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**Working Paper**

## A note on export redirection: Evidence following the onset of the war in Ukraine

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## 07|2023 A note on export redirection: Evidence following the onset of the war in Ukraine

Christian Hutter, Ignat Stepanok, Enzo Weber



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# A note on export redirection: Evidence following the onset of the war in Ukraine

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Mit der Reihe „IAB-Discussion Paper“ will das Forschungsinstitut der Bundesagentur für Arbeit den Dialog mit der externen Wissenschaft intensivieren. Durch die rasche Verbreitung von Forschungsergebnissen über das Internet soll noch vor Drucklegung Kritik angeregt und Qualität gesichert werden.

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## Abstract

The war in Ukraine triggered a global trade shock, with German exports to Russia also collapsing abruptly. Using this break, we analyse whether the exports were redirected to other destinations. We divide the world market into three regions: domestic, eurozone, and the rest of the world (ROW). In a panel model of German industries, we find that higher export exposure to Russia meant lower sales to the ROW after the war began. This was offset by higher sales in the eurozone and domestic markets. The effects occurred quickly but later receded. We find no production decline due to the trade shock.

## Zusammenfassung

Der Krieg in der Ukraine löste einen weltweiten Handelsschock aus, auch die deutschen Exporte nach Russland brachen abrupt ein. Anhand dieses Bruchs analysieren wir, ob es eine Umlenkung der Exporte gab. Wir gliedern den Weltmarkt in drei Regionen: Inland, Eurozone und restliche Welt. In einem Panelmodell im deutschen verarbeitenden Gewerbe stellen wir fest, dass eine höhere Abhängigkeit von Exporten nach Russland nach Kriegsbeginn zu geringeren Verkäufen in die restliche Welt (inkl. Russland) führte. Dies wurde durch höhere Umsätze in der Eurozone und den Inlandsmärkten ausgeglichen. Die Auswirkungen traten schnell ein, ließen aber später nach. Wir stellen keinen Produktionsrückgang aufgrund des Handelsschocks fest.

## JEL

E23, F14

## Keywords

war in Ukraine, export redirection, trade shock, panel model

## Acknowledgements

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# 1 Introduction

In the workhorse models of international trade it is usually assumed that there is a quick adjustment of production and exports following changes in trade costs or shocks in general. Production capacity in the models expands or contracts at no cost, which implies that both capital investments and labour adjust to the desired level instantaneously. In reality, capital adjustment is the result of a costly planning process and takes time. Keeping production capacity idle is also costly. Expanding or contracting the workforce at the establishment level also takes time and is not frictionless. Fajgelbaum (2020), for instance, builds a trade model where it takes time for firms to adjust their labour force and expand. He finds that labour market frictions are a key factor in the size of gains from trade.

We would therefore expect a sudden and unexpected shock between two countries to affect the trade flows but to have a low effect on the production of the exporting country initially. Reducing production and production capacity abruptly would be too costly. It would be optimal (for firms) to continue producing at the same or a similar capacity potentially to sell at lower prices elsewhere in the short term. We would expect exports to be redirected to the domestic market and to third countries, potentially with a gradual reduction in production over time.

We look at Germany's domestic sales, sales to the eurozone, and sales to the rest of the world (ROW; including Russia) at the sector level. The trade shock created by the war in Ukraine, which started in February 2022, represents a break that affects the sectors differently according to their export exposure to Russia. A number of trade sanctions were introduced. Additionally, many firms left the Russian market voluntarily, not only to avoid reputation effects on other markets but also to avoid the much higher risks in Russia. The event was abrupt and largely unexpected, leading to exports declining by about 52 per cent in March 2022 relative to the previous month and then by a further 19 per cent in April according to the German Federal Statistical Office.

We estimate a negative effect of export exposure to the Russian market (before the war) on sales to the ROW after the beginning of the war. This coincides with a positive effect of this exposure on sales to the eurozone and the domestic market after the beginning of the war. The goods that were likely meant for the Russian market ended up being exported in the eurozone or sold in Germany.<sup>1</sup> We find that this redirection of sales to the eurozone and Germany decreases over time and almost disappears in the fifth month after the war began.

