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The indirect effect of the Russian-Ukrainian war through international linkages: early evidence from the stock market

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Abstract
This paper investigates how firms' international linkages to Russia and Ukraine affected investors' expectations following the escalation of the Russian-Ukrainian war. For this, we perform an event study around the Russian invasion of Ukraine on February 24, 2022, finding that firms with significant trade activity with Russia experienced a substantial reduction in cumulative returns. The effect on cumulative returns is especially pronounced for firms that are dependent on Russian commodities. The impact on the aggregate stock market performance of third countries was on average 0.8 percentage points. The highest losses were borne by European countries.

Key words: Russia-Ukraine war, trade linkages, multinationals, stock market, event study
JEL codes: F15; F23; G14; G15

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1 Introduction

The war in Ukraine, which escalated on February 24, 2022, has had devastating human consequences. One and half years after the beginning of the conflict, the Office of the UN High Commissioner for Human Rights estimates the number of civilians casualties to be 26,717 and the number of Ukrainian refugees in Europe to be 5,840,200. In addition, Ukraine has incurred tremendous immediate economic losses that are likely to have severe long-term effects. The consequences of this war are also being felt far beyond Ukraine's borders. Since the onset of the war, inflation has soared globally, and Europe is experiencing a severe energy crisis. It is thus crucial to understand the global impact of the war; however, quantifying the extent of the war's indirect economic impact is challenging at this stage.

Studying stock market responses provides insight into market anticipation of the extent of spillovers and potential damages worldwide. Share prices reflect the information available to market participants at a given point in time and indicate the future profitability expectations for individual companies and sectors. Given the scale of the Ukraine war, it is plausible that it has altered agents' expectations of firm performance. International linkages are known to be major vectors through which shocks spread on a global scale; hence, one would expect that countries and industries with strong links to Russia and Ukraine are more prone to suffering the consequences. Understanding whether this was a determinant in market participants' expectations is central for assessing the impact of the war. Of course, market participants may be wrong, and share price movements might not correctly capture the overall impact of such an event. However, given the information aggregation function of stock markets, share price reactions capture the "consensus view" of a large number of well-informed economic actors such as banks, insurance companies, and investment funds.

In this paper, we add to the growing literature on the short-run effect of the war worldwide by studying whether firms' exposure to Russia and Ukraine through trade is an important determinant of the stock market response to the war. We assembled a data set of 19,774 firms listed in 29 countries, with detailed information on their exposure to Russia and Ukraine arising predominantly through trade. Our proxies for firms' trade exposure are constructed using industry-level trade flows and detailed firm ownership data. We find that firms with high exposure to Russia experienced a significant decrease in cumulative returns following the Russian invasion of Ukraine. These results are robust, with the inclusion of physical distance to Russia as well as firm size and market controls. After controlling for the proximity penalty, we find that trade exposure to Russia still matters. The negative effect on cumulative returns is driven by import dependence on Russia, and mainly by imports of commodities. However, we do not find robust evidence of a similar role for trade

activity with Ukraine on cumulative returns. Another key finding is that the ripple effects of the war have been important, but they are uneven across countries. The losses due to exposure to Russian trade are on average 0.8 percentage points, mainly concentrated in Europe. Meanwhile, the effects are relatively modest in large economies like Australia, Canada, China, and the US, which have less intense linkages with Russia.

Our paper focuses on understanding how firms' exposure to Russia and Ukraine, predominantly through trade, affects stock returns. Other papers have found that exposure to globalization generally – but also country-level trade exposure to Russia (Boubaker et al. 2022; Sun and Zhang 2022) and proximity to Russia (Boungou and Yatié 2022) – negatively affected returns in the aftermath of the escalation of the Russian-Ukrainian conflict.

We provide new evidence that highlights how differential exposures of firms *within* a country negatively affects cumulative stock returns. In the absence of firm-level bilateral trade flows covering the universe of firms in our sample, we derive proxies that reflect firm trade activity with Russia and Ukraine by considering their activity in industries with relatively high trade dependence on Russia, as well their affiliate presence. We build on the work of Antràs et al. (2023), which documents that multinationals are not only significantly more likely to trade with countries in which they have an affiliate but also with other countries in the same region. We find that firms with relatively stronger ties with Russia experience a significant decrease in cumulative returns following the escalation of the conflict.

Our paper is most closely related to that of Federle et al. (2023a), who identify a proximity penalty in the stock market response using both country-level and firm-level data. Their key finding is that shorter distance to Ukraine at both the country level and the firm level (within countries) is associated with a lower return. Federle et al. (2023a) control for trade exposure to Russia and Ukraine using country and industry fixed effects. Furthermore, they construct firm-level proxies for the association of firm returns with the stock markets in Russia, Ukraine, and the world. We follow their approach and additionally show that a firm-level proxy for trade with the conflict region is crucial to understanding observed changes in stock prices, even after controlling for proximity to Russia. Moreover, we show that having an affiliate in the region decreases cumulative returns, even after controlling for country-industry fixed effects. We further disentangle the effect of Russian trade exposure on cumulative returns between exports and imports, and we find that the effect is driven by imports. Within imports, the effect is stronger for Russian commodities relative to other goods.

Our second contribution is in quantifying the heterogeneity in the war's ripple effects across countries in an aggregation exercise. The aggregate losses due to trade linkages with Russia are economically significant, with about 0.8 percentage points on average, and they are concentrated in Europe. This additional evidence reinforces the idea that proximity is

crucial to understanding the current and potential effects of the war.

More broadly, we contribute to the literature on the effects of conflicts on stock prices (Leigh et al. 2003; Schneider and Troeger 2006; Guidolin and La Ferrara 2007; Zussman et al. 2008; Guidolin and La Ferrara 2010; Verdickt 2020; Caldara and Iacoviello 2022). This study also relates to the real transmission of wars through trade linkages to countries and firms that are not directly involved (for example, Glick and Taylor 2010; Qureshi 2013; Couttenier et al. 2022; Korovkin and Makarin 2022; Federle et al. 2023b). We contribute by studying the stock market response to the Russia-Ukrainian war in third countries through trade links.

Finally, we contribute to the literature on the transmission of shocks through supply chains. Influential contributions have examined the transmission of supply chain disruptions following by natural disasters through domestic input-output linkages (Barrot and Sauvagnat 2016; Carvalho et al. 2020) and through multinational networks (Boehm et al. 2019). We contribute by studying how investors respond to expected war-induced supply chain disruptions, showing that it is Russia-specific exposure that decreases firms' cumulative returns and not exposure to globalization in general. We also highlight that dependence on Russian commodities is a key determinant of the stock price reaction following the invasion of Ukraine and that high dependence on other countries' commodity imports mitigates negative effects.

The rest of this paper is structured as follows. Section 2 presents the methodology used to analyze the stock market response. Section 3 describes the data we used and presents summary statistics. Section 4 exposes our results as well as a number of robustness checks. Section 5 concludes.

