefore, this level of assistance is insufficient to impact effective exchange rates significantly.

The same pattern persists when splitting the sample into G7 versus non-G7 countries (Figure 6), developed versus developing countries (Figure 7), or examining geographical patterns (Figure 8). In none of these estimations can significant differences be observed among the groups, and moreover, the estimates rarely deviate significantly from zero.

5.2 Russian results

What are the effects of sanctions and economic support on Russian stock prices and exchange rates? This is the question we aim to answer in this section.

The overall response of stock prices, as shown in Figure 9, reveals that the main determinants are sanctions imposed by the Russian Federation itself. Surprisingly, financial, individual, and export sanctions applied by Russia tend to boost stock prices. This could potentially be attributed to a confidence effect, as Russia primarily established sanctions in response to sanctions from other countries. Therefore, stock markets may interpret Russian sanctions as having the power to compel other countries to lower their own sanctions. As expected, international sanctions such as financial and import sanctions have a negative impact on Russian stock prices. The opposite holds true for export sanctions, indicating a certain degree of import substitution by Russian firms. Furthermore, trade support to Russia is found to have a positive effect on stock market prices, while trade support for Ukraine and other economic support measures for Ukraine do not exhibit a significant effect on Russian stock prices. Finally, the negative response of stock prices to interest rate changes aligns with expectations, although this effect only materializes after approximately six days.

When splitting the sample, the estimates related to sanctions imposed by Russia and interest rates remain unchanged. Hence, we do not report them in the following

figures. In Figure 10, countries are divided into G7 and non-G7 countries. Two significant differences are observed in this context. First, financial sanctions imposed by G7 countries have a significantly greater impact on lowering Russian stock prices compared to financial sanctions imposed by non-G7 countries. This can be expected as G7 countries have larger capital markets, and being partly cut off from those markets has more substantial effects. Second, travel sanctions by G7 countries lead to significantly lower stock prices in Russia compared to the same sanctions imposed by non-G7 countries. This finding holds for at least the first two days after the sanctions are imposed.

The finding regarding financial sanctions is further reinforced when splitting the sample into developed and developing countries, as shown in Figure 11. In this case, sanctions from developed countries have a more pronounced depressing effect on Russian stock prices compared to sanctions from developing countries.

In terms of geographical differences (Figure 12), only one clear pattern emerges. Export sanctions from American countries significantly lower stock prices in Russia, whereas European and Asian countries' export sanctions tend to increase stock prices. This may be attributed to the specific export structure of American firms to Russia, which cannot be easily substituted by the Russian industry.

Applying the same methodology to the Russian effective exchange rate leads to the overall results presented in Figure 13. The effects are substantial. First and foremost, sanctions imposed by the Russian Federation lead to the depreciation of their currency. This holds true for financial sanctions, export sanctions, and travel sanctions, at least initially. However, the effect of individual sanctions switches to appreciation after approximately five days. Among international sanctions, financial sanctions have a significant impact, depreciating the Ruble in line with Itskhoki and Mukhin (2022) or Eichengreen et al. (2023). Import sanctions and export sanctions, however, do not exhibit a significant effect on exchange rates, contrary to the findings of previous studies. Notably, travel sanctions induce a devaluation of the Ruble, which is rational as lower convertibility of the Ruble due to travel sanctions decreases its value. Trade support for Russia appreciates the Ruble as expected, while the other support measures do not have any significant effect. Interestingly, changes in interest rates do have an impact: contrary to expectations, interest rate increases lead to a depreciation of the Ruble. This outcome may be attributed to higher market expectations for interest rate increases, which were not met by the Russian central bank.

When splitting the sample into G7 and non-G7 countries (Figure 14), we find that the majority of the devaluation in response to financial sanctions is driven by

those implemented by G7 countries. This can be explained by the fact that most of the frozen financial assets are likely deposited in G7 countries, thereby amplifying the effects of sanctions imposed by these countries.

To a lesser extent, this also holds true for the comparison between developed and developing countries (Figure 15). Financial sanctions imposed by developed countries result in larger devaluations of the Ruble. We now find that export sanctions from developing countries lead to the devaluation effect as proposed by Itskhoki and Mukhin (2022). Therefore, the channel through which sanctions operate in this war is crucially dependent on the development status of the country imposing the sanction.

The geographical differentiation in Figure 16 shows that financial sanctions from European countries depreciate the Ruble. This also holds true for travel sanctions, but only for the first two days after implementation.

5.3 Ukrainian results

In this section, we discuss the results for the Ukrainian stock market and exchange rate.

The overall response of the Ukrainian stock market to sanctions imposed on Russia and economic support given to Ukraine is shown in Figure 17. The most significant impact is observed when Ukraine announces its own export sanctions. In such cases, stock prices tend to rise, potentially because goods that were previously exported to Russia can be easily redirected to other countries. Other types of sanctions implemented by Ukraine do not appear to have a significant effect on its stock market. Surprisingly, international financial, individual, and travel sanctions imposed on Russia have negative effects on Ukrainian stocks. At first glance, this may seem puzzling, but it becomes reasonable when considering that sanctioning the war opponent triggers fear of further escalation. Additionally, international announcements of not joining sanctions by a country tend to lower stock prices in Ukraine, presumably because it indicates that the non-sanctioning country is not a partner of Ukraine. Economic support measures, surprisingly, do not have any effect on the Ukrainian stock market. However, interest rate changes demonstrate the expected negative response in line with theory.

Figure 18 shows the Ukrainian stock price response when the sample is split into G7 and non-G7 countries. It can be observed that the negative response to financial and travel sanctions is primarily driven by sanctions imposed by G7 countries. This is rational, as sanctions from these countries have a larger potential to escalate the war further.

The result regarding financial sanctions is reinforced when comparing the reactions between developed and developing countries (Figure 19). In this case, stock price decreases are solely attributable to sanctions imposed by developed countries, while sanctions from developing countries remain insignificant throughout.

Regarding geographical differences in Ukrainian stock prices, as shown in Figure 20, one pattern stands out. Travel sanctions imposed by American countries are found to increase stock prices in Ukraine, whereas the reverse is true for the other two regions. As the primary country imposing travel sanctions in America is the US, this result can be interpreted as a sign of confidence by financial markets that the US will support Ukraine when needed.

Regarding the exchange rate response of the Ukrainian Hryvnia, the overall reaction is presented in Figure 21. Once again, economic support measures do not exhibit a significant effect on the effective exchange rate. The same holds true for sanctions imposed by Ukraine itself. However, international financial sanctions and travel sanctions on Russia lead to an appreciation of the Hryvnia. This may be attributed to the fact that sanctioning the war opponent benefits Ukraine and makes its currency more attractive. Moreover, interest rate increases by the Ukrainian central bank result in the expected appreciation of the Hryvnia, but this effect occurs only after approximately eight business days.

There appear to be no significant differences in the aforementioned response regardless of whether the sample is split based on G7 versus non-G7 countries (Figure 22), developed versus developing countries (Figure 23), or geographical differences (Figure 24).

6 Conclusions

Our panel-VAR analysis of stock prices and exchange rates' reactions to sanctions and economic support measures in the Russia-Ukraine war has yielded some interesting results.

Firstly, economic support measures provided to Ukraine do not appear to have any effect on stock prices, regardless of whether we consider the donor countries or the two warring parties. While the objective of this support is certainly not to influence financial market variables, this finding is actually good news. It indicates that financial markets in donor countries are not negatively affected by helping Ukraine, and financial markets in the warring economies do not respond to the support provided. Therefore, the policy conclusion that can be drawn regarding economic support measures is clear: Do not worry about potential undesired effects

in financial markets because they do not exist. Instead, provide support for other reasons, if necessary.

Secondly, sanctions imposed by countries have almost no effects on their own economy. However, they can have substantial influences on stock prices and exchange rates in the sanctioned country, which in our case is Russia. The effectiveness of sanctions crucially depends on the type of sanctions applied. Our analysis shows that financial sanctions, in particular, appear to be very effective in this regard. Therefore, as a policy advice, financial sanctions should be the primary type of sanctions applied to maximize the impact on the sanctioned country. However, we have also demonstrated that these types of sanctions not only affect the sanctioned country (Russia) but also the other war party (Ukraine).

While the reactions to sanctions and support measures could potentially be asymmetric across different country groups, we have shown that this is hardly the case for most indicators. One notable exception is the response to financial sanctions. In this case, sanctions imposed by G7 or developed countries have a significant impact on lowering stock prices and depreciating the currency of Russia while effects for non-G7 and developing countries are less pronounced or even non-existent. Policymakers in both G7 and non-G7 countries, as well as in developed and developing countries, should take note of this. G7 and developed countries can independently implement sanctions to achieve an effect, while non-G7 or developing countries need to collaborate with G7 or developed countries to impose sanctions jointly in order to have an impact.

While this paper is the first to estimate the effects of sanctions and economic support measures on financial market variables in the Russia-Ukraine war, there are still patterns that warrant further research. This is particularly true regarding the timing of events. There may be an optimal mix of sanctions and economic support applied by a single country to minimize effects on their own economy while maximizing the impact on the sanctioned country or benefiting the other war party to the maximum extent. Additionally, we have not explored the role of simultaneous events involving multiple countries. It can be assumed that if the same sanction is imposed by multiple countries instead of just one, it may have a larger impact on the sanctioned country. The same logic applies to economic support provided to the supported country.