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<sup>1</sup> These were not necessarily the *same* goods – they may have been modified. The point is that production capacities were not reduced abruptly after the start of the war.

The results show that higher export exposure to Russia did not cause declining production in Germany.

Lastauskas/Proskute/Zaldokas (2023) study the adjustment strategies of Lithuanian firms following a Russian import ban on food products in 2014. While they find changes to firm employment and investment, they also see that the firms reduce the effects of the trade shock by expanding to other export markets. The Great Recession and the substantial decrease in international trade, between the second half of 2008 and first half of 2009, was also a relatively abrupt trade shock. The great trade collapse was much more pervasive however and had a very different cause (see Baldwin (2011) and Eaton et al. (2016)).

In the next section we discuss the data and explain our methodology, we then show the results in Section 3 and explore a few robustness checks.

## 2 Data and methodology

We estimate the effects of export exposure to Russia on German sales and production during the war in Ukraine in a sectoral panel model. Our identification strategy borrows from the literature concerned with measuring the effects of minimum wages on employment (see Card (1992) or recent applications in Bauer/Weber (2021) and Caliendo et al. (2018), for example). In our approach, the treatment begins at the start of the war – 24 February 2022. Instead of a binary treatment, we use a bite: differences in export exposure to Russia across sectors. Exposure is defined as the share of exports to Russia with respect to a sector's total sales in 2021 (or a sector's total production when estimating effects on production). Figure 1 shows that the sectors are indeed exposed very differently to the Russian market and to the trade shock.

We use 24 sectors of the manufacturing industry at the 2-digit level. The sample ranges from September 2021 to July 2022 so that the pre-war period is approximately as long as the war period and does not include lockdowns in Germany during the COVID-19 pandemic. The combination of the time and sector dimensions yields 264 observations in our panel setting. All the data for our study was taken from the German Federal Statistical Office website.<sup>2</sup>

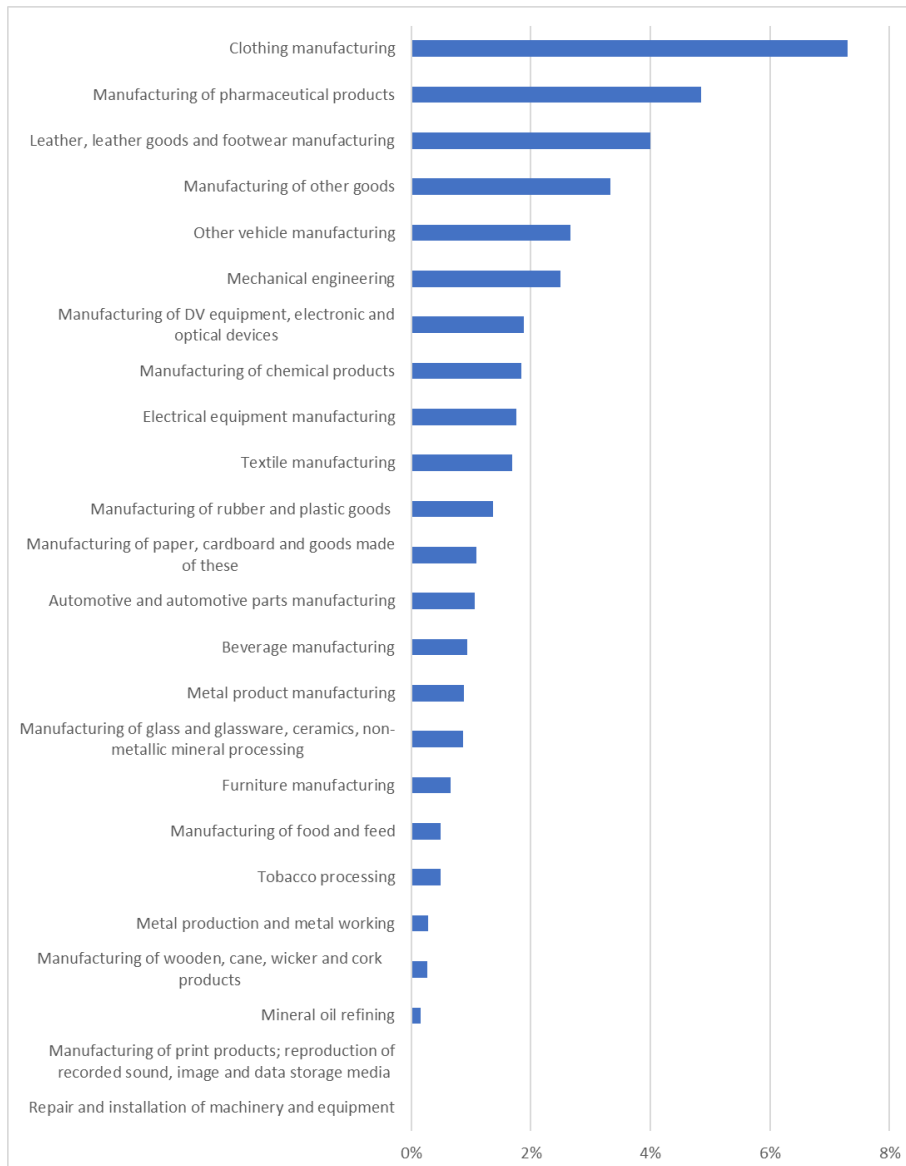
The dependent variables are log differences multiplied by 100, that is, growth rates of production, domestic sales, sales to the eurozone, and sales to the ROW (in per cent). The