2 Methodology

We use cumulative returns for a two-week window centered around the event to proxy for the market-response to the event. We calculate the cumulative return as multiplication of daily returns at the firm-level. For a given event window of τ trading days the cumulative return of firm i active in industry j and located in country c is given by:

$$CR_{ijc}(t-\tau,t+\tau) = \prod_{j=-\tau}^{j=\tau} (1+r_{ijc,t+j}), \tag{1}$$

where $1+r_{ijc,t+j}$ is the daily return between trading days t+j and t+j-1.[1]

In the main analysis we choose τ equal to 14 as in Federle et al. (2023a), because the war was not a totally unanticipated event. While many observers were still surprised

[1] We winsorize the dependent variable at the 1 and 99 percent level. The results are robust to not winsorizing.

by the invasion, early signs for the invasion with the benefit of hindsight include the prior build-up of Russian military near the Ukrainian border and the recognition of two Russian-controlled regions in eastern Ukraine. To test, whether exposure to Russia and Ukraine is relevant in understanding the reaction of cumulative returns to the event, we specify the following cross-sectional regression:

$$\begin{aligned} CR_{ijc}(t-\tau,t+\tau) = \mu &+ \gamma_1 \mathbb{1}(\text{Trade Dependence on Russia}_{jc}) \\ &+ \gamma_2 \mathbb{1}(\text{Affiliate in Russia}_i) + \gamma_3 \mathbb{1}(\text{Affiliate in Ukraine}_i) \\ &+ \gamma_4 \mathbb{1}(\text{Affiliate in Region}_i) + \xi X_i + \eta_j + \lambda_c + \varepsilon_{ijc}. \end{aligned} \tag{2}$$

The key coefficients of interests are γ_1, γ_2, γ_3, and γ_4. They collectively quantify the extent to which firms' exposure to Russia and Ukraine affect cumulative returns. Firms can be exposed to Russia and Ukraine in multiple ways, we focus here on exposure arising predominantly through trade. In absence of firm-level bilateral trade flows covering the universe of firms in our sample, we have derived proxies that reflect a firm trade activity with Russia and Ukraine. We first consider whether a firm is active in industries with relatively high direct trade dependence on Russia with $\mathbb{1}(\text{Trade Dependence on Russia}_{jc})$. These firms should be relatively more affected by the war than the other firms, hence we expect γ_1 to be negative. Unfortunately, data limitations precluded the possibility of constructing a comparable variable for Ukraine.[2] Drawing from the recent work by Antràs et al. (2023), we use affiliate presence to refine firms' specific exposure to Russia and Ukraine. Antràs et al. (2023) document important complementary between trade and affiliate presence. US multinationals are not only significantly more likely to import and export from countries in which they have an affiliate, but they are also more likely to import and export from countries in the region where they have an affiliate. We then add dummy variables indicating affiliate presence of firms in Russia, in Ukraine, as well as in the countries in their vicinity as additional regressors.[3] We expect γ_1, γ_2, γ_3, and γ_4 to be negative.

Our regression also includes control variables within vector X_i. Given our specific context, we add a dummy equal to one if the firm announced to take actions with respect to its Russian operations, and a firm-level distance to Moscow to control for the proximity penalty identified by Federle et al. (2023a).[4] The remaining control variables are common in the literature. We account for size dependent effects by including the logarithm of firm

[2] We discuss this issue in greater details in the data section.

[3] Similar to Federle et al. (2023a), we define the region as first and second degree neighboring countries to Russia and Ukraine in Western Europe. These countries are Austria, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Finland, Germany, Hungary, Latvia, Lithuania, Moldova, Norway, Poland, Romania, Serbia, Slovakia, Slovenia, and Sweden.

[4] Federle et al. (2023a) use the shortest distance to Ukraine as control. We use the distance to Moscow as the WIOD contains information on trade linkages to Russia only. The correlation between the firm-level distances to Kyiv and Moscow is 0.99.

market capitalization and the logarithm of total assets as additional controls.[5] We also add leverage to measure the financial risks of firms.

To control for country-specific and industry-specific reactions to the event, we also include country fixed effects λ_c and industry fixed effects η_j . Standard errors are clustered at the level of the industry to account for cross-sectional dependence.

3 Data

3.1 Data Sources

In our study, we consider all firms in Orbis that are listed on the stock market and located in a country covered by the World Input-Output Database. We make use of five different types of data sources to construct the dependent and independent variables. Our final data set contains data from 29 countries of which 21 are European countries and 8 other major economies including the US and China (see Table A.1 for the full list of countries).

Orbis We identify stock listed companies in Orbis and their ticker symbol. Additionally, we downloaded rich information on the structure of the international affiliates on March 11, 2022.[6] We know how many affiliates are owned by a multinational and where they are located. In particular, we are interested in whether a firm has an affiliate in Russia, Ukraine, or the first and second degree neighbors of Russia and Ukraine. The information spans the network of all international affiliates as covered by Orbis. We also gather information on firm size measured by total assets and current and non-current liabilities to calculate firms' leverage. Finally, we use information on the headquarter location of the company (i.e. the city name and country).

Bloomberg We use the ticker in Orbis to retrieve stock prices of listed companies between March 30, 2021, and March 24, 2022.[7] Additionally, we obtain data on market capitalization in the last two weeks of December 2021. We only keep in our sample companies with an average market capitalization above 10 million US dollar in this time span similarly to Deng et al. (2022).[8]

[5] We use total assets as measure of size to maximize the sample. The results are robust to using employment or sales as measures of size.

[6] We define an affiliate as more than 50 percent global ultimate ownership of an entity in a country other than the firm's headquarter.

[7] If multiple companies have the same ticker symbol in a given country in Orbis, we identify them individually in Bloomberg.

[8] We do so to avoid our results to be driven by penny stocks.

World Input-Output Database We use the World Input-Output Database (WIOD) described in Timmer et al. (2015) to retrieve country-industry specific trade dependence on Russia prior to the start of the conflict. We define *Trade Dependence on Russia* for industry j in country c as:

$$\text{Trade Dependence on Russia}_{jc} = \frac{\sum_v M_{jv,cR}}{Y_{jc}} + \frac{\sum_v X_{jv,cR}}{Y_{jc}}. \tag{3}$$

where $M_{jv,cR}$ denote the expenditure on Russian inputs from industry v by industry j in country c, $X_{jv,cR}$ denote the exports of industry j in country c to industry v in Russia, and Y_{jc} the gross output of industry j in country c. For a given country-industry pair, trade dependence encompasses intermediate input use from Russia as well as exports to Russia scaled by gross output. We use the 2014 World Input-Output Table to compute the measure as it is the most recent table available in WIOD.[9]

For firms operating in a single industry, we assign the value of the trade dependence corresponding to the industry in which it operates in its headquarter location. For the 28.74 percent of firms in our sample that operate in multiple industries, we compute the average trade dependence in its headquarter location over all industries in which the firm operates.

The trade dependence on Russia on average 0.25 percent in our sample, 0.15 percent comes from imports and 0.10 percent from exports. The distribution of the dependence measure is, however, highly skewed. The median dependence is 0.06 percent, the 75th percentile is 0.20 percent, and the 90th percentile is 0.54 percent. Our baseline measure $\mathbb{1}(\text{Trade Dependence on Russia}_{jc})$ distinguishes firms below and above the 90th percentile as we believe that only significantly high dependence is likely to matter for cumulative returns. We present evidence in section 4 that supports the existence of non-linearity.

Ukraine is not among the countries covered by WIOD, and to our knowledge, no alternative sources offer global input-output linkages for Ukraine. We are, hence, unable to compute a similar measure for Ukraine. Using data on country-level trade flows, we can compute an aggregate measure of a country's dependence to Ukraine as the share of total trade with Ukraine in GDP. Table A.2 shows aggregate trade dependence on Ukraine and Russia for countries in our sample. The dependence to Russia is much higher than the dependence to Ukraine for all countries considered. The average dependence on Russia is six-times as high as the average dependence on Ukraine at the country level. Interestingly, country's aggregate dependence to Russia is highly correlated to that country's aggregate dependence to Ukraine: the correlation is 0.95. Taken together, this suggests that trade with Ukraine is likely to matter less for the average firm and that to some extent trade with Russia may proxy for trade with Ukraine.

[9] We find similar results when using measures from Figaro in 2020. Given that WIOD are the most widely used tables and we started out working with them, we decided to continue with WIOD.

Distance measures We use information from Orbis to obtain the name of the city in which a firm's headquarter is located. We use two publicly available data sources to construct the firm-level location. We obtain the latitude and longitude of cities from Simplemaps. For those cities that we could not match in Simplemaps, we accessed data on latitudes and longitudes from Geonames as second data source. We complete the collection of firms' location using Google maps for those cities that we cannot uniquely identify using the aforementioned data.[10] We then calculate the geodetic distance between each firm and the capital Moscow.