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Tables

Table 1: Event-Cases

	US	UK	JP	AU	CA	DE	FR	IT	CH	CN	SK	NO	IC	NZ	IN	TW	IND	TU	ME	BR	AR	SA	SR	RUS	UKR	Σ
Sanctions																										
Financial	31	23	17	11	19	22	22	22	13	0	2	6	1	8	0	0	0	0	0	0	0	0	0	2	2	201
Individual	29	27	16	18	24	21	21	21	12	0	0	6	1	13	0	0	0	0	0	0	0	0	0	2	2	213
Import	13	14	12	6	10	19	18	18	12	0	0	7	1	3	0	0	0	0	0	0	0	0	0	1	0	134
Export	19	16	16	2	8	16	16	16	11	0	2	7	1	3	0	1	0	0	0	0	0	0	0	5	2	141
Travel	3	14	2	4	1	14	14	14	8	0	0	3	2	3	0	0	0	0	0	0	0	0	0	8	1	91
Trade Support Russia	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Trade Support Ukraine	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
No Sanction	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	1	1	1	1	1	1	1	0	0	10
Σ	96	97	63	42	62	92	91	91	56	3	4	29	6	30	1	1	1	1	1	1	1	1	1	18	7	796
Economic Support																										
Financial	4	8	5	0	8	9	10	8	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	56
Humanitarian	11	9	7	3	7	13	14	12	3	2	6	2	0	2	1	4	0	0	0	0	0	0	0	0	0	96
Military	5	14	3	9	13	8	13	8	0	0	3	11	0	4	0	0	0	1	0	0	0	0	0	0	0	92
Σ	20	31	15	12	28	30	37	28	4	2	9	16	0	6	1	4	0	1	0	0	0	0	0	0	0	244

Notes: The table shows the number of events in each category by country. US=United States, UK=United Kingdom, JP=Japan, AU=Australia, CA=Canada, DE=Germany, FR=France, IT=Italy, CH= Switzerland, CN=China, SK=South Korea, NO=Norway, IC=Iceland, NZ=New Zealand, IN=India, TW=Taiwan, IND=Indonesia, TU=Turkey, ME=Mexico, BR=Brasil, AR=Argentina, SA=South Africa, SR=Serbia, RUS=Russia, UKR=Ukraine.

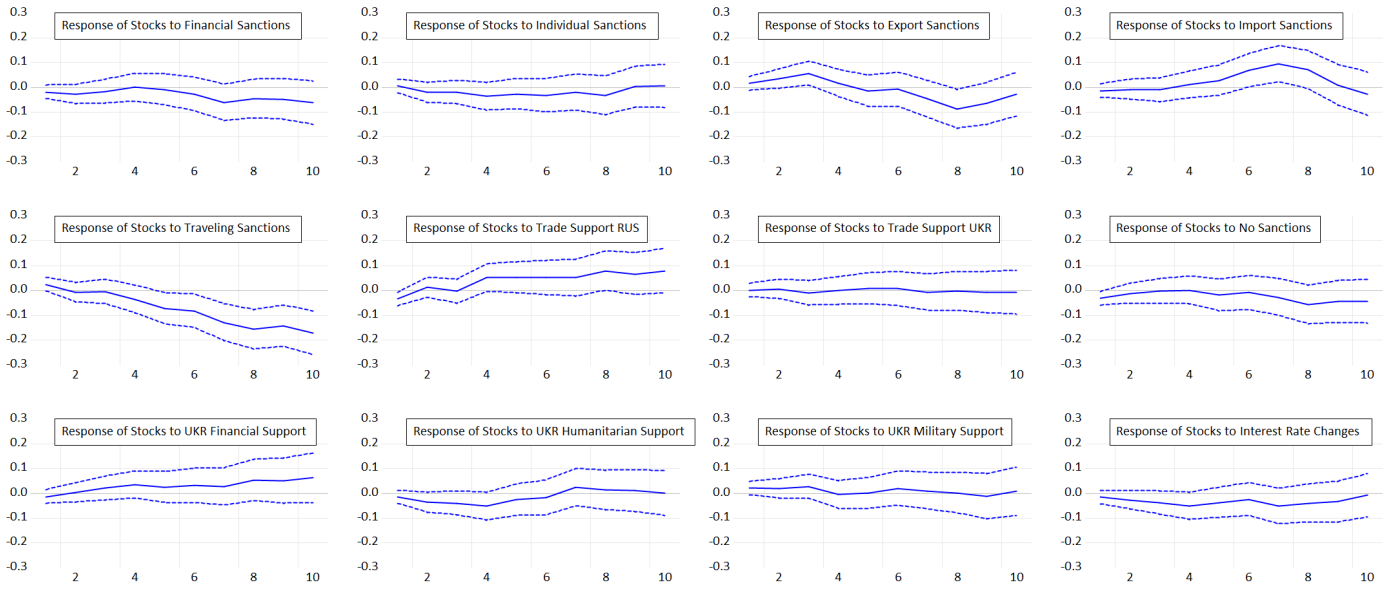
Table 2: Descriptive statistics and panel unit root tests

	Stock Prices	Exchange Rate	Interest Rate	Financial Sanctions	Individual Sanctions	Import Sanctions	Export Sanctions	Travel Sanctions	Trade Support Russia	Trade Support Ukraine	No Sanctions	Financial Support	Humanitarian Support	Military Support
Descriptive statistics														
Mean	0.022	-0.012	0.015	0.020	0.022	0.013	0.014	0.009	0.000	0.001	0.001	0.000	0.000	0.000
Minimum	-38.629	-19.852	-3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	26.118	14.881	15.000	1.000	1.000	1.000	1.000	1.000	0.750	1.000	1.000	0.194	0.028	0.205
Standard deviation	1.691	0.756	0.290	0.124	0.126	0.100	0.101	0.081	0.009	0.025	0.033	0.004	0.001	0.003
Panel unit root test														
Im et al. (2003)	-34.391 (0.000)	-36.313 (0.000)	-29.455 (0.000)	-16.736 (0.000)	-18.890 (0.000)	-17.965 (0.000)	-16.301 (0.000)	-9.040 (0.000)	-7.104 (0.000)	-17.502 (0.000)	-21.313 (0.000)	-18.095 (0.000)	-25.351 (0.000)	-25.324 (0.000)

Notes: For the economic support variables the GDP deflated numbers are shown. Panel unit root test testing for an individual unit root as introduced by Im et al. (2003). For the unit root tests, we show the corresponding p-values in parenthesis.

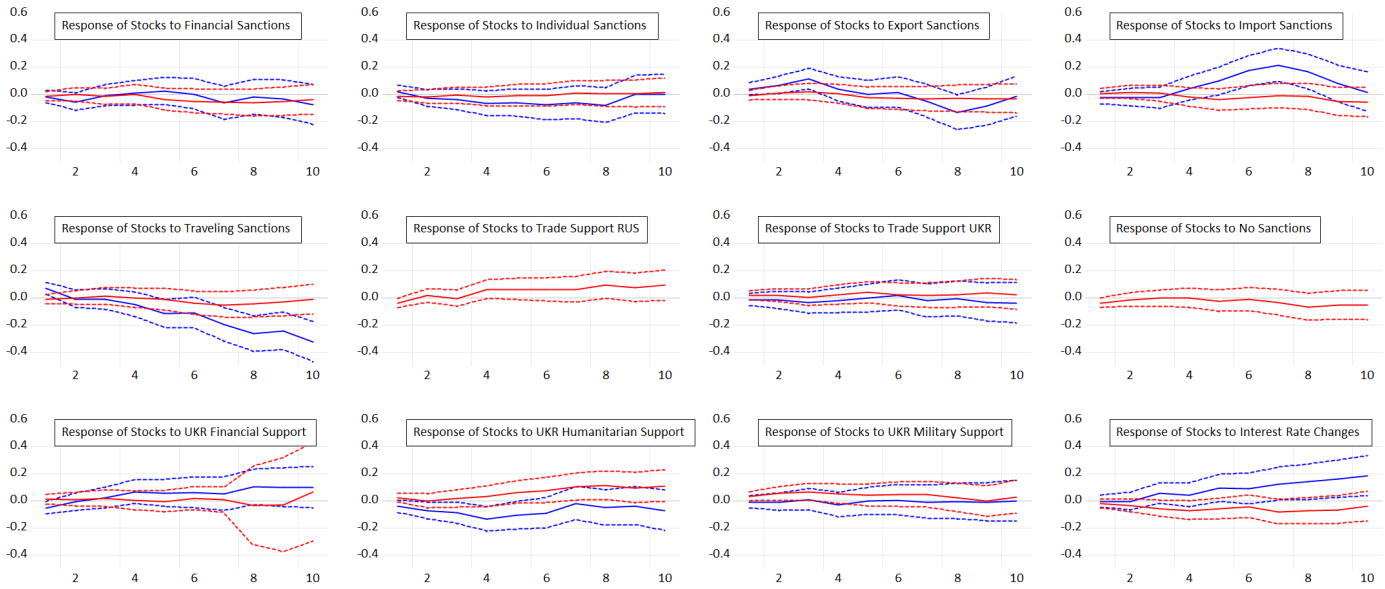
Figures

Figure 1: Responses of Stock Prices in Domestic Countries



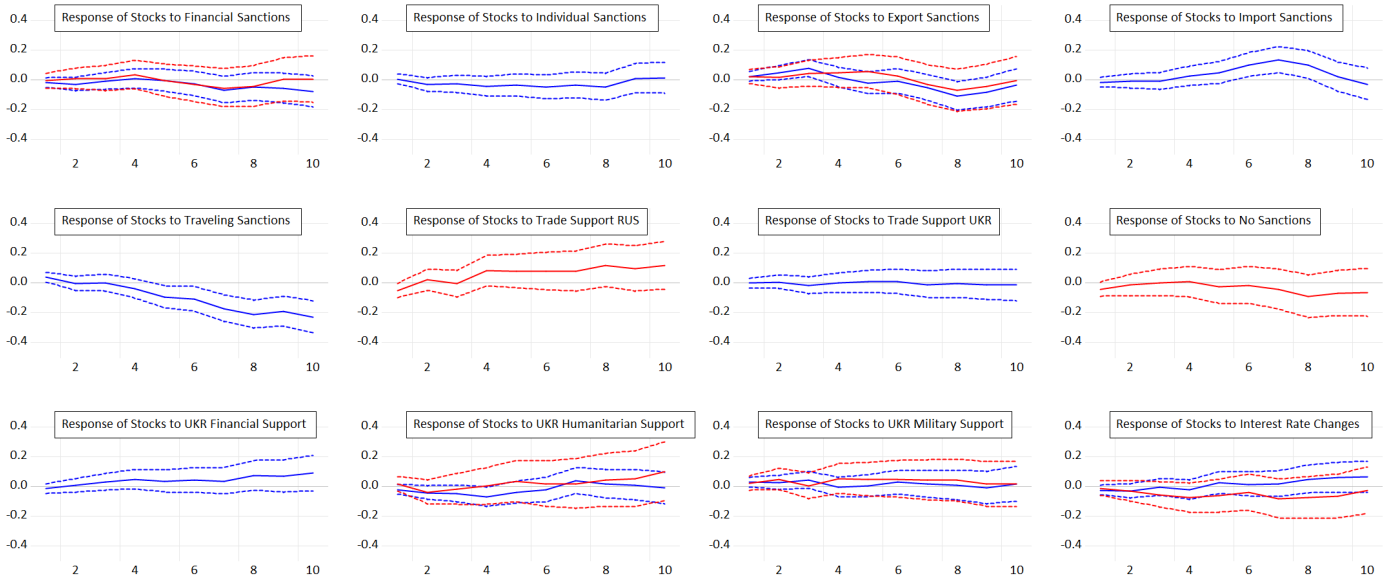
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval.