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<sup>2</sup> To be precise, we use the data products 42152 – 0005 (sales) and 42153 – 0002 (production) available at <https://www-genesis.destatis.de/genesis/online?operation=sprachwechsel&language=en>.



**Figure 1: Export exposure to Russia**



Notes: Share of exports to Russia with respect to the total sales in 2021 by sector (24 sectors at the 2-digit level). While *repair and installation of machinery and equipment* belongs to the service sector according to the International Standard Industrial Classification (ISIC), according to the German classification of sectors (WZ) it belongs to the manufacturing sector and is hence included in this study.

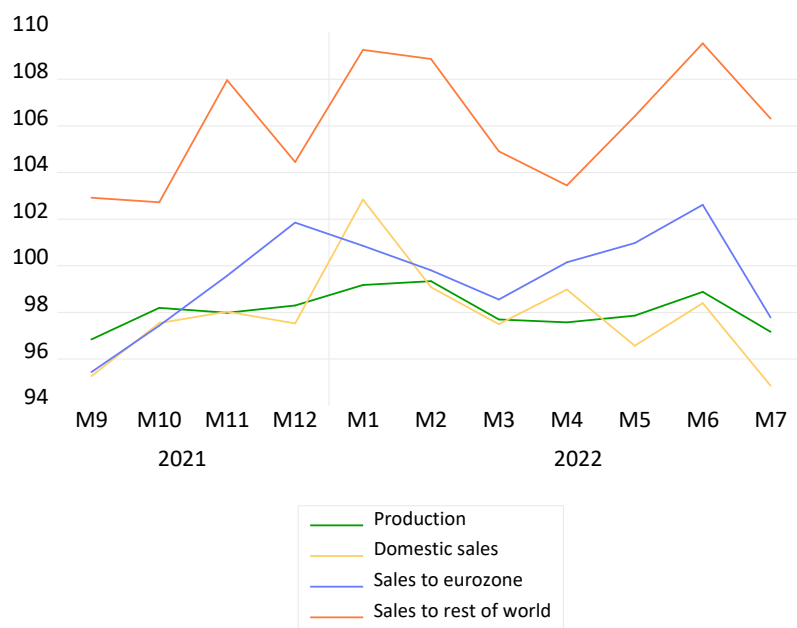
Source: destatis.

three sales variables are mutually exclusive. All dependent variables are seasonally adjusted and in real terms (volume index), the latter of which is crucial because the war and the energy crisis have caused substantial price effects that could spoil our results if not taken into account. Summary statistics and the development during the sample period are shown in Table 1 and Figure 2, respectively. Our goal is to identify the effects of export exposure to Russia behind these macro developments.