Company's actions with respect to Russia We obtain the list of companies taking action with respect to their operations in Russia provided by Jeffrey Sonnenfeld and his team following the beginning of the war.[11] The list was compiled using an extensive list of public sources from 166 countries and non-public sources such as information from company insiders. We match the firms in our sample by their name.[12]

3.2 Summary statistics

Our final sample comprises 19,974 firms with headquarters in 29 countries. The majority of these firms are located in Asia (48.31 percent), while by 28.48 percent are based in the Americas and 17.06 percent in Europe. The average firm has 263.17 million US dollar of total assets[13], 354.84 million US dollar of market capitalization and a leverage of 46.68 percent.[14] There are 8,651 multinational firms in our sample, which represent 43.75 percent of firms and 77.05 percent of total assets. A multinational firm owns on average 22.44 affiliates abroad in 7.16 countries. Table 1 provides detailed descriptive statistics for our main variables.

The average cumulative return for the window of 14 trading days around the beginning of the war is -4.51 percentage points, but this hides significant cross-sectional variation. The standard deviation of cumulative returns of firms in our sample is 13.39 percentage points.

Only a minority of firms in our sample have a direct ownership link with either Ukraine or Russia: 1.37 percent of firms own an affiliate in Ukraine, 3.78 percent of firms own

[10] When there are multiple cities with the same name in one country, we check the firm's location individually.

[11] We accessed the list on the 11th of March, i.e. two weeks after the outbreak of the war. Source: https://som.yale.edu/story/2022/over-1000-companies-have-curtailed-operations-russia-some-remain.

[12] The literature has found ambiguous results as to whether firms' announcements to reduce their activity in Russia deteriorates (for example, Basnet et al. 2022; Berninger et al. 2022; Huang and Lu 2022) or improves firms' stock performance (for example, Sonnenfeld et al. 2022; Tosun and Eshraghi 2022).

[13] We obtain value on total assets for the accounting years 2020 and 2021. We control for the year in which the value of total asset was reported last.

[14] Three firms report negative liabilities, which is why the minimum leverage is negative.

an affiliate in Russia, and 0.99 percent of firms own both an affiliate in Russia and in Ukraine. On average, affiliates in Russia account for 0.58 percent of the total number of a multinationals' affiliates and affiliates in Ukraine for 0.18 percent. However, 14.73 percent of the firms in the sample have an affiliate in the region, and hence may be likely to trade with both Russia and Ukraine.

Among the firms active in Russia in our sample, only a few have announced to take action with respect to their operations there. 66 firms, representing 8.8 percent of firms active in Russia, are part of the list put together by Jefferey Sonnenfeld and his team.

While not all firms have direct ownership links, most of the firms in our sample are operating in sector and country pairs that depend on Russia through trade. The trade dependence on Russia is on average 0.25 percent: 0.15 percent is due to import dependence and 0.10 percent is export dependence. This average masks not only significant heterogeneity across firms but also across countries. The average trade dependence on Russia in the EU is 0.80 percent, whereas it is much lower in the US with 0.06 percent. Table 2 shows the ten industries that are most dependent on Russia in the EU. The most exposed industry is directly linked to raw materials from Russia, namely coke and refined petroleum products. Other industries highly dependent on Russia are mostly in manufacturing and include energy intensive sectors such as chemicals and chemical products.

4 Estimation results

4.1 Firm exposure to Ukraine and Russia and stock market returns

Suggestive evidence Before estimating equation (2), we present evidence suggesting that firms' trade activity with Russia was an important determinant of cumulative returns around the start of the invasion. Figure 1 illustrates the average cumulative returns of firms with high exposure to Russia compared to those with lower exposure over a 14-day window at the start of the invasion. The figure reveals a substantial drop in cumulative returns for firms with higher exposure to Russia, as proxied by trade dependency (Panel A) or affiliate presence (Panel B), around the war's commencement.

Baseline results We now turn to estimating the effect of firms' trade activity with Russia and Ukraine for stock market returns using the specification in equation (2). The estimation sample covers stock market returns of 19,974 firms with headquarters in 29 countries over a window of 14 trading days around the beginning of the war.

The estimation results are shown in Table 3 with standard errors clustered by industry. We start in column (1) by estimating equation (2) omitting firm-level controls. We progressively add controls in the subsequent columns. We include the distance to Moscow

in column (2), and further add proxies for the size of the firm (firm market capitalization, total assets) as well as leverage in column (3). We add estimates from a CAPM regression for the firm-level intercept, the MSCI Russia, and the PFTS in Ukraine in column (4) (see Appendix for more details). Columns (1)-(4) include country and industry fixed effects to control for country-specific and industry-specific reactions to the event. Column (5) introduces country-industry fixed effects to absorb any country-industry specific shock.

Our results corroborate the evidence in Figure 1 that strong trade relationships with Russia significantly affect cumulative returns at the war's onset. The coefficient γ_1 is negative and statistically significant implying that a firm that has relatively important trade linkages to Russia, as measured by belonging to the top decile of the trade dependence on Russia, experienced a decrease in returns of 2.20 percentage points with respect to other firms. This coefficient is robust to the introduction of distance to Moscow as well as controls of firm size and CAPM coefficient estimates. The coefficient γ_2 is negative and significant, meaning that having an affiliate in Russia, which likely reflects even stronger trade ties to Russia, reduces cumulative returns. More specifically, the results in column (4) imply that, conditional on firm characteristics including trade dependence, stocks of firms with an affiliate in Russia experienced cumulative returns 2.58 percentage points lower. When introducing country-industry fixed effects, the coefficient remains significant and similar in magnitude.

Without a concrete measure of trade dependence, drawing a similar comparison for Ukraine is difficult. Nonetheless, affiliate presence yields valuable insights into the role of trade ties. The coefficient γ_3 is small and insignificant in all specifications, suggesting that having an affiliate in Ukraine does not significantly affect cumulative returns. In our preferred specification (column 4), if anything, the effect is slightly negative but insignificant. However, it is important to note that these estimates are fairly imprecise and hence have to be interpreted with caution. Only a small fraction of firms in our sample have an affiliate in Ukraine, causing standard errors to be high.

The coefficient γ_4 is negative and significant across specifications. According to column (4), conditional on firm characteristics, stocks of firms with an affiliate in the region experienced cumulative returns 1.25 percentage points lower. Firms with an affiliate in the region are likely to trade more with Russia and Ukraine, suggesting that both are important for understanding stock market returns.

We do not find any evidence for the proximity penalty as bigger distance is insignificantly associated with lower returns.[15] Larger assets are significantly associated with a higher cumulative return, whereas a higher market capitalization is significantly associated with a lower cumulative return. The firms' leverage negatively correlates with the cumu-

[15]We also do not find different effects of the proximity penalty for neighboring countries in contrast to Federle et al. (2023a).

lative return but the coefficient is insignificant. The firms' sensitivities with respect to the world, Russia, and Ukraine are negatively and significantly associated with the cumulative return.

To make sure that our results are not driven by the definition of our main explanatory variables, we estimate equation (2) with alternative definitions of our linkages measures. The results are shown in Table A.3. In column (1) we present our baseline estimates (Table 3, column 4). In column (2) we replace our baseline dependence measure by a dependence measure computed based on the core industry code in which the firm operates.[16] The coefficient γ_1 is positive and significant, and comparable in magnitude to our baseline estimate. In column (3) we augment our ownership measures to capture the extent of affiliate presence in a country/region. We replace our dichotomous measures by the share of affiliates that a firm has in the respective country/region out of all its affiliates. The share is set to zero for firms that do not have foreign affiliates. We further control for the log of the number of affiliates in the regression.[17] Similarly to our baseline estimates, γ_2 and γ_4 are negative and significant, and γ_3 is insignificant but imprecisely estimated. The stronger the firm presence in Russia and in the region, the lower their cumulative returns around the event window. Our results contrasts with the results from Davies and Studnicka (2018) that studied the stock market response of German firms with UK affiliates following the Brexit referendum. This may indicate that agents expected the Russian-Ukrainian war to be a stronger shock to multinationals than Brexit.

Further tests on the baseline estimates, including variation of the event windows (Table A.4) and restriction of the sample to non-Asian firms (Table A.5), are provided in the Appendix. The findings from these additional tests affirm the robustness of our results.