Figure 2: Responses of Stock Prices in Domestic Countries: G7 versus Non-G7 Countries



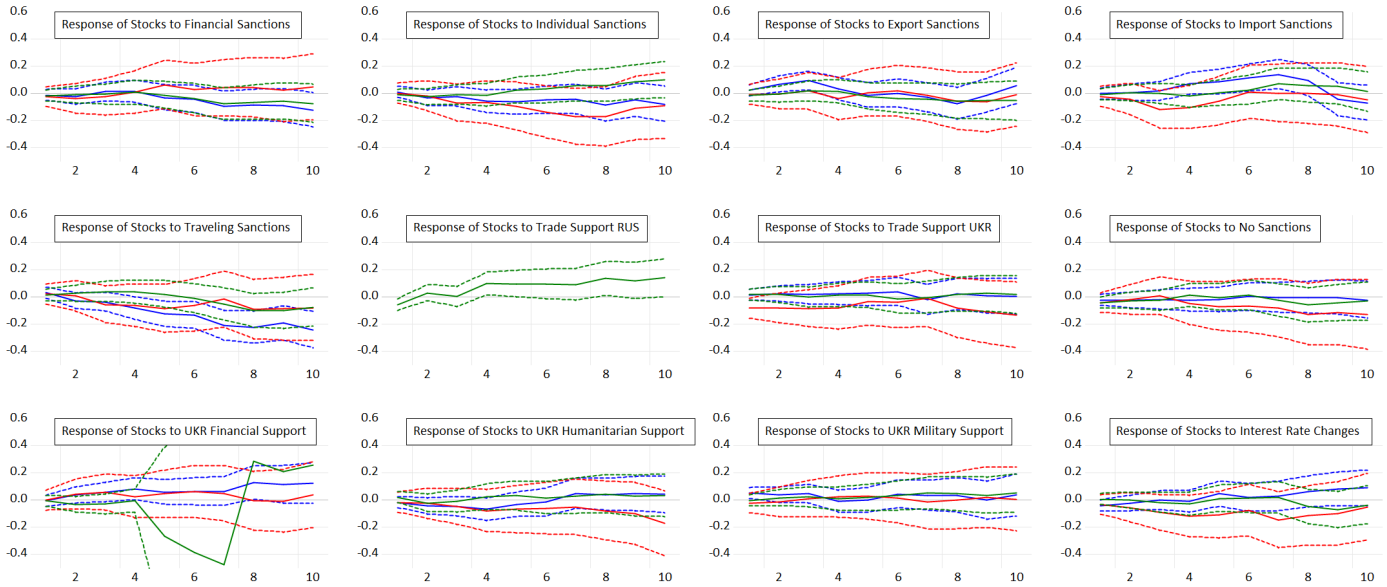
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = G7 countries, red lines = non-G7 countries.

Figure 3: Responses of Stock Prices in Domestic Countries: Developed versus Developing Countries



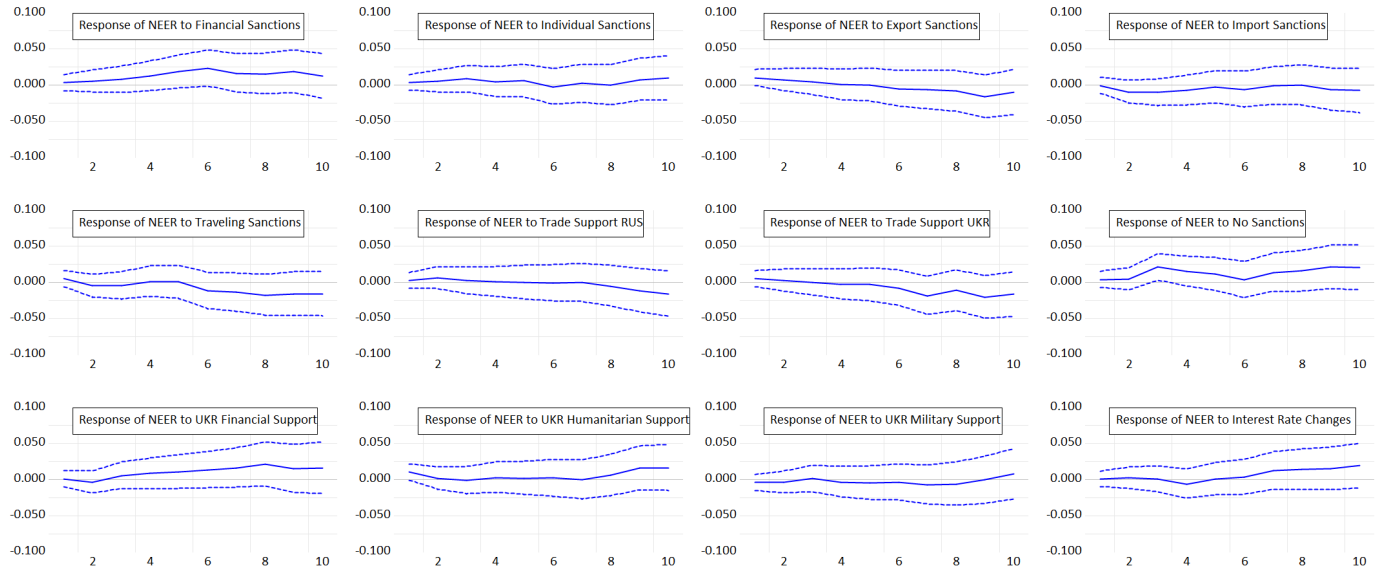
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = developed countries, red lines = developing countries.

Figure 4: Responses of Stock Prices in Domestic Countries: Geographical



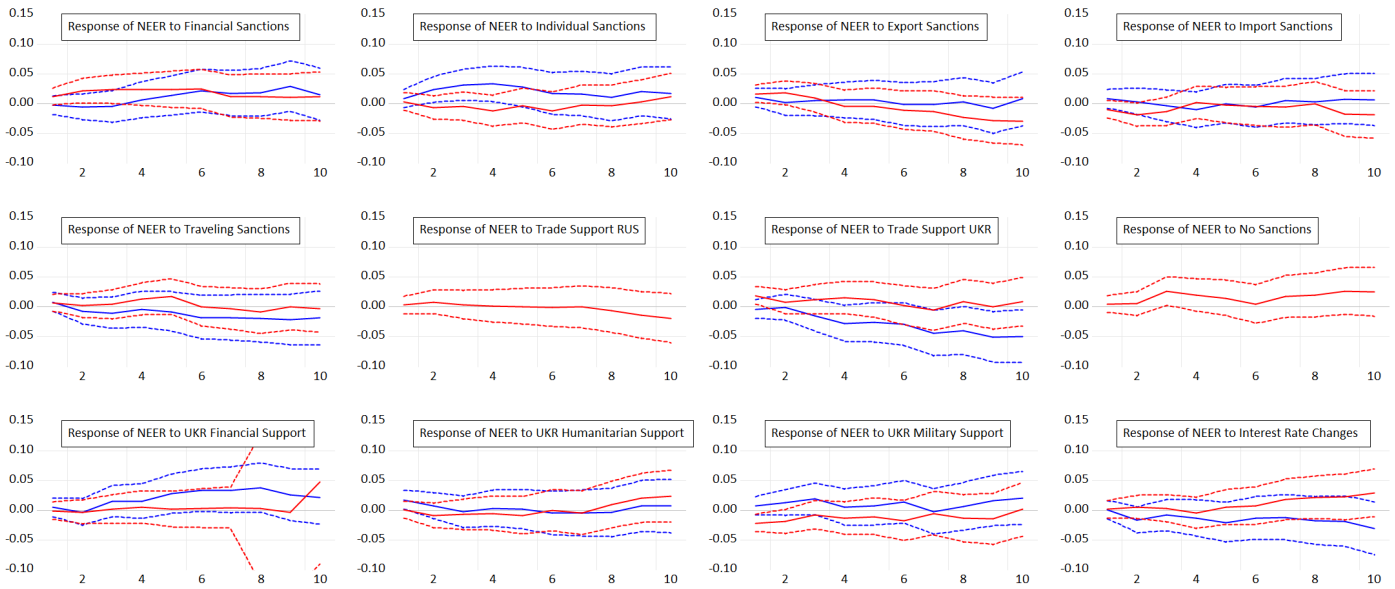
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = European countries, red lines = American countries, green lines = Asian and Australian countries.