**Table 1: Summary statistics**

	pre-war period (September 2021 to January 2022)			
	production	domestic sales	sales to eurozone	sales to rest of world
mean	98.09	98.24	99.03	105.46
std. dev.	13.89	19.28	15.36	23.85
min.	60.30	63.00	61.50	51.30
max.	124.50	214.20	137.00	169.80
	war period (March 2022 to July 2022)			
	production	domestic sales	sales to eurozone	sales to rest of world
mean	97.83	97.26	100.01	106.12
std. dev.	15.29	17.65	15.31	25.19
min.	54.70	57.80	60.00	37.90
max.	131.40	153.00	150.00	171.30

Notes: All variables are in levels, seasonally adjusted and in real terms (volume indices). They are based on 24 sectors at the 2-digit level. std. dev.: standard deviation. min.: minimum value. max.: maximum value. In this table, February 2022 is not included in either sample since this month contains both pre-war and war days. Source: destatis.

**Figure 2: Development of production and sales**

Notes: The lines show the respective averages based on sectoral data (24 sectors at the 2-digit level). The variables are in levels, seasonally adjusted and in real terms (volume indices). Source: destatis.

Due to data availability we cannot single out exports to Russia at a sectoral level.<sup>3</sup> However, when one looks at aggregate nominal trade, exports to Russia decreased abruptly after the beginning of the war while exports to ROW (excluding Russia) increased.

<sup>3</sup> What is available is exports to Russia at the *commodity* level (i.e. commodity groups of foreign trade statistics). However, this data is only given in nominal terms, which is critical in view of the price shocks at the beginning of the war. Furthermore, this cross section unit (commodity groups) is not available for the data on production and domestic sales. Similarly, estimations with supply chain bottlenecks and energy intensity which are conducted below would be infeasible.

The central explanatory variable is given by export exposure interacting with the monthly dummies from March to July (index  $j = 1, 2, \dots, 5$ ) to capture how the effects of the war developed over time.<sup>4</sup> We use sectoral fixed effects to control for general sector differences, while time fixed effects take into account the macro development and specifics of the months. Furthermore, we control for the sectoral share of exports with respect to total sales, interacting again with the war dummies. This isolates the effect of export exposure to Russia, which is correlated with the overall export share across the sectors at +0.42. Controlling for exports as a share of total sales is important because it captures the degree to which a sector is dominated by larger and more productive enterprises (exporters), which likely responded to the shock in a different way. The panel model is shown in the following equation:

$$y_{it} = \alpha + (\beta_j x_i + \gamma_j z_i) \times d_{j,t} + \mu_i + \nu_t + \epsilon_{it}, \quad (1)$$