Non-linearity We have shown that strong ties to Russia are relevant for understanding stock market response to the Russian-Ukrainian war. To further investigate whether the strength of the ties is determinant, we analyze potential non-linearity in the effect. First, we adjust our measure of trade dependence. The results are displayed in Table 4. In column (1) we introduce a linear dependence measure. The coefficient γ_1 is negative but not statistically significant, meaning that a marginal increase in the trade dependence with Russia has on average no significant incidence on the cumulative returns after the beginning of the war. In column (2) we use a dichotomous dependence measure differentiating firms below and above the median dependence. The coefficient γ_1 is negative, much smaller in magnitude to our baseline, and not statistically significant. However, when using the top quartile as the cut-off, γ_1 becomes more negative and statistically significant. The dependence of firms to Russia affects cumulative returns differently for firms at the top of the distribution.

[16] The core code reflects the main activity of the company in the respective industry classification.

[17] We add one to the number of affiliates before taking the log to include domestic firms.

This suggests that only strong ties are relevant.

The interaction between trade dependence and affiliate presence also offers valuable insights into the non-linearity of the effect. As documented by Antràs et al. (2023), firms with affiliates in Russia are more likely to trade with Russia and its neighbors. Therefore, conditional on trade dependence, we expect firms with affiliates in Russia to experience a more substantial relative decrease in cumulative returns. We include the interaction of $\mathbb{1}(\text{Trade Dependence on Russia}_{jc})$ with $\mathbb{1}(\text{Affiliate in Russia}_i)$ in our baseline specification to assess this. The results are presented in column (1) of Table 5. The interaction effect appears negative and significant, implying that the effect of trade dependence on cumulative returns is magnified by affiliate presence. Consistently with our prediction, dependence matters more for affiliates.

Our results show that trade linkages are relevant for understanding stock market response provided that they are big enough. This is intuitive given that strong linkages are not only much more visible to agents who form their expectations, but also are likely to matter more for the firm.

4.2 Unpacking the effect of trade dependence

We have established that strong ties to Russia, and to a lesser extent Ukraine, are important for cumulative returns following the beginning of the Russian-Ukrainian war.

Yet we cannot rule out that our results may be driven by a firms' overall exposure to global value chains. To examine this possibility, we estimate equation (2) adding a dummy capturing firm's relatively more depend to foreign countries. Similarly to our definition of Russia trade dependence, the variable global dependence equals one if a firm belongs to the top decile of exposure to other countries than Russia. The results are shown in Table 6. While the coefficient γ_1 is negative, statistically significant and even slightly greater than our baseline, the coefficient for the global dependence is positive and not significant. The overall dependence to global value chain is not a key driver of our results. If anything, investors expect that firms with higher exposure on other countries may find it easier to substitute away from trade with Russia.

To dig deeper into the mechanisms driving our results, we allow the impact of dependence on Russia to differ by flow type. Table 7 presents the results of estimating equation (2) where import and export dependence enter separately. Across all specifications, the coefficient for the import dependence is negative and statistically significant. On the other hand, the coefficient for the export dependence is negative, but small and not statistically significant. While it is hard to directly compare the magnitude of the coefficients to our baseline, the import dependence clearly appears to be the solely driver of the response in cumulative returns. This suggests that investors expect firms to suffer more severely from

difficulties to substitute intermediate inputs in the short-run in comparison to finding new markets when their sales to the Russian market decrease.

Given the importance of Russian commodity sector, the effect of the import dependence may entirely be driven by import dependence on Russian commodity. In Table 8, we further disentangle Russian import dependence between dependence on commodity imports and dependence on other imports. Column (1) shows that dependence on Russian commodity imports decrease cumulative returns by 2.96 percentage points, whereas dependence on other Russian imports only decrease cumulative returns by 0.87 percentage points. High commodity dependence seems to be the main driver for the effect of Russian imports on cumulative returns, but not the sole driver. The regression in column (2) introduces a dummy equal to one if commodity imports from countries other than Russia is in the top decile to capture global dependence on commodity imports. The point estimate is positive and significant at the 1 percent level suggesting that higher commodity exposure on other countries mitigates the effect of Russian imports as firms may find it easier to adjust their commodity sourcing.

4.3 The aggregate affect across countries

To understand the scope of the war's impact, we used our estimates to calculate the aggregate impact of trade activity with Russia, as approximated through dependence on Russia and affiliate presence in Russia, on third countries. We computed the aggregate stock market losses by country related to high dependence on Russia, assuming that an investor in a particular country c held stocks that reflect the market capitalization at the end of 2021 for listed firms in our sample. Equation (4) shows the aggregation for the trade dependence on Russia.

$$\text{Total Effect}_c = \frac{\text{Market cap. of firms with Total Dep. on Russia in top decile}_{jc}}{\text{Market cap. of firms}_c} \times \widehat{\gamma_1}. \quad (4)$$

For affiliate presence in Russia, the aggregation by country is performed similarly, using the coefficient γ_2.

The resulting aggregate effects are displayed in Table 9. The average loss due to trade dependence on Russia across all countries stands at 0.8 percentage points, with median loss of 0.47 percentage points. The respective figures for losses due to affiliates in Russia are 0.73 and 0.52 percentage points. Therefore, the war appears to have provoked non-negligible spillovers. Noticeably, both proxies considered lead to rather similar results.

Significant disparities exist across nations, as depicted in Table 9, where the losses appear concentrated in Europe. The figures in column (1) reveals that the five countries most dependent on Russia are all situated in Europe. Among these, three are in Eastern

Europe, implying a critical role of geographic proximity. The losses equate to nearly 2 percentage points for Luxembourg, Estonia, Latvia, and the Czech Republic. The losses equate to nearly 2 percentage points for Luxembourg, Estonia, Latvia, and the Czech Republic. Federle et al. (2023b) study wars between 1870 and 2022. They estimate the effect of war through trade on third countries using local projections and find a decline in output of roughly 3 percent in the first year after the onset of a war for the maximum trade exposure in their sample. Our country-level estimates for the largest responses in the stock market are within that magnitude. The aggregate effects using affiliate presence in Russia, presented in column (2) reveals a similar picture. Even large economies like Germany, the United Kingdom, and Italy have experienced an aggregate decrease approximating 1.5 percentage points. The largest losses were realized in Luxembourg and Switzerland, both exceeding 2.3 percentage points.[18]

On the other hand, non-European large economies were unaffected. As shown in column (1) large economies such as Brazil, Indonesia, and the US are unaffected when using trade dependence as no firm in these countries is in the top decile in terms of dependence on Russia. The effect is also modest in China with 0.01 percentage points. When using affiliate presence (column 2), large economies such as Australia (0.02 percentage points), Canada (0.06 percentage points), and China (0.08 percentage points) were not significantly affected due to their lack of substantial foreign direct investment in Russia. Similarly, our results reveal no effects for Bulgaria, the Czech Republic, and Indonesia, as no companies in these countries have affiliates located in Russia.

5 Conclusion

The Russian-Ukrainian war is likely to have long-lasting effects on the landscape of globalization. In order to achieve a first assessment of whether market participants expect that exposure to Russia and Ukraine through trade activity will harm firms, we analyzed stock market responses around the Russian invasion of Ukraine. We found that the cumulative returns of firms that have important trade activity with Russia were negatively impacted at the start of the invasion. For firms at the top of the distribution, the more important the trade activity, the stronger the response. We also showed that the effect is especially strong for firms that import inputs, and especially commodity inputs. Our results hold after controlling for the proximity penalty due to military spillover risks. The findings also suggest a minor role for trade activity with Ukraine, though the estimates are statistically insignificant. We highlight that investors expect significant distributional consequences

[18]Other countries with significant ownership linkages to Russia (more than 3 percent of listed firms) for which we expect significant aggregate effects are Hungary, Island, the Netherlands, Slovenia, Sweden, and Turkey.

of international dis-integration from Russia between firms and industries within a given country based on their international linkages to Russia and to the region.