Figure 5: Responses of NEER Prices in Domestic Countries



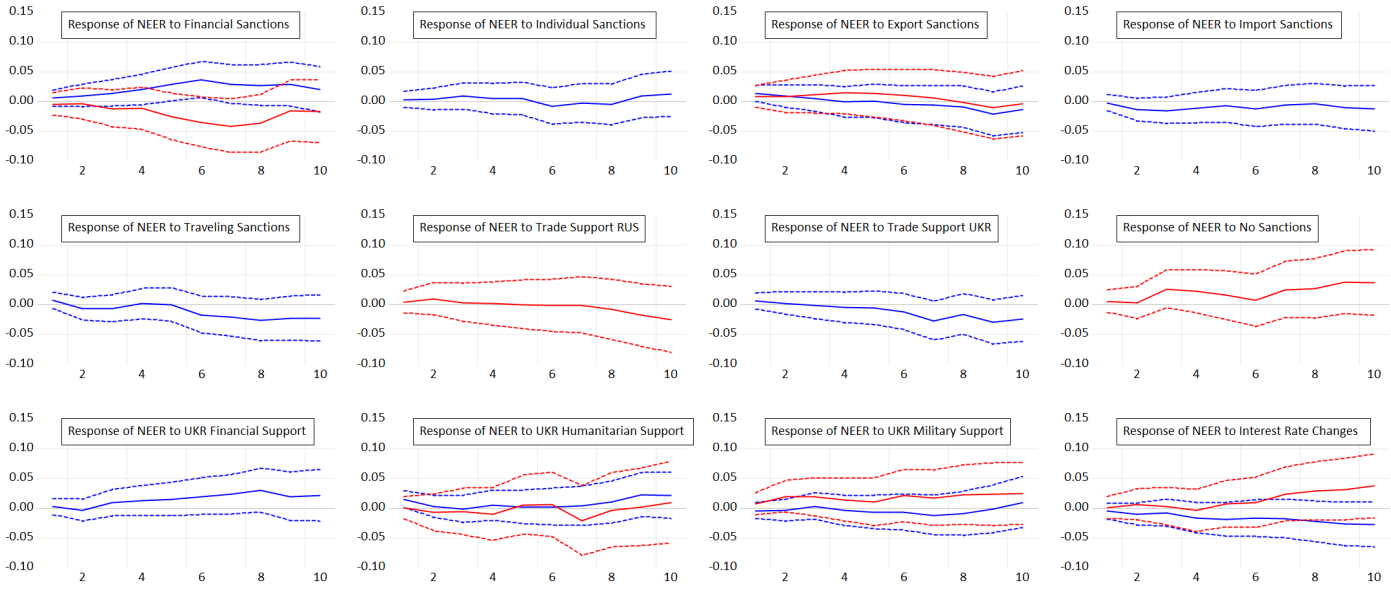
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval.

Figure 6: Responses of NEER Prices in Domestic Countries: G7 versus Non-G7 Countries



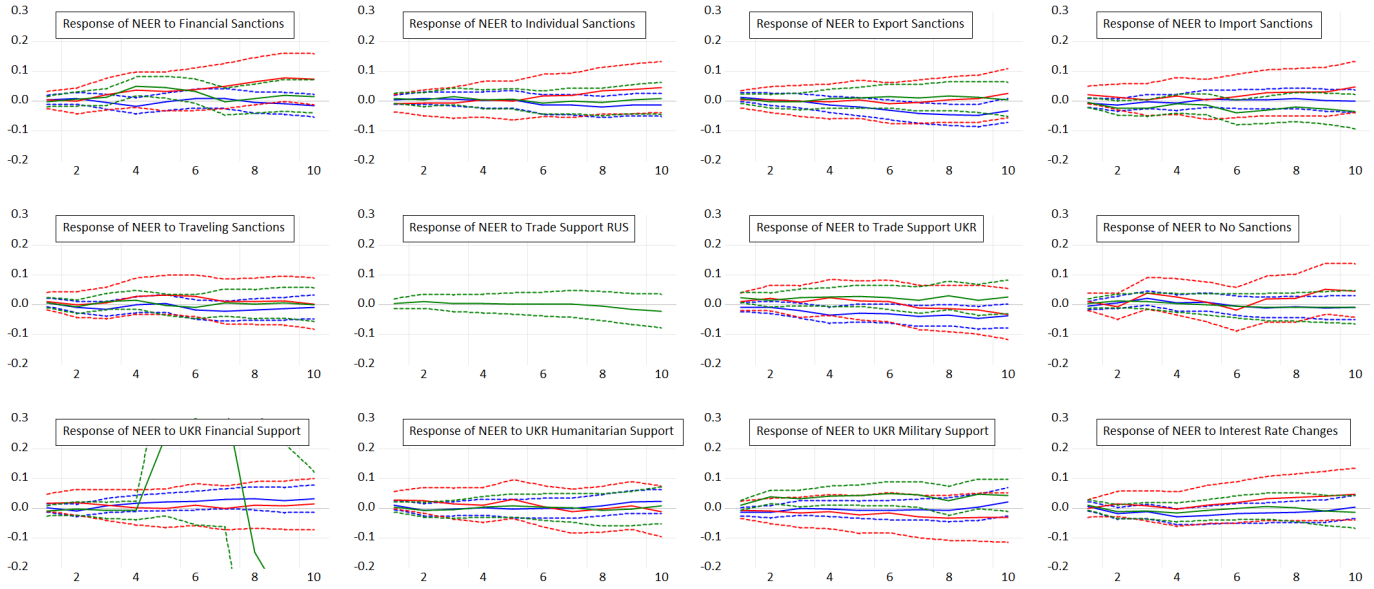
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = G7 countries, red lines = non-G7 countries.

Figure 7: Responses of NEER Prices in Domestic Countries: Developed versus Developing Countries



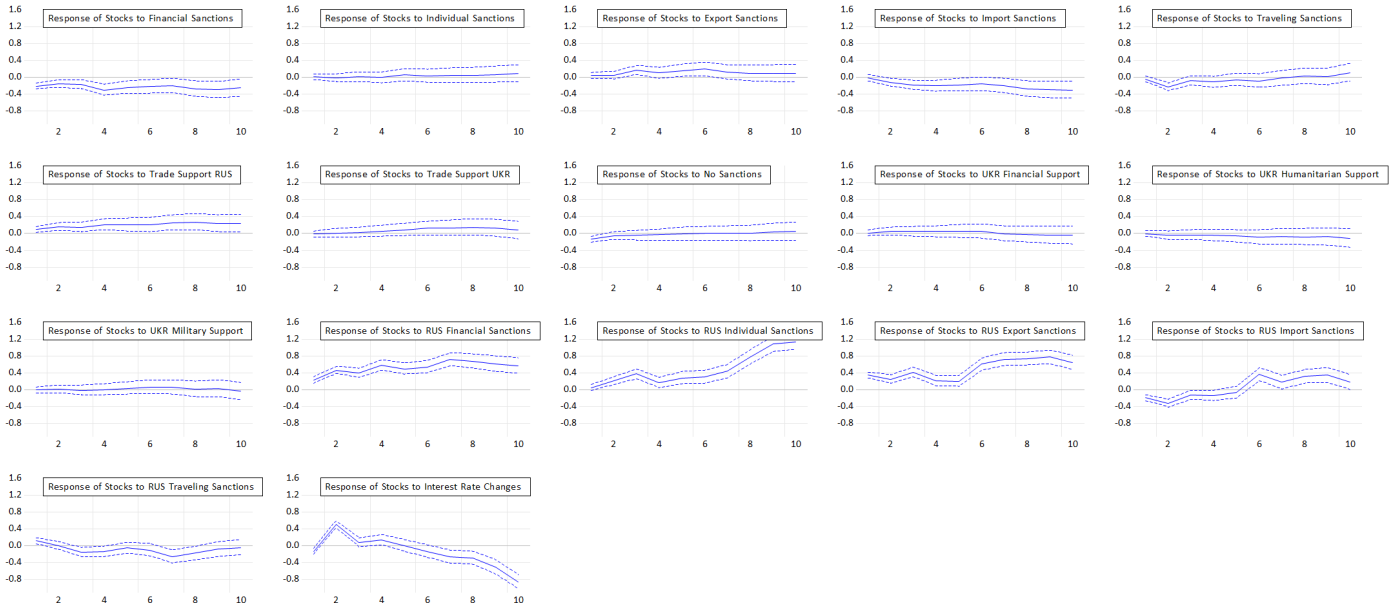
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = developed countries, red lines = developing countries.

Figure 8: Responses of NEER Prices in Domestic Countries: Geographical



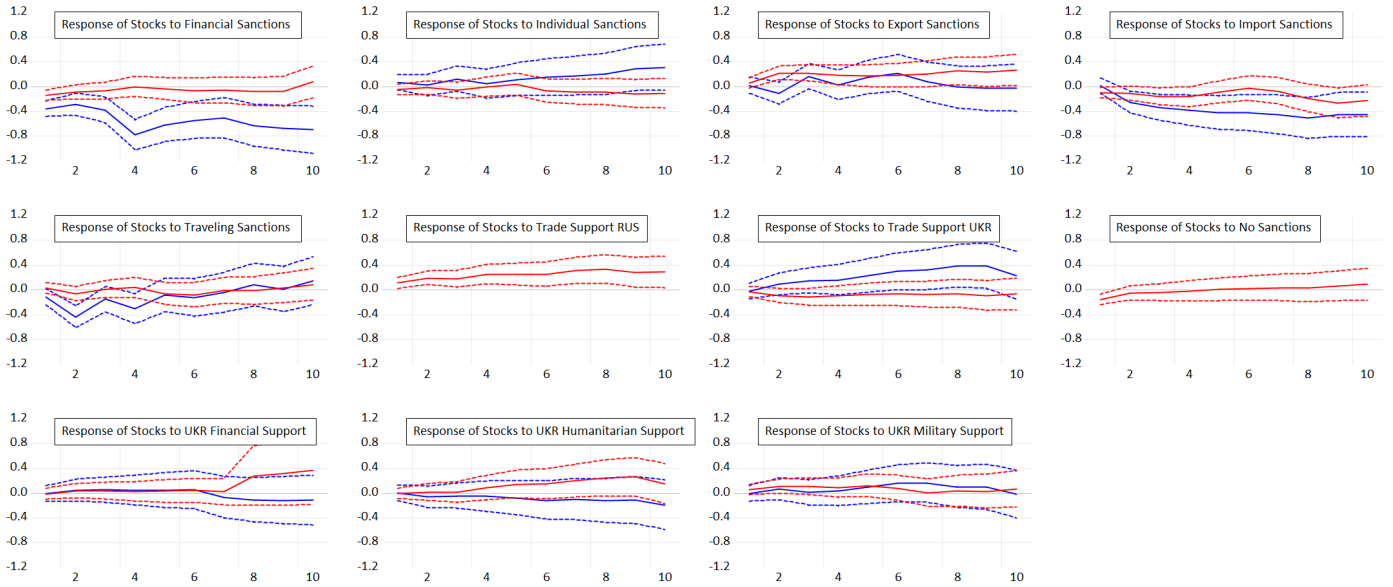
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = European countries, red lines = American countries, green lines = Asian and Australian countries.