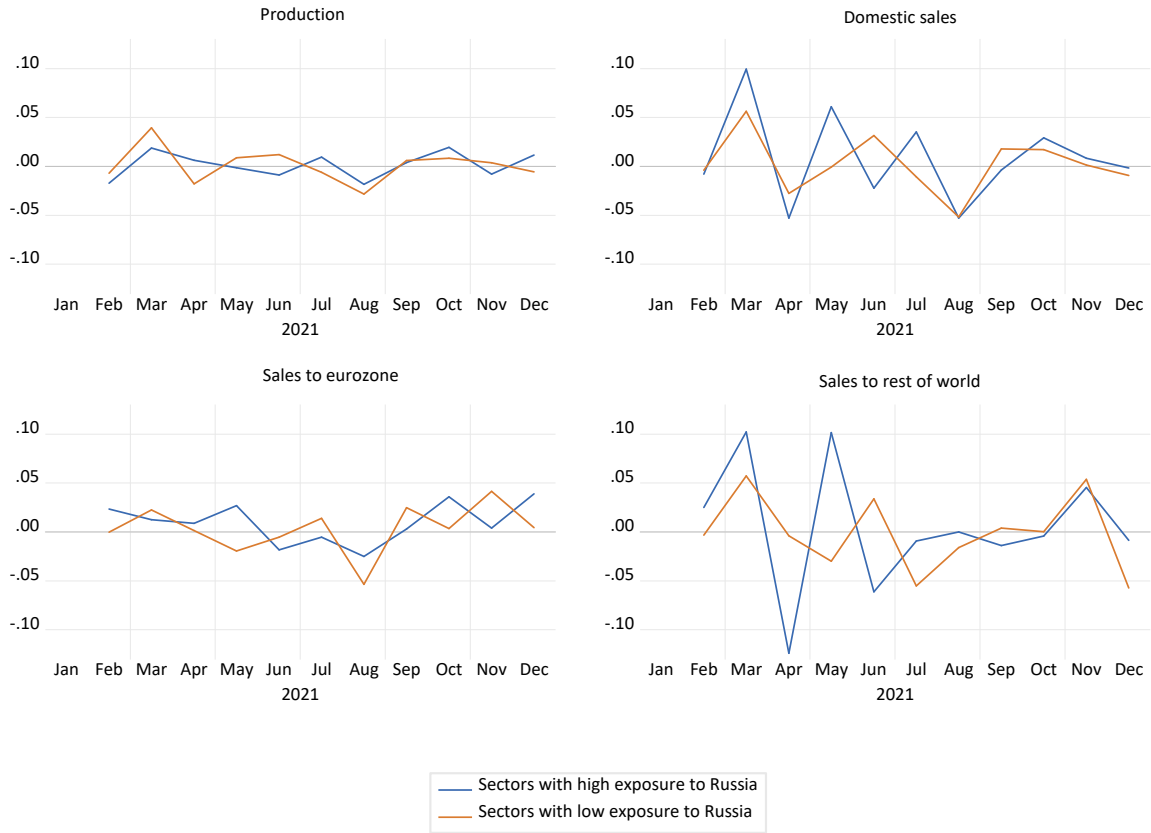
where  $j = 1, \dots, 5$  is an index for the months of March to July during the war,  $\alpha$ ,  $\beta_j$  and  $\gamma_j$  are the coefficients,  $y$  is the outcome,  $x_i$  the treatment variable (export exposure to Russia in sector  $i$ ),  $z_i$  the overall export share of sector  $i$ ,  $d_{j,t}$  the war dummies (March to July),  $\mu_i$  the sector fixed effects,  $\nu_t$  the time fixed effects, and  $\epsilon_{it}$  the error terms. Individual sectors are denoted by  $i$  and months by  $t$ . Note that beyond their interaction terms,  $x_i$ ,  $z_i$  and  $d_{j,t}$  are not included as separate variables because their effects are already absorbed by the sector and time fixed effects.

A wartime effect, given by the  $\beta_j$  coefficients, can be presumed if export exposure has an additional effect on the outcome variable during the war period. In robustness checks, we control for two further channels of potential effects of the war: energy and supply chains. Furthermore, we check whether the results still hold when excluding non-sanctioned sectors.

One crucial assumption of our identification strategy is that the sectors underwent parallel trends independently of the export exposure to Russia. Logically, this cannot be tested for the treatment period due to the lack of counterfactual observations. Thus, Figure 3 shows the pre-war development of the mean of the dependent variables separately for the 12 sectors with the highest exposure to Russia and the 12 sectors with lowest exposure. In general, it displays parallel trends for both groups. While there are occasional outliers – sales to the ROW in the spring of 2021, for example – those outliers tend to cancel each other out over time and do not lead to persistent deviations from the common trend.

<sup>4</sup> As the war began on 24 February 2022, that month contains five post-treatment days. Hence,  $d_1$  in Equation (1) is zero until January,  $\frac{5}{28}$  in February, and 1 in March.

**Figure 3: Pre-war development of sectors with high and low exposure to Russia**



Notes: The lines show the pre-war development of the dependent variables (in growth rates) in 2021 while distinguishing sectors with high and low exposure to Russia.

Sources: destatis, own calculations.

A more formal test for parallel trends that takes into account the full range of variation in the exposure variable<sup>5</sup> is done by modifying Equation (1) as follows:

$$y_{it} = \alpha + \beta x_i + \gamma z_i + \nu_t + \epsilon_{it}. \quad (2)$$

We estimate Equation (2) for different pre-treatment periods, namely September 2021 to January 2022 (the baseline pre-treatment period in this paper) and February 2021 to January 2022 (one full year before the war). To avoid multicollinearity, the war dummy and consequently the sector fixed effect are not included in the regressions. A significant  $\beta$  would mean that the growth rates of production and sales depend on export exposure to Russia and hence signal diverging trends instead of parallel ones. However, as Table 2 shows,  $\beta$  is insignificant in all cases.