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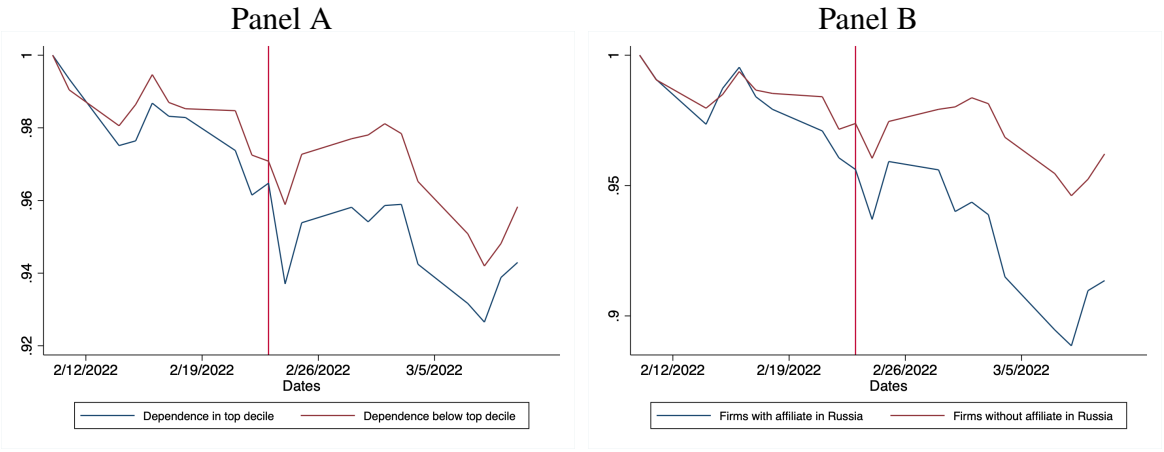
Figure 1: Cumulative Stock Market Returns



Notes: Both panels show the cumulative returns starting on the 10th of February for a four week window. The left panel shows the average return of firms in the top decile of trade dependence on Russia relative to the average return of firms below the top decile. The right panel shows the average return of firms with at least one affiliate in Russia relative to the average return of firms without an affiliate in Russia.

Table 1: Summary Statistics

		Mean	Std. dev.	Min	Max
Dependent variables	Description				
CR(t-14, t+14)	Cumulative return for window of 14 days around the 24th of February, 2022	-0.0451	0.1339	-0.3959	0.4454
CR(t-1, t+7)	Cumulative return for window of 1 day before and 7 days after the 24th of February, 2022	0.0078	0.0838	-0.2344	0.3235
CR(t-7, t+7)	Cumulative return for window of 7 days around the 24th of February, 2022	-0.0159	0.0991	-0.3108	0.3322
CR(t-1, t+14)	Cumulative return for window of 1 day before and 14 days after the 24th of February, 2022	-0.0136	0.1103	-0.2998	0.4231
CR(t-1, t+28)	Cumulative return for window of 1 day before and 28 days after the 24th of February, 2022	0.0191	0.1451	-0.3200	0.5991
CR(t-28, t+28)	Cumulative return for window of 28 days around the 24th of February, 2022	0.0136	0.1825	-0.4313	0.7323
Independent variables	Description				
$\mathbb{1}$(Affiliate in Russia$_i$)	Dummy equal to one, if the firm has an affiliate in Russia	0.0378	0.1907	0	1
$\mathbb{1}$(Affiliate in Ukraine$_i$)	Dummy equal to one, if the firm has an affiliate in Ukraine	0.0137	0.1163	0	1
$\mathbb{1}$(Affiliate in Region$_i$)	Dummy equal to one, if the firm has an affiliate has an affiliate in the region	0.1473	0.3544	0	1
ln(number affiliates$_i$+1)	Log of the number of foreign affiliates	0.8801	1.3107	0	7.1444
Share Affiliates in Russia$_i$	Share of affiliates in Russia as of all foreign affiliates	0.0028	0.0332	0	1
Share Affiliates in Ukraine$_i$	Share of affiliates in Ukraine as of all foreign affiliates	0.00065	0.01621	0	1
$\mathbb{1}$(Action Russia$_i$)	Dummy equal to one, if the firm has announced to reduce its activities in Russia by the 10th of March	0.0033	0.0577	0	1
Trade Dependence on Russia$_{jc}$	Dependence on imports from and exports to Russia scaled by output	0.0025	0.0102	9.52×10^{-7}	0.8123
Dependence on Russian Exports$_{jc}$	Dependence on exports to Russia scaled by output	0.0010	0.0072	0	0.7750
Dependence on Russian Imports$_{jc}$	Dependence on inputs from Russia scaled by output	0.0015	0.0060	9.47×10^{-7}	0.3057
Trade Dependence of core Industry on Russia$_{jc}$	Trade dependence of core industry on Russia scaled by output	0.0027	0.0108	9.52×10^{-7}	0.8123
ln(Distance to Moscow$_i$)	Log of firm-level distance to Moscow	8.7414	0.5457	6.5775	9.6122
ln(total assets$_i$)	Log of firm-level total assets in units of thousand US dollar	5.5728	2.3467	-6.9078	13.3025
ln(market capitalization$_i$)	Log of firm-level market capitalization in units of million US dollar	5.8717	2.0163	2.3037	14.8764
leverage$_i$	Firm-level leverage	0.4668	0.2575	-0.0385	1
$\hat{\alpha}_i$	Firm-level intercept from the CAPM regression	-0.0032	0.0361	-0.9892	1.2919
$\hat{\beta}_{world}$	World market coefficient from the CAPM regression	0.6485	1.7865	-51.3668	45.6722
$\hat{\beta}_{ukraine}$	Russian market coefficient from the CAPM regression	-0.0043	0.7957	-24.9882	28.5771
$\hat{\beta}_{russia}$	Ukrainian market coefficient from the CAPM regression	0.2281	56.0484	-1891.139	2312.418

Notes: The table shows means, standard deviations, minima, and maxima of the dependent and independent variables. The dependent variables are presented in percent.

Table 2: Top 10 industries in the EU by trade dependence on Russia

Industry	Trade Dependence on Russia
Manufacture of coke and refined petroleum products	14.64
Printing and reproduction of recorded media	8.06
Fishing and aquaculture	3.61
Manufacture of motor vehicles, trailers and semi-trailers	3.54
Manufacture of basic metals	3.51
Manufacture of chemicals and chemical products	3.41
Electricity, gas, steam, and air conditioning supply	2.91
Manufacture of other non-metallic mineral products	2.36
Manufacture of machinery and equipment n.e.c.	2.21
Mining of coal and lignite	2.17

Notes: The table shows the average trade dependence on Russia across firms in the EU for the ten industries with the highest dependence.

Table 3: Cumulative returns and international linkages to Russia

Outcome	(1) CR(t-14, t+14)	(2) CR(t-14, t+14)	(3) CR(t-14, t+14)	(4) CR(t-14, t+14)	(5) CR(t-14, t+14)
$\mathbb{1}$(Trade Dependence on Russia in top decile$_{jc}$)	−0.0225***	−0.0225***	−0.0225***	−0.0220***	
	(0.0055)	(0.0056)	(0.0057)	(0.0057)	
$\mathbb{1}$(Affiliate in Russia$_i$)	−0.0238***	−0.0238***	−0.0256***	−0.0258***	−0.0222***
	(0.0065)	(0.0065)	(0.0067)	(0.0066)	(0.0068)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	0.0002	0.0001	−0.0007	−0.0007	0.0002
	(0.0107)	(0.0107)	(0.0107)	(0.0106)	(0.0110)
$\mathbb{1}$(Affiliate in Region$_i$)	−0.0099*	−0.0100*	−0.0130**	−0.0125**	−0.0114**
	(0.0052)	(0.0051)	(0.0054)	(0.0053)	(0.0054)
$\mathbb{1}$(Action Russia$_i$)	0.0033	0.0034	0.0020	0.0017	0.0001
	(0.0121)	(0.0121)	(0.0122)	(0.0119)	(0.0114)
ln(Distance to Moscow$_i$)		−0.0170	−0.0114	−0.0092	−0.0294*
		(0.0185)	(0.0186)	(0.0188)	(0.0163)
ln(total assets$_i$)			0.0080***	0.0079***	0.0087***
			(0.0015)	(0.0015)	(0.0016)
ln(market capitalization$_i$)			−0.0070***	−0.0070***	−0.0075***
			(0.0017)	(0.0017)	(0.0016)
leverage$_i$			−0.0070	−0.0073	−0.0020
			(0.0059)	(0.0058)	(0.0049)
$\hat{\alpha}_i$				0.2147***	0.2125***
				(0.0549)	(0.0523)
$\hat{\beta}_{world}$				−0.0070***	−0.0065***
				(0.0018)	(0.0018)
$\hat{\beta}_{ukraine}$				−0.0101**	−0.0100**
				(0.0047)	(0.0047)
$\hat{\beta}_{russia}$				−0.000077*	−0.000068*
				(0.000044)	(0.000040)
R^2	0.120	0.120	0.125	0.130	0.192
Number of firms	19,774	19,774	19,774	19,774	19,774