Figure 9: Responses of Stock Prices in Russia



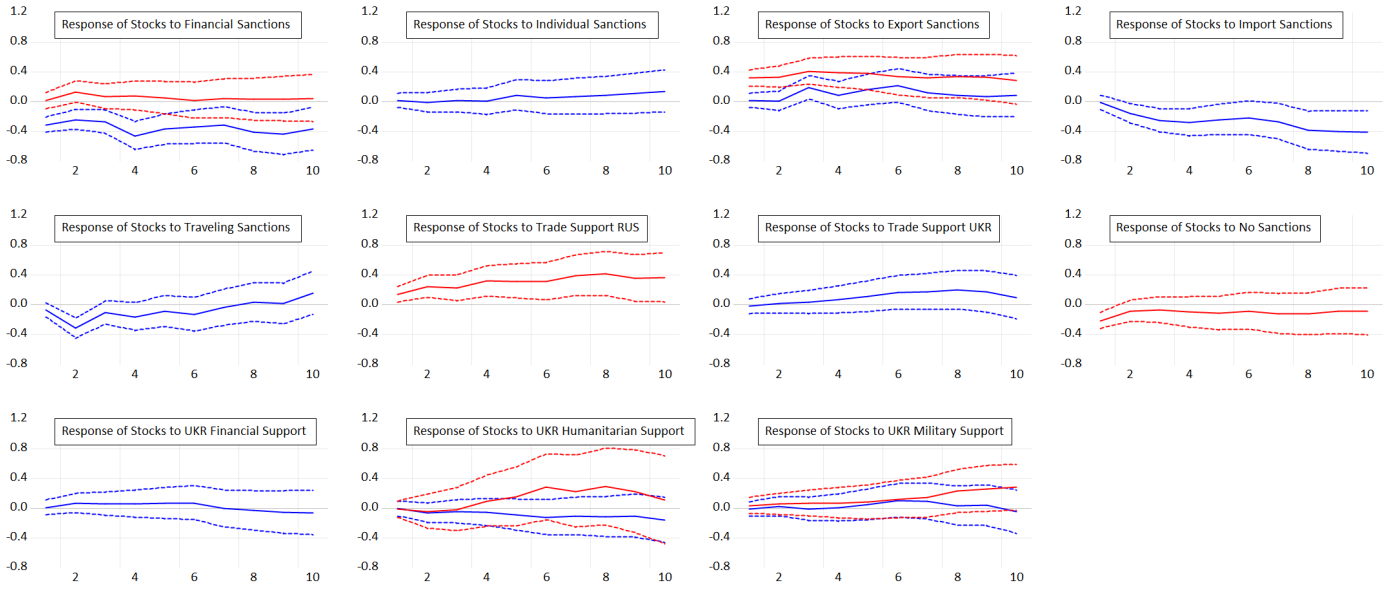
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval.

Figure 10: Responses of Stock Prices in Russia: G7 versus Non-G7 Countries



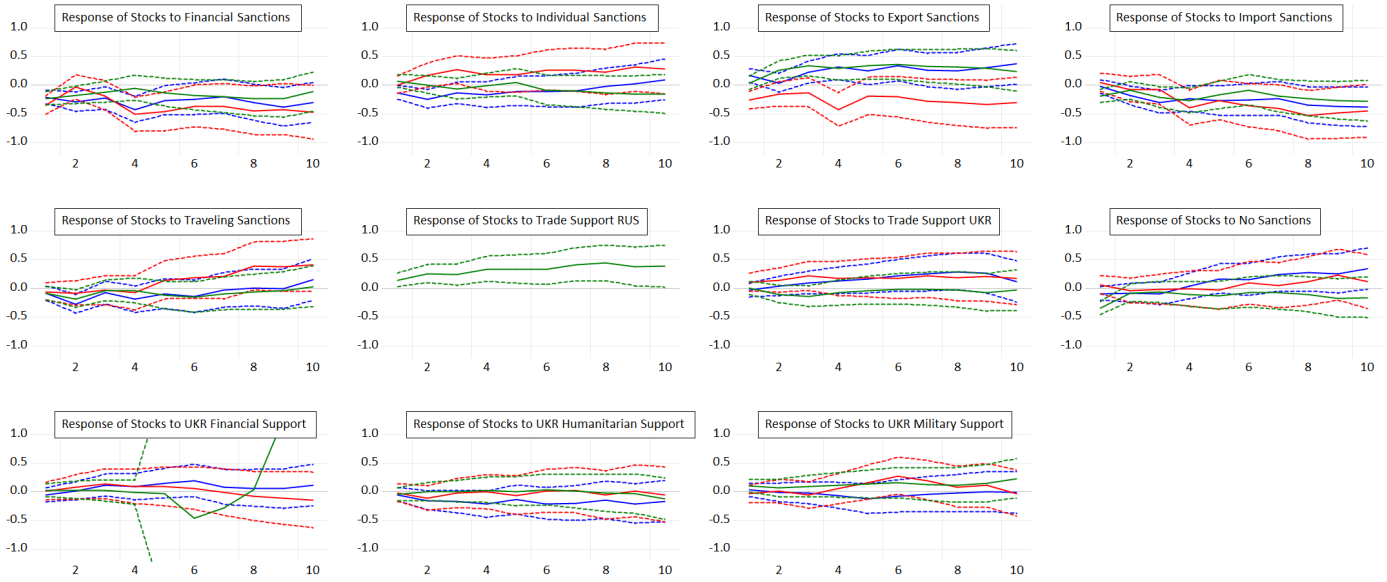
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = G7 countries, red lines = non-G7 countries.

Figure 11: Responses of Stock Prices in Russia: Developed versus Developing Countries



Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = developed countries, red lines = developing countries.

Figure 12: Responses of Stock Prices in Russia: Geographical

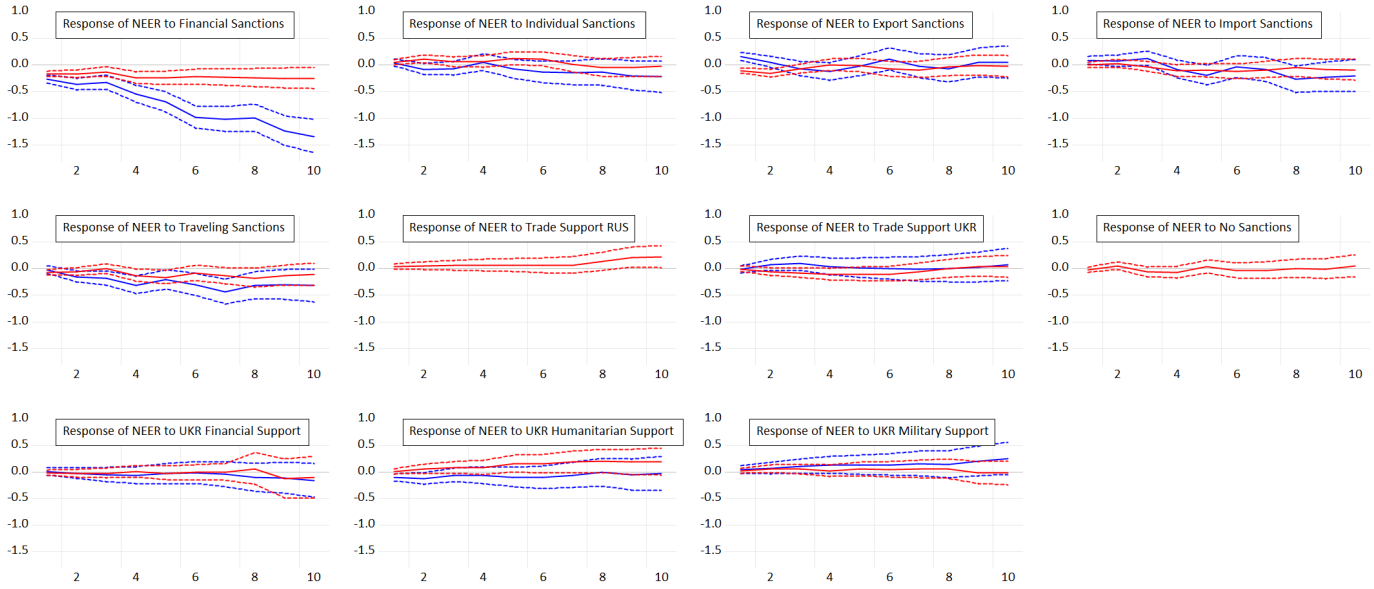


Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = European countries, red lines = American countries, green lines = Asian and Australian countries.