<sup>5</sup> See Callaway/Goodman-Bacon/Sant'Anna (2021), for example, for a discussion on the assumptions needed when working with a continuous instead of a binary treatment variable.

**Table 2: Testing for parallel trends**

Sample: September 2021 to January 2022				
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta$	0.011 (0.918)	-0.323 (0.296)	-0.380 (0.603)	-0.110 (0.605)
obs.	120	120	120	120

Sample: February 2021 to January 2022				
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta$	0.059 (0.450)	0.535 (0.296)	0.392 (0.553)	0.323 (0.427)
obs.	288	288	288	288

Notes: Estimated effects following Equation (2); p-values in parentheses. White cross-section (period cluster) standard errors and covariance were used to calculate p-values. obs.: number of observations.  
Source: own calculations.

### 3 Results

Table 3 shows the results for the treatment interaction effects. During the first month of the war, one additional percentage point in export exposure reduces the growth rate of sales to the ROW (including Russia) by 1.2 per cent. In July, the effect is another -1.3 per cent. In contrast, the growth rate of sales to the eurozone increased with export exposure during the first two months of the war (+3.0% and +1.7%, respectively). In the following months, this effect of the war recedes again. Intriguingly, a similar pattern emerges for domestic sales. Compared to sales, production is hardly influenced during the five months of the war.

**Table 3: Estimated treatment interaction effects**

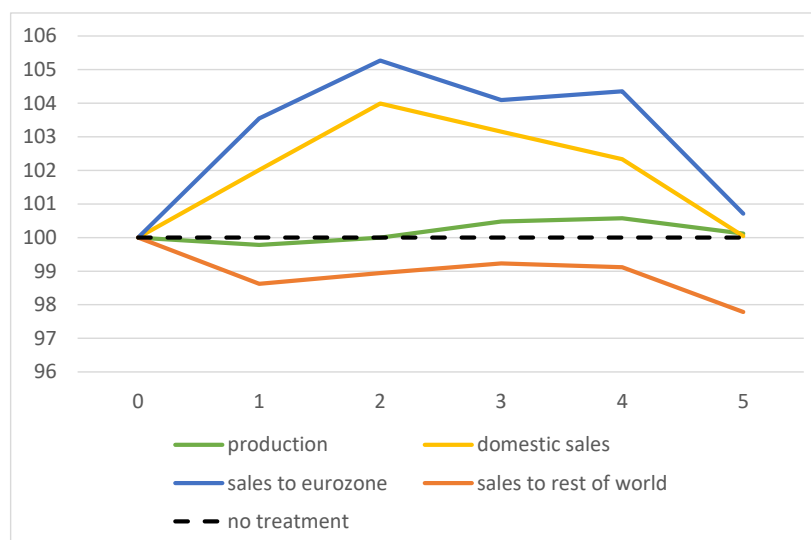
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta_1$	-0.213 (0.116)	1.720 (0.003)	2.917 (0.009)	-1.580 (0.002)
$\beta_2$	0.272 (0.029)	2.026 (0.000)	2.433 (0.011)	0.335 (0.329)
$\beta_3$	0.556 (0.000)	0.257 (0.511)	-1.483 (0.087)	0.877 (0.023)
$\beta_4$	0.115 (0.306)	-1.756 (0.001)	-1.339 (0.117)	0.576 (0.108)
$\beta_5$	-0.454 (0.002)	-0.250 (0.523)	-1.830 (0.041)	-2.457 (0.000)
obs.	253	253	253	253

Notes: Estimated treatment interaction effects following Equation (1). Estimation period: September 2021 to July 2022; p-values in parentheses. White cross-section (period cluster) standard errors and covariance were used to calculate p-values. obs.: number of observations.  
Source: own calculations.

Since the outcome variable is a growth rate, the overall effect on sales is given by calculating the *cumulative* coefficients of the interaction terms during the months of the

war. Figure 4 visualises this cumulative effect. It shows a clear inverse-U shape for domestic sales and sales to the eurozone and negative effects for sales to the ROW, whereas production remains quite unaffected.

**Figure 4: Cumulative effect of dependence on Russia over the first five months of the war**



Notes: Cumulative treatment effects (1 percentage point in export exposure) estimated with Equation (1). Note that the first period covers the last five days of February (plus the whole of March), hence  $\beta_1$  is multiplied by  $(1+5/28)$ . Source: own calculations.