Notes: Estimates of equation (2). The outcome variable in all columns is the cumulative return for a time window of four weeks around the Russian invasion into Ukraine. All regressions control for country and industry fixed effects. The regression in columns (4) and (5) includes coefficient estimates for the firm-level coefficients from a CAPM regression for the firm-level intercept, the MSCI World, MSCI Russia and the PFTS in Ukraine. In column (5) we also add country-industry fixed effects. The standard errors are clustered at the industry-level.

Table 4: Cumulative returns and international linkages to Russia - non-linearity

Outcome	(1) CR(t-14, t+14) Linear Dep	(2) CR(t-14, t+14) P50 Dep	(3) CR(t-14, t+14) P75 Dep
Total Dependence on Russia$_{jc}$	−0.2283		
	(0.1622)		
$\mathbb{1}$(Trade Dependence on Russia in top half$_{jc}$)		−0.0036	
		(0.0070)	
$\mathbb{1}$(Trade Dependence on Russia in top quartile$_{jc}$)			−0.0126*
			(0.0066)
$\mathbb{1}$(Affiliate in Russia$_i$)	−0.0265***	−0.0265***	−0.0263***
	(0.0066)	(0.0066)	(0.0066)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	−0.0020	−0.0020	−0.0015
	(0.0105)	(0.0106)	(0.0107)
[1em] $\mathbb{1}$(Affiliate in Region$_i$)	−0.0120**	−0.0119**	−0.0122**
	(0.0052)	(0.0051)	(0.0053)
$\mathbb{1}$(Action Russia$_i$)	0.0016	0.0018	0.0016
	(0.0120)	(0.0121)	(0.0121)
ln(Distance to Moscow$_i$)	−0.0083	−0.0087	−0.0092
	(0.0187)	(0.0183)	(0.0187)
ln(total assets$_i$)	0.0079***	0.0079***	0.0079***
	(0.0015)	(0.0015)	(0.0015)
ln(market capitalization$_i$)	−0.0071***	−0.0071***	−0.0070***
	(0.0017)	(0.0017)	(0.0017)
leverage$_i$	−0.0075	−0.0076	−0.0071
	(0.0058)	(0.0058)	(0.0056)
$\hat{\alpha}_i$	0.2174***	0.2184***	0.2151***
	(0.0546)	(0.0540)	(0.0546)
$\hat{\beta}_{world}$	−0.0071***	−0.0071***	−0.0071***
	(0.0018)	(0.0018)	(0.0018)
$\hat{\beta}_{ukraine}$	−0.0104**	−0.0105**	−0.0102**
	(0.0047)	(0.0047)	(0.0047)
$\hat{\beta}_{russia}$	−0.000076*	−0.000076*	−0.000077*
	(0.000041)	(0.000041)	(0.000041)
R^2	0.128	0.128	0.129
Number of firms	19,774	19,774	19,774

Notes: Estimates of equation (2). The outcome variable in all columns is the cumulative return for a time window of four weeks around the Russian invasion into Ukraine. The three columns show the effect of trade dependence on Russia, trade dependence on Russia in the top half, and in the top quartile on the cumulative return for a window of four weeks. All regressions control for country and industry fixed effects. The standard errors are clustered at the industry-level.

Table 5: Cumulative returns and international linkages to Russia - heterogeneity by affiliate linkages with Russia

Outcome	(1) CR(t-14, t+14)
$\mathbb{1}$(Trade Dependence on Russia in top decile$_{jc}$)	–0.0219** (0.0099)
$\mathbb{1}$(Trade Dependence on Russia in top decile$_{jc}$) $\times$ $\mathbb{1}$(Affiliate in Russia$_i$)	–0.0206** (0.0095)
$\mathbb{1}$(Affiliate in Russia$_i$)	–0.0212*** (0.0062)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	–0.0024 (0.0103)
$\mathbb{1}$(Affiliate in Region$_i$)	–0.0174*** (0.0048)
$\mathbb{1}$(Action Russia$_i$)	0.0042 (0.0133)
ln(Distance to Moscow$_i$)	0.0165*** (0.0035)
ln(total assets$_i$)	0.0093*** (0.0016)
ln(market capitalization$_i$)	–0.0072*** (0.0015)
leverage$_i$	–0.0059 (0.0057)
$\hat{\alpha}_i$	0.1891*** (0.0654)
$\hat{\beta}_{world}$	–0.0071*** (0.0021)
$\hat{\beta}_{ukraine}$	–0.0103 (0.0063)
$\hat{\beta}_{russia}$	–0.000071 (0.000043)
R^2	0.106
Number of firms	19,774

Notes: Estimates of equation (2). The outcome variable in all columns is the cumulative return for a time windows of four weeks around the Russian invasion into Ukraine. The regression in column (1) examines heterogeneity of the trade dependence on Russia by whether the firm owns an affiliate in Russia. All regressions control for country and industry fixed effects. The standard errors are clustered at the industry-level.

Table 6: Cumulative returns and international linkages to Russia - controlling for international exposure

Outcome	(1) CR(t-14, t+14)
$\mathbb{1}$(Trade Dependence on Russia in top decile$_{jc}$)	−0.0228***
	(0.0058)
$\mathbb{1}$(Trade Dependence on other countries in top decile$_{jc}$)	0.0174
	(0.0134)
$\mathbb{1}$(Affiliate in Russia$_i$)	−0.0262***
	(0.0066)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	−0.0011
	(0.0105)
$\mathbb{1}$(Affiliate in Region$_i$)	−0.0123**
	(0.0052)
$\mathbb{1}$(Action Russia$_i$)	0.0015
	(0.0117)
ln(Distance to Moscow$_i$)	−0.0078
	(0.0183)
ln(total assets$_i$)	0.0081***
	(0.0015)
ln(market capitalization$_i$)	−0.0071***
	(0.0016)
leverage$_i$	−0.0066
	(0.0053)
$\hat{\alpha}_i$	0.2147***
	(0.0551)
$\hat{\beta}_{world}$	−0.0070***
	(0.0018)
$\hat{\beta}_{ukraine}$	−0.0100**
	(0.0047)
$\hat{\beta}_{russia}$	−0.00077*
	(0.000040)
R^2	0.130
Number of firms	19,774

Notes: Estimates of equation (2). The outcome variable in all columns is the cumulative return for a time windows of four weeks around the Russian invasion into Ukraine. The regression in column (1) controls for a dummy equal to one if the trade dependence on other countries is in the top decile. All regressions control for country and industry fixed effects. The standard errors are clustered at the industry-level.