Figure 13: Responses of NEER Prices in Russia

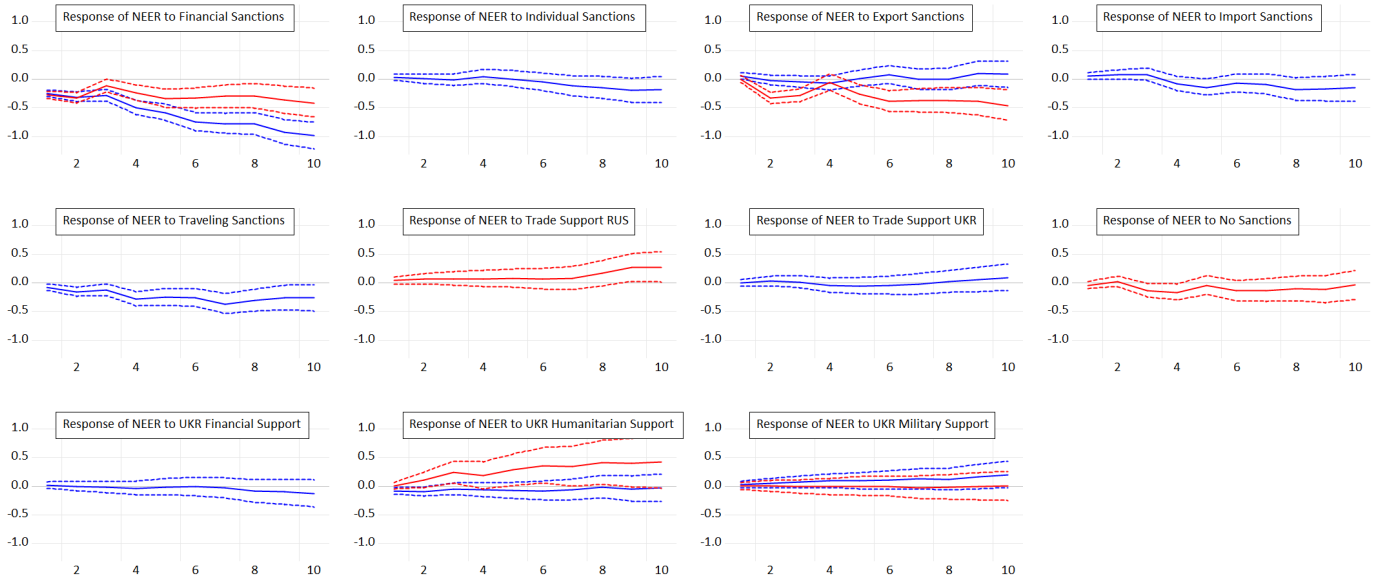
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval.

Figure 14: Responses of NEER Prices in Russia: G7 versus Non-G7 Countries



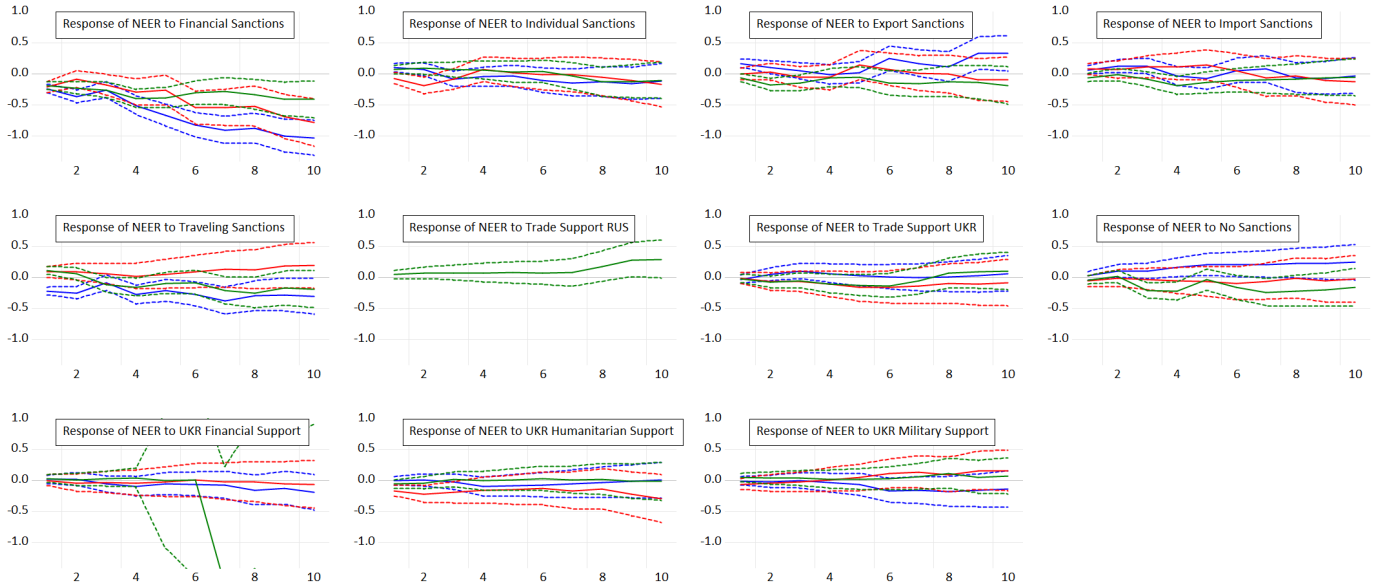
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = G7 countries, red lines = non-G7 countries.

Figure 15: Responses of NEER Prices in Russia: Developed versus Developing Countries



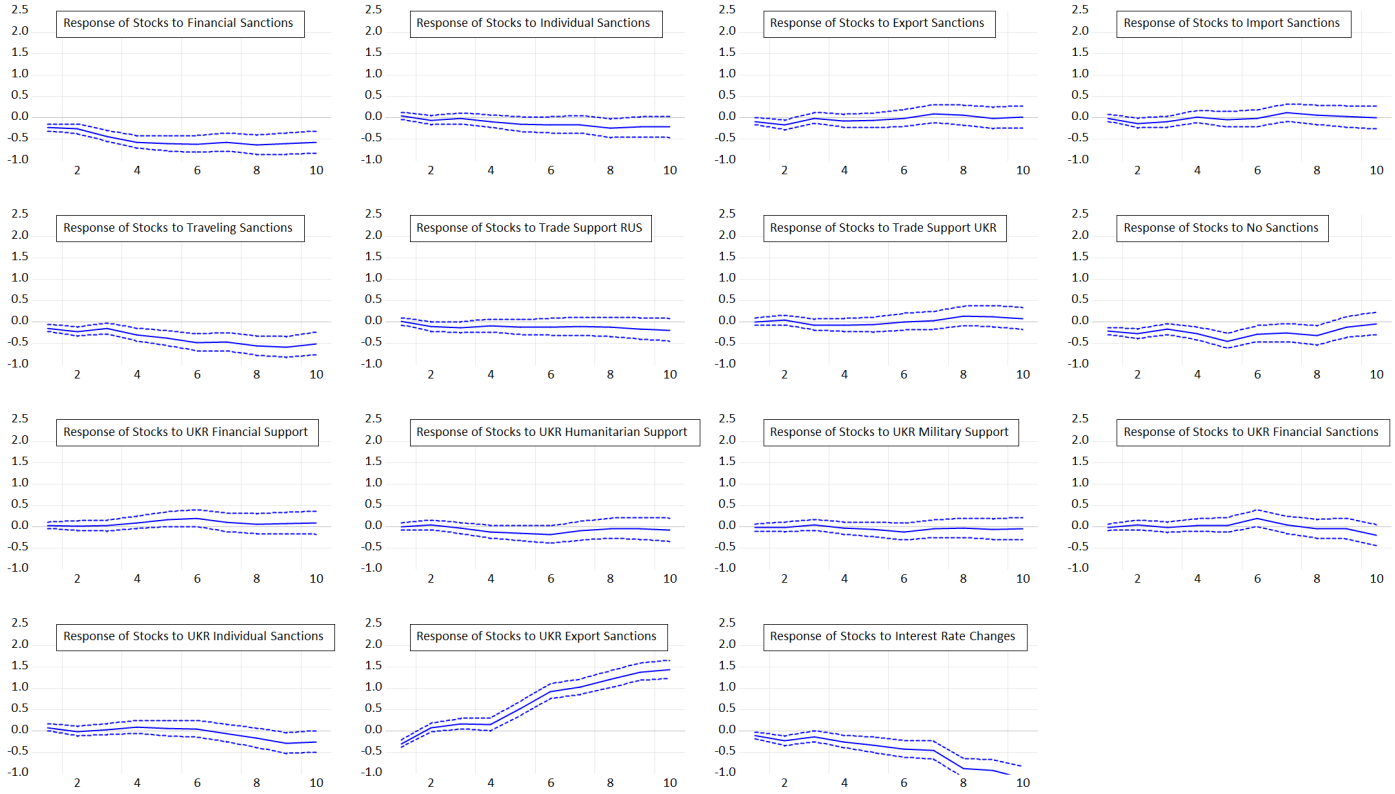
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = developed countries, red lines = developing countries.