Our results suggest that cancelled sales to Russia were redirected to customers in Germany and the eurozone – during the first months of the war at least. In a sense, German exporters shifted to markets that were known and established.<sup>6</sup> From a theoretical point of view we expect that firms were more likely to redirect goods to the largest and closest alternative markets. Selling closer to home or even at home would be more easy to organise at short notice from a logistical point of view. In this sense, the domestic market and the eurozone are the best alternative options for German firms.

We conduct several robustness checks, taking into account further important issues in addition to trade exposure.

- We control for (sector-specific and time-varying) supply chain bottlenecks. This shortage variable is obtained from a survey by the ifo Institute denoting the share of firms reporting a lack of primary and intermediate products. It is only available for 19 sectors.
- Secondly, we add energy intensity, interacting again with the monthly war dummies to check whether the different exposure to the energy crisis changes our baseline

<sup>6</sup> There is bound to have been some redirection within the ROW as well, meaning that cancelled exports to Russia were exported to the US or China, for instance. However, we cannot observe this based on our data.

treatment interaction effects. Energy intensity is defined as energy usage in 2019 divided by gross output value and obtained from the destatis cost structure statistics.<sup>7</sup>

- Our bite variable is agnostic regarding the question of whether the sectors were actually sanctioned or not. Therefore, we draw on information on commodity trade restrictions affecting German exports to Russia. The data was obtained from the Global Trade Alert website.<sup>8</sup> We find that all sectors were hit by sanctions during the treatment period, except one (*repair and installation of machinery and equipment*). Thus, in a third robustness check, we exclude this non-sanctioned sector from our estimations. This sector is part of the manufacturing industry according to the German classification (WZ) but belongs to the service sector according to the international classification (ISIC). Hence, this robustness check also shows how the results look like if one follows the international classification scheme.
- On a related note, the monthly exports of pharmaceutical products to Russia increased on a year-over-year basis from the onset of the war (except for April 2022) until September 2022 despite the presence of sanctions. This can be seen in nominal commodity-level data. Therefore, in a fourth robustness check, we exclude the pharmaceutical sector from our estimations.
- Finally, we define  $d$  as a conventional dummy, that is, it is 0 until February 2022 and 1 from March 2022.

Table 4 shows that in all robustness checks the main findings of our paper are upheld (quite stable production, negative effects on sales to the ROW, inverted U-shaped pattern of sales to the eurozone and domestic sales). When supply chain bottlenecks are controlled for, the redirection pattern is slightly stronger, whereas controlling for energy intensity tends to yield somewhat smaller effects of the war with regard to exposure to Russia. If the non-sanctioned sector is excluded, the results are also quite stable, as can be seen in Figure 5.

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<sup>7</sup> Data from 2019 is the most recent one available.

<sup>8</sup> See <https://www.globaltradealert.org>.

**Table 4: Robustness checks**

<b>Controlling for supply chain bottlenecks</b>				
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta_1$	-0.224 (0.116)	1.649 (0.005)	3.008 (0.007)	-1.426 (0.016)
$\beta_2$	0.319 (0.018)	2.386 (0.000)	2.517 (0.009)	0.894 (0.051)
$\beta_3$	0.501 (0.001)	0.501 (0.240)	-1.204 (0.159)	-0.218 (0.601)
$\beta_4$	0.093 (0.430)	-1.337 (0.008)	-1.728 (0.057)	-0.423 (0.331)
$\beta_5$	-0.432 (0.003)	-0.034 (0.610)	-1.298 (0.129)	-2.121 (0.000)
obs.	209	209	209	209

<b>Controlling for energy intensity</b>				
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta_1$	-0.228 (0.051)	2.170 (0.002)	3.132 (0.003)	-0.884 (0.154)
$\beta_2$	0.240 (0.023)	1.491 (0.006)	0.961 (0.181)	0.570 (0.259)
$\beta_3$	0.389 (0.002)	-0.876 (0.071)	-1.363 (0.069)	-0.471 (0.346)
$\beta_4$	0.010 (0.912)	-1.060 (0.034)	0.577 (0.409)	-0.680 (0.184)
$\beta_5$	-0.475 (0.000)	-2.450 (0.000)	-3.590 (0.000)	-1.145 (0.037)
obs.	264	264	264	264