Table 7: Cumulative returns and trade dependence - Decomposition by type of flows

Outcome	(1) CR(t-14, t+14)	(2) CR(t-14, t+14)	(3) CR(t-14, t+14)	(4) CR(t-14, t+14)
$\mathbb{1}$(Dependence on Russian Imports in top decile$_{jc}$)	−0.0241**	−0.0243**	−0.0245**	−0.0241**
	(0.0093)	(0.0094)	(0.0095)	(0.0093)
$\mathbb{1}$(Dependence on Russian Exports$_{jc}$ in top decile$_{jc}$)	−0.0029	−0.0027	−0.0014	−0.0009
	(0.0054)	(0.0055)	(0.0056)	(0.0056)
$\mathbb{1}$(Affiliate in Russia$_i$)	−0.0238***	−0.0238***	−0.0257***	−0.0259***
	(0.0065)	(0.0065)	(0.0067)	(0.0065)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	0.0002	0.0001	−0.0008	−0.0008
	(0.0107)	(0.0108)	(0.0107)	(0.0106)
$\mathbb{1}$(Affiliate in Region$_i$)	−0.0096*	−0.0098*	−0.0127**	−0.0123**
	(0.0051)	(0.0050)	(0.0053)	(0.0052)
$\mathbb{1}$(Action Russia$_i$)	0.0026	0.0026	0.0012	0.0009
	(0.0122)	(0.0122)	(0.0123)	(0.0121)
ln(Distance to Moscow$_i$)		−0.0174	−0.0120	−0.0097
		(0.0188)	(0.0189)	(0.0190)
ln(total assets$_i$)			0.0080***	0.0079***
			(0.0015)	(0.0015)
ln(market capitalization$_i$)			−0.0070***	−0.0070***
			(0.0017)	(0.0017)
leverage$_i$			−0.0067	−0.0070
			(0.0056)	(0.0055)
$\hat{\alpha}_i$				0.2134***
				(0.0552)
$\hat{\beta}_{world}$				−0.0070***
				(0.0018)
$\hat{\beta}_{ukraine}$				−0.0103**
				(0.0047)
$\hat{\beta}_{russia}$				−0.000074*
				(0.000040)
R^2	0.120	0.120	0.126	0.130
Number of firms	19,774	19,774	19,774	19,774

Notes: Estimates of equation (2). The outcome variable in all columns is the cumulative return for a time window of four weeks around the Russian invasion into Ukraine. The variables of interest are export and import dependence on Russia. All regressions control for country and industry fixed effects. The regression in column (4) includes coefficient estimates for the firm-level coefficients from a CAPM regression for the firm-level intercept, the MSCI World, MSCI Russia and the PFTS in Ukraine. The standard errors are clustered at the industry-level.

Table 8: Cumulative returns and international linkages to Russia - controlling for commodity exposure

	(1)	(2)
$\mathbb{1}$(Dependence on Russian commodity imports in top decile$_{jc}$)	−0.0296***	−0.0431***
	(0.0112)	(0.0124)
$\mathbb{1}$(Dependence on other Russian imports in top decile$_{jc}$)	−0.0087*	
	(0.0049)	
$\mathbb{1}$(Dependence on other countries commodity imports in top decile$_{jc}$)		0.0366***
		(0.0103)
$\mathbb{1}$(Affiliate in Russia$_i$)	−0.0255***	−0.0253***
	(0.0064)	(0.0064)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	−0.0011	−0.0016
	(0.0107)	(0.0106)
$\mathbb{1}$(Affiliate in Region$_i$)	−0.0122**	−0.0118**
	(0.0052)	(0.0051)
$\mathbb{1}$(Action Russia$_i$)	0.0002	0.0002
	(0.0121)	(0.0120)
ln(Distance to Moscow$_i$)	−0.0115	−0.0137
	(0.0190)	(0.0185)
ln(total assets$_i$)	0.0080***	0.0080***
	(0.0015)	(0.0015)
ln(market capitalization$_i$)	−0.0071***	−0.0070***
	(0.0017)	(0.0016)
leverage$_i$	−0.0067	−0.0063
	(0.0054)	(0.0052)
$\hat{\alpha}_i$	0.2139***	0.2139***
	(0.0548)	(0.0543)
$\hat{\beta}_{world}$	−0.0071***	−0.0070***
	(0.0018)	(0.0018)
$\hat{\beta}_{ukraine}$	−0.0104**	−0.0103**
	(0.0047)	(0.0047)
$\hat{\beta}_{russia}$	−0.000075*	−0.000075*
	(0.000040)	(0.000040)
R^2	0.131	0.132
Number of firms	19,774	19,774

Notes: Estimates of equation (2). The outcome variable in all columns is the cumulative return for a time windows of four weeks around the Russian invasion into Ukraine. The regression in column (1) analyzes trade dependence on Russian commodities and other imports in the top decile. The regression in column (2) examines trade dependence on Russian commodity imports and on other countries' commodity imports in the top decile. All regressions control for country and industry fixed effects. The standard errors are clustered at the industry-level.

Table 9: The aggregate losses across countries

Country	(1) Total Effect through Trade Dependence on Russia	(2) Total Effect through affiliate presence in Russia
Australia	0.08	0.02
Austria	1.52	0.62
Belgium	0.35	0.30
Brazil	0	0.08
Bulgaria	0.47	0
Canada	0.30	0.06
China	0.01	0.08
Croatia	0.13	0.16
Cyprus	1.73	0.28
Czech Republic	1.91	0
Denmark	0.04	1.37
Estonia	1.98	0.72
Finland	1.38	1.22
France	0.93	1.30
Germany	1.19	1.50
Greece	0.24	0.11
Indonesia	0	0
Ireland	0.04	0.96
Italy	1.17	1.63
Japan	0.25	1.12
Latvia	1.97	0.52
Lithuania	1.47	0.01
Luxembourg	2.16	2.50
Poland	1.31	0.37
South Korea	0.44	1.11
Spain	0.28	0.41
Switzerland	1.19	2.31
United Kingdom	0.62	1.60
United States	0	0.81
Mean	0.80	0.73
Median	0.47	0.52

Notes: The Table shows in column (1) the aggregate losses of firms in the top decile in terms of trade dependence on Russia and in column (2) of firms having an affiliate in Russia by country.

6 Online Appendix

MSCI Country Indices We follow the approach by Federle et al. (2023a) to control for the sensitivity of stock prices to events in the world, in Ukraine, and in Russia. We retrieved daily stock observations between March 30, 2021, and March 24,2022, from `investing.com`. We use the PFTS index for Ukraine and the MSCI Russia to capture the sensitivity with respect to the two countries and the MSCI World as proxy for sensitivity with respect to with-respect to the world economy. For each firm we identified a firm specific intercept and three region-specific coefficients using the following regression:

$$ln(R_{i,t}) = \alpha_i + \beta_{world} \times ln(R_{world,t}) + \beta_{ukraine} \times ln(R_{ukraine,t}) + \beta_{russia} \times ln(R_{russia,t}) + \varepsilon_{i,t}, \tag{5}$$

where R_i represents $1 + r_{i,t}$ and correspondingly for the country-level and world-level returns. Following Federle et al. (2023a), we calculate the returns as weekly returns comparing the first trading day of each working week.

Table A.1: Country distribution

Country	Total firms
Australia	1,215
Austria	43
Belgium	100
Brazil	274
Bulgaria	51
Canada	1,359
China	3,793
Croatia	51
Cyprus	28
Czech Republic	10
Denmark	81
Estonia	15
Finland	143
France	475
Germany	376
Greece	97
Indonesia	535
Ireland	8
Italy	289
Japan	3,405
Latvia	7
Lithuania	22
Luxembourg	3
Poland	334
South Korea	1,820
Spain	200
Switzerland	157
United Kingdom	884
United States	4,000
Total	19,974

Notes: The table shows the distribution of firms included in the sample across countries.

Table A.2: Aggregate trade dependence to Russia and Ukraine by country

Country	Trade Dependence on Russia$_c$	Trade Dependence on Ukraine$_c$
Australia	0.12	0.01
Austria	1.38	0.28
Belgium	1.71	0.23
Brazil	0.24	0.01
Bulgaria	4.77	1.37
Canada	0.10	0.01
China	0.76	0.09
Croatia	2.70	0.14
Cyprus	3.05	0.26
Czech Republic	3.33	0.82
Denmark	1.26	0.15
Estonia	9.44	0.92
Finland	5.04	0.12
France	0.55	0.08
Germany	1.37	0.21
Greece	2.03	0.28
Indonesia	0.22	0.10
Ireland	0.51	0.08
Italy	1.25	0.22
Japan	0.39	0.02
Latvia	15.83	1.36
Lithuania	7.42	2.84
Luxembourg	0.34	0.11
Poland	2.92	1.24
South Korea	1.47	0.04
Spain	0.42	0.17
Switzerland	0.92	0.24
United Kingdom	0.60	0.05
United States	0.12	0.01
Average	2.42	0.40

Notes: The table shows the share of export plus imports to Russia and Ukraine as of GDP in 2019 expressed as percentage points. The last row shows the average in the shares across countries. The country-level trade data come from the International Monetary Fund and the GDP data from the World Bank.