Figure 16: Responses of NEER Prices in Russia: Geographical



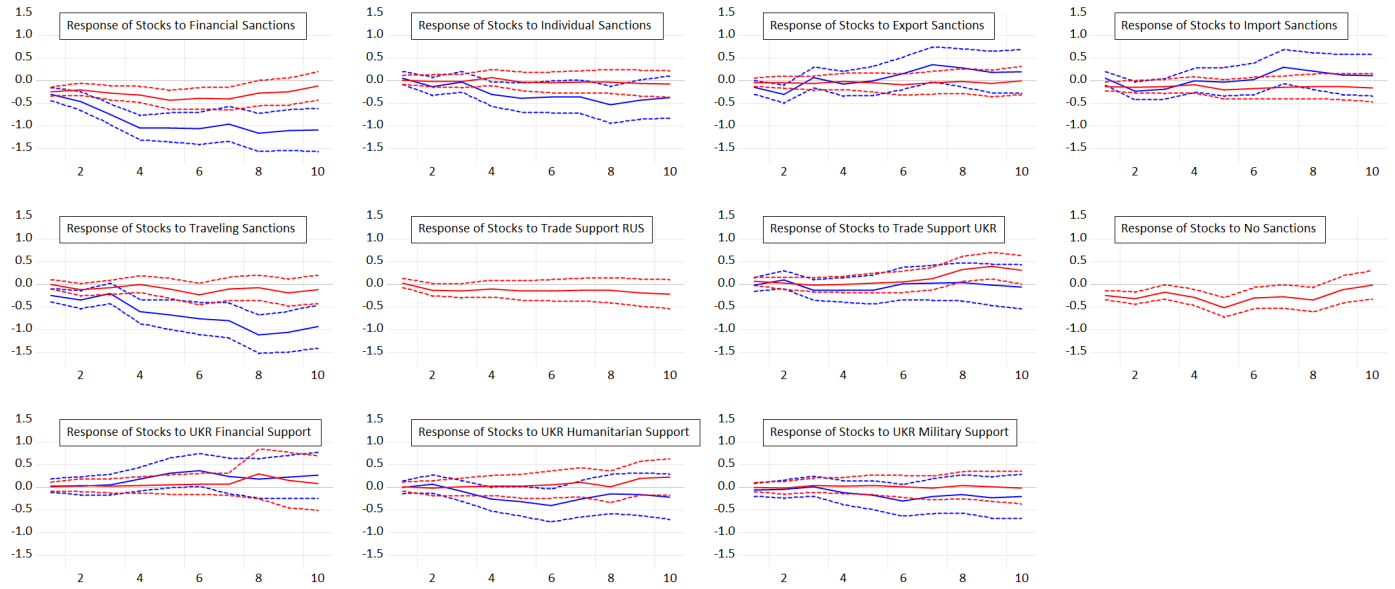
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = European countries, red lines = American countries, green lines = Asian and Australian countries.

Figure 17: Responses of Stock Prices in Ukraine



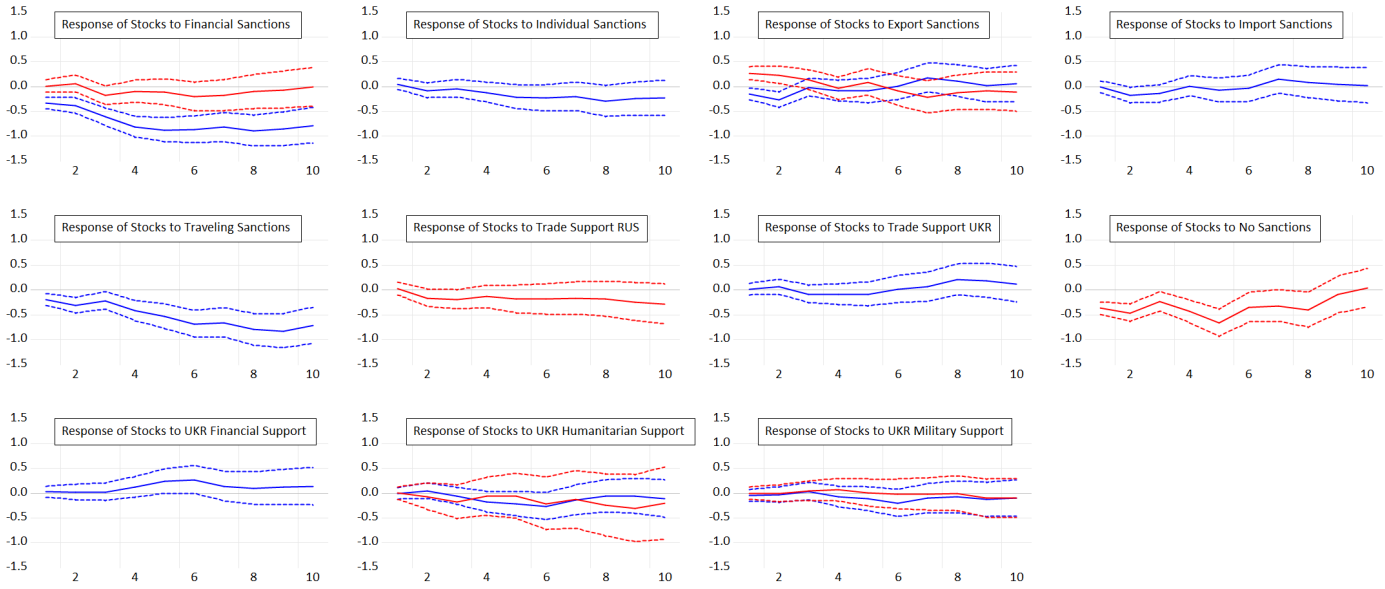
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval.

Figure 18: Responses of Stock Prices in Ukraine: G7 versus Non-G7 Countries



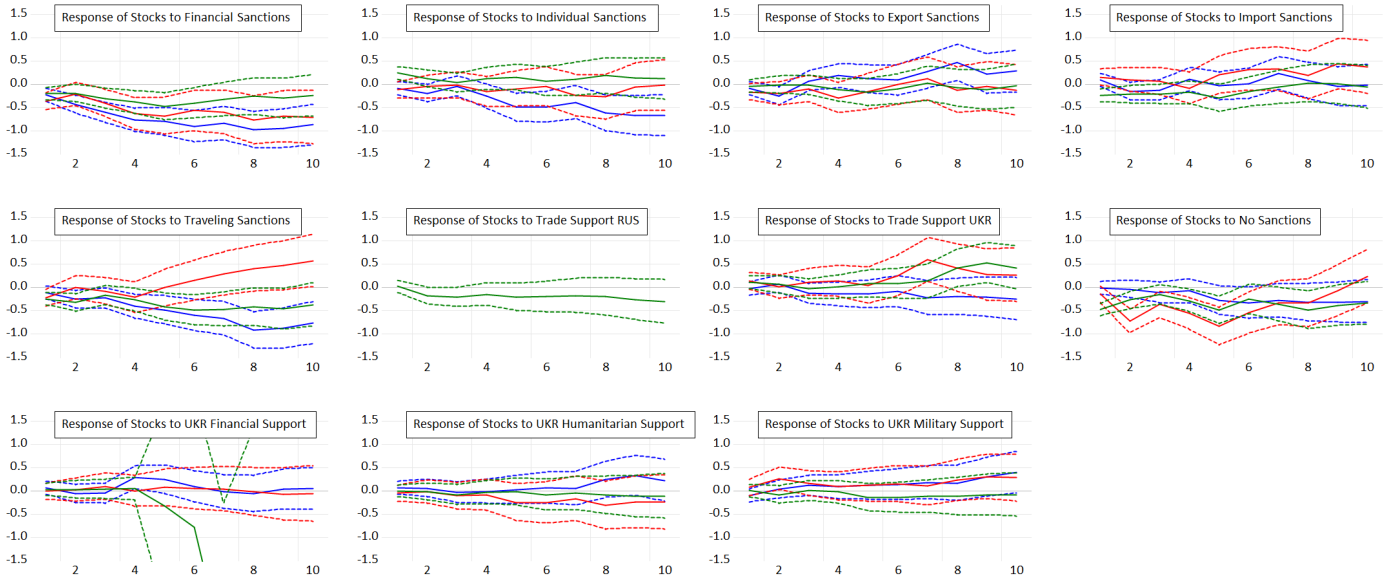
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = G7 countries, red lines = non-G7 countries.

Figure 19: Responses of Stock Prices in Ukraine: Developed versus Developing Countries



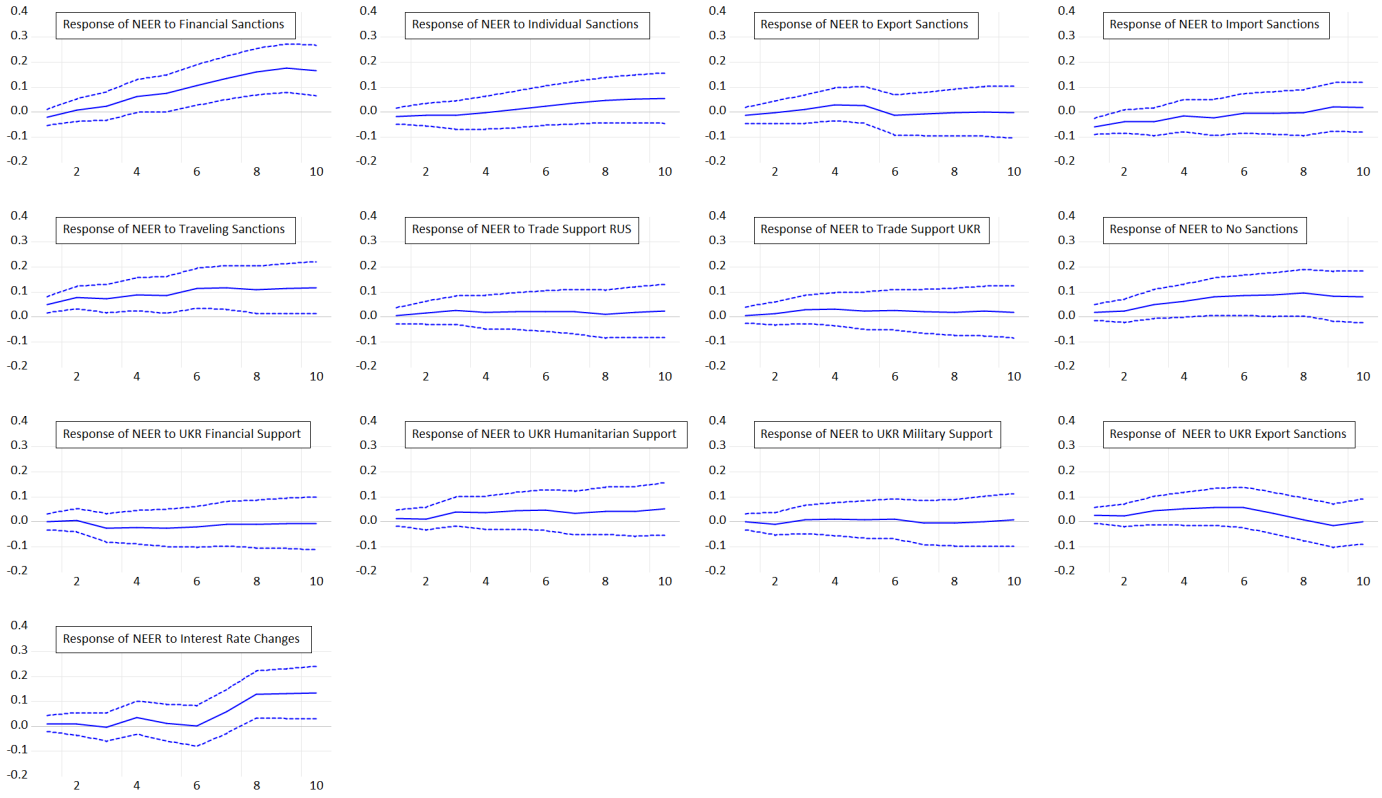
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = developed countries, red lines = developing countries.