Table A.3: Cumulative returns and international linkages to Russia - Alternative measures

Outcome	(1) CR(t-14, t+14) Baseline	(2) CR(t-14, t+14) Core Industry Dep	(3) CR(t-14, t+14) Affiliate Share
$\mathbb{1}$(Trade Dependence on Russia in top decile$_{jc}$)	−0.0220***	−0.0199***	−0.0221***
	(0.0057)	(0.0061)	(0.0057)
Affiliate in Russia$_i$	−0.0258***	−0.0259***	−0.1455***
	(0.0066)	(0.0066)	(0.0348)
Affiliate in Ukraine$_i$	−0.0007	−0.0009	−0.0026
	(0.0106)	(0.0106)	(0.0589)
Affiliate in Region$_i$	−0.0125**	−0.0125**	−0.0234***
	(0.0053)	(0.0053)	(0.0088)
ln(number affiliates$_i$ + 1)			−0.0018
			(0.0011)
$\mathbb{1}$(Action Russia$_i$)	0.0017	0.0022	−0.0148
	(0.0119)	(0.0118)	(0.0111)
ln(Distance to Moscow$_i$)	−0.0092	−0.0091	−0.0087
	(0.0188)	(0.0188)	(0.0188)
ln(total assets$_i$)	0.0079***	0.0079***	0.0078***
	(0.0015)	(0.0015)	(0.0015)
ln(market capitalization$_i$)	−0.0070***	−0.0071***	−0.0076***
	(0.0017)	(0.0017)	(0.0016)
leverage$_i$	−0.0073	−0.0074	−0.0078
	(0.0058)	(0.0058)	(0.0059)
$\hat{\alpha}_i$	0.2147***	0.2150***	0.2164***
	(0.0549)	(0.0550)	(0.0549)
$\hat{\beta}_{world}$	−0.0070***	−0.0070***	−0.0070***
	(0.0018)	(0.0018)	(0.0018)
$\hat{\beta}_{ukraine}$	−0.0101**	−0.0102**	−0.0099**
	(0.0047)	(0.0047)	(0.0047)
$\hat{\beta}_{russia}$	−0.000077*	−0.000079*	−0.000077*
	(0.000044)	(0.000041)	(0.000041)
R^2	0.130	0.129	0.130
Number of firms	19,774	19,774	19,774

Notes: Estimates of equation (2). The outcome variable in all columns is the cumulative return for a time window of four weeks around the Russian invasion into Ukraine. Column (1) presents the results of our preferred baseline specification. Columns (2) and (3) displays estimation results with alternative measures for the main explanatory variables. In column (2) trade dependence to Russia is measured according to the firm's core industry. Column (3) presents estimates where affiliates presence is proxied by the share of affiliates in each region and also includes the log of the number of foreign affiliates of a firm. All regressions control for country and industry fixed effects. The standard errors are clustered at the industry-level.

Table A.4: Cumulative returns and international linkages to Russia - time windows

Outcome	(1) CR(t-1, t+7)	(2) CR(t-7, t+7)	(3) CR(t-1, t+14)	(4) CR(t-1, t+28)	(5) CR(t-28, t+28)
$\mathbb{1}$(Trade Dependence on Russia in top decile$_{jc}$)	−0.0052*	−0.0119***	−0.0100***	−0.0090	−0.0181***
	(0.0027)	(0.0030)	(0.0037)	(0.0064)	(0.0061)
$\mathbb{1}$(Affiliate in Russia$_i$)	−0.0211***	−0.0172***	−0.0276***	−0.0264***	−0.0347***
	(0.0042)	(0.0051)	(0.0053)	(0.0054)	(0.0071)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	−0.0079	−0.0056	−0.0045	−0.0059	0.0002
	(0.0063)	(0.0076)	(0.0080)	(0.0074)	(0.0097)
$\mathbb{1}$(Affiliate in Region$_i$)	−0.0046*	−0.0071**	−0.0109***	−0.0054	−0.0071
	(0.0026)	(0.0032)	(0.0038)	(0.0042)	(0.0064)
$\mathbb{1}$(Action Russia$_i$)	−0.0084	0.0027	−0.0045	0.0025	−0.0072
	(0.0076)	(0.0112)	(0.0098)	(0.0113)	(0.0179)
ln(Distance to Moscow$_i$)	−0.0174**	−0.0280***	−0.0130	−0.0178	−0.0282
	(0.0076)	(0.0098)	(0.0133)	(0.0135)	(0.0198)
ln(total assets$_i$)	−0.0004	0.0028***	0.0030***	0.0033**	0.0145***
	(0.0009)	(0.0010)	(0.0011)	(0.0014)	(0.0020)
ln(market capitalization$_i$)	0.0027**	−0.0016	−0.0013	−0.0012	−0.0097***
	(0.0010)	(0.0010)	(0.0013)	(0.0019)	(0.0024)
leverage$_i$	−0.0030	−0.0031	−0.0110*	−0.0108	−0.0089
	(0.0034)	(0.0036)	(0.0057)	(0.0072)	(0.0071)
$\hat{\alpha}_i$	0.0221	0.1821***	0.0133	−0.0800	−0.1312**
	(0.0497)	(0.0596)	(0.0494)	(0.0881)	(0.0634)
$\hat{\beta}_{world}$	0.0029**	−0.0051***	0.0021	0.0087***	0.0066***
	(0.0012)	(0.0016)	(0.0016)	(0.0019)	(0.0020)
$\hat{\beta}_{ukraine}$	0.0097***	−0.0093**	0.0085*	0.0223***	0.0188***
	(0.0032)	(0.0042)	(0.0044)	(0.0058)	(0.0052)
$\hat{\beta}_{russia}$	−0.000034	−0.000038	−0.000034	−0.000042	−0.0000021
	(0.000041)	(0.000043)	(0.000040)	(0.000072)	(0.000046)
R^2	0.122	0.165	0.127	0.130	0.114
Number of firms	19,774	19,774	19,774	19,774	19,774

Notes: Estimates of equation (2). The outcome variable in columns (1) to (5) is the cumulative return for different time windows increasing in length from column (1) to column (5) around the Russian invasion into Ukraine. All regressions control for country and industry fixed effects. The standard errors are clustered at the industry-level.

Table A.5: Cumulative returns and international linkages to Russia - excluding Asian firms

Outcome	(1) CR(t-14, t+14)
$\mathbb{1}$(Trade Dependence on Russia in top decile$_{jc}$)	–0.0297***
	(0.0071)
$\mathbb{1}$(Affiliate in Russia$_i$)	–0.0340***
	(0.0086)
$\mathbb{1}$(Affiliate in Ukraine$_i$)	–0.0014
	(0.0110)
$\mathbb{1}$(Affiliate in Region$_i$)	–0.0102*
	(0.0059)
$\mathbb{1}$(Action Russia$_i$)	–0.0135
	(0.0156)
ln(Distance to Moscow$_i$)	0.0211
	(0.0211)
ln(total assets$_i$)	0.0094***
	(0.0020)
ln(market capitalization$_i$)	–0.0069***
	(0.0023)
leverage$_i$	–0.0012
	(0.0062)
$\hat{\alpha}_i$	0.1748***
	(0.0618)
$\hat{\beta}_{world}$	–0.0078***
	(0.0021)
$\hat{\beta}_{ukraine}$	–0.0100
	(0.0061)
$\hat{\beta}_{russia}$	–0.000041
	(0.000043)
R^2	0.177
Number of firms	10,219

Notes: Estimates of equation (2). The outcome variable in column (1) is the cumulative return for a time windows of four weeks around the Russian invasion into Ukraine. The regression in column (1) excludes all firms in Asia from the estimation. All regressions control for country and industry fixed effects. The standard errors are clustered at the industry-level.

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