Figure 20: Responses of Stock Prices in Ukraine: Geographical



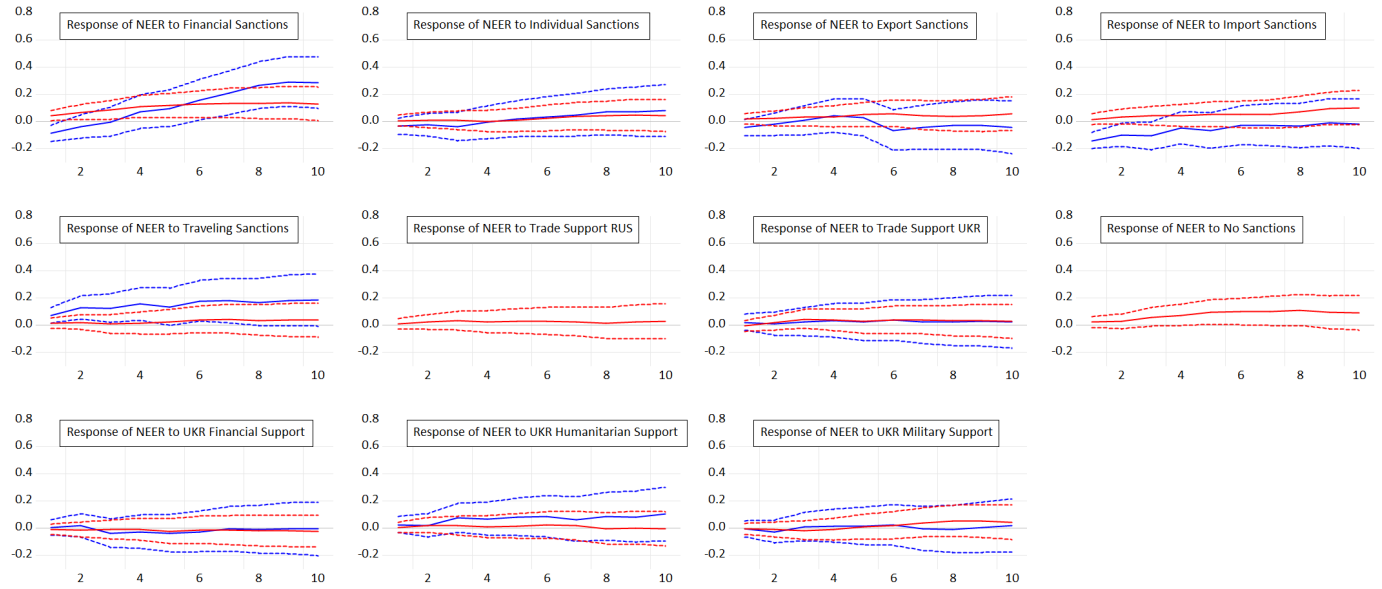
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = European countries, red lines = American countries, green lines = Asian and Australian countries.

Figure 21: Responses of NEER Prices in Ukraine



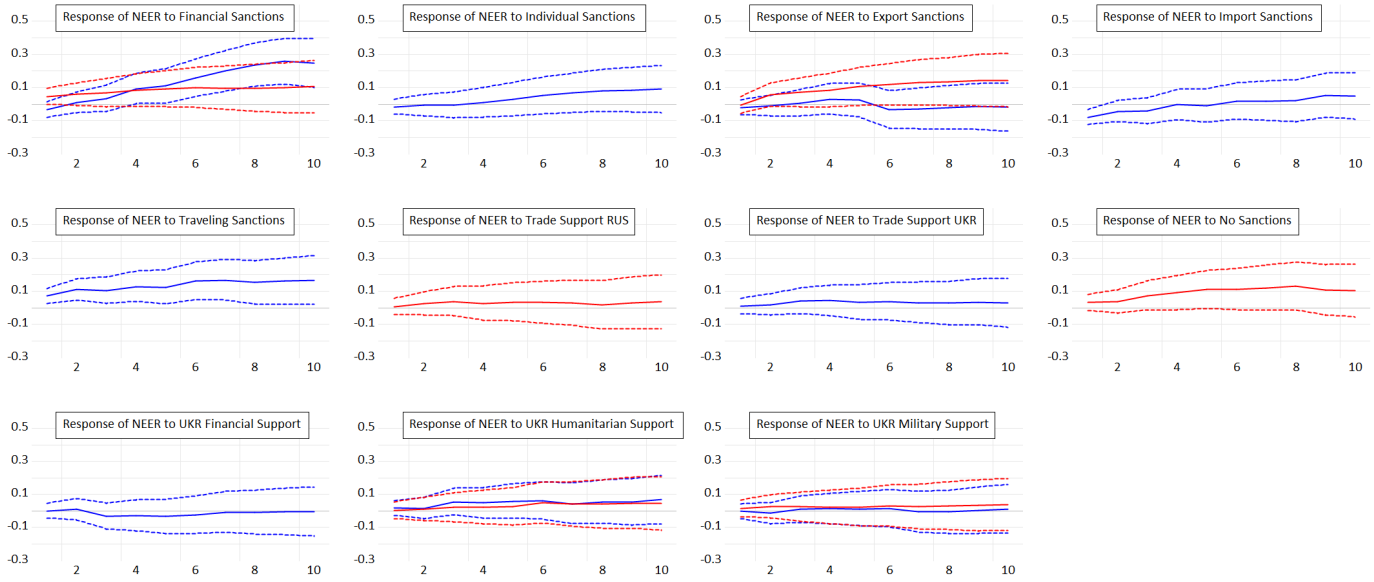
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval.

Figure 22: Responses of NEER Prices in Ukraine: G7 versus Non-G7 Countries



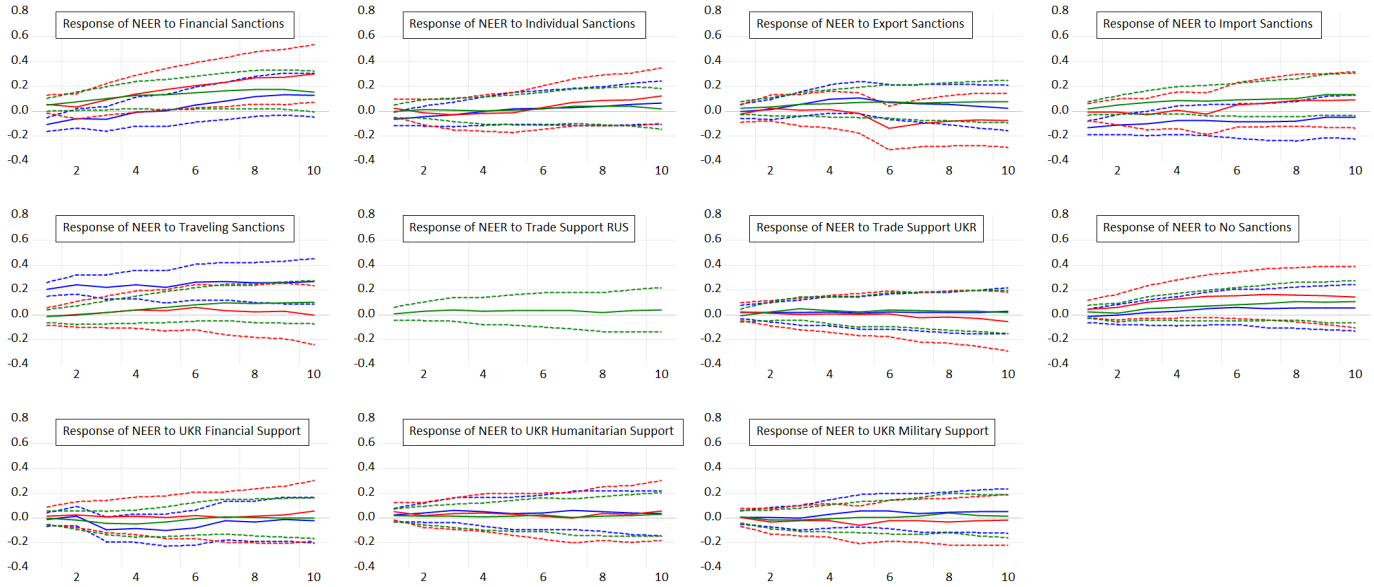
Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = G7 countries, red lines = non-G7 countries.

Figure 23: Responses of NEER Prices in Ukraine: Developed versus Developing Countries



Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = developed countries, red lines = developing countries.

Figure 24: Responses of NEER Prices in Ukraine: Geographical



Notes: Accumulated impulse response functions to an one standard deviation shock for the next ten business days. Solid line = impulse response, dashed lines = 90% confidence interval. Blue lines = European countries, red lines = American countries, green lines = Asian and Australian countries.