<b>Excluding the non-sanctioned sector</b>				
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta_1$	-0.189 (0.115)	1.723 (0.000)	3.215 (0.003)	-0.978 (0.065)
$\beta_2$	0.224 (0.040)	2.000 (0.000)	1.803 (0.028)	0.367 (0.369)
$\beta_3$	0.484 (0.000)	-0.708 (0.013)	-0.874 (0.242)	0.020 (0.961)
$\beta_4$	0.084 (0.398)	-0.718 (0.012)	-0.047 (0.948)	0.191 (0.635)
$\beta_5$	-0.433 (0.001)	-2.166 (0.000)	-2.868 (0.002)	-1.007 (0.027)
obs.	253	253	253	253

<b>Excluding the pharmaceutical sector</b>				
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta_1$	-0.228 (0.051)	2.170 (0.002)	3.132 (0.003)	-0.884 (0.154)
$\beta_2$	0.240 (0.023)	1.491 (0.006)	0.961 (0.181)	0.570 (0.259)
$\beta_3$	0.389 (0.002)	-0.876 (0.071)	-1.363 (0.069)	-0.471 (0.346)
$\beta_4$	0.010 (0.912)	-1.060 (0.034)	0.577 (0.409)	-0.680 (0.184)
$\beta_5$	-0.475 (0.000)	-2.450 (0.000)	-3.590 (0.000)	-1.145 (0.037)
obs.	264	264	264	264

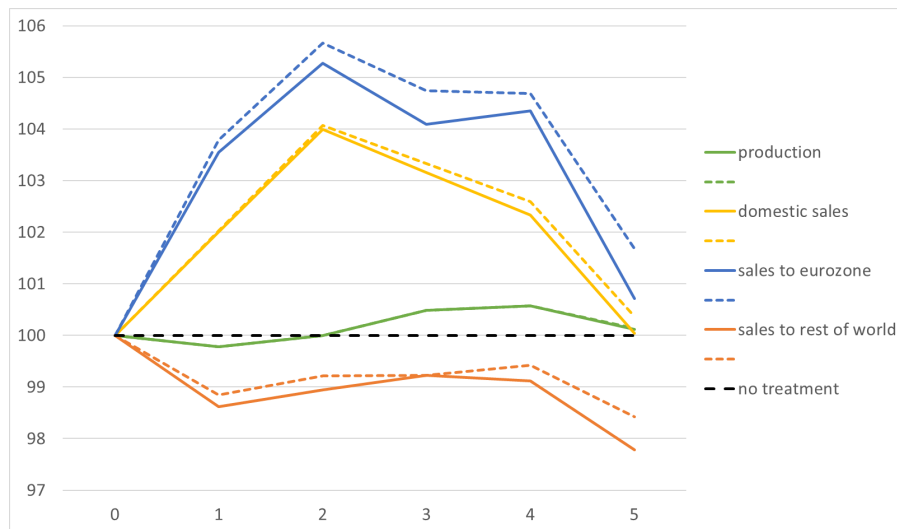
<b>Conventional monthly war dummies</b>				
Dependent variable: Growth of...				
	production	domestic sales	sales to eurozone	sales to rest of world
$\beta_1$	-0.147 (0.138)	1.576 (0.000)	2.514 (0.005)	-1.576 (0.002)
$\beta_2$	0.226 (0.033)	1.879 (0.000)	1.515 (0.057)	0.302 (0.444)
$\beta_3$	0.495 (0.000)	-0.865 (0.006)	-1.265 (0.103)	0.258 (0.513)
$\beta_4$	0.103 (0.283)	-0.856 (0.007)	0.106 (0.884)	-0.142 (0.716)
$\beta_5$	-0.443 (0.001)	-2.299 (0.000)	-3.638 (0.000)	-1.371 (0.005)
obs.	264	264	264	264

Notes: Estimated treatment interaction effects following Equation (1). Estimation period: September 2021 to July 2022; p-values in parentheses. White cross-section (period cluster) standard errors and covariance were used to calculate p-values. obs.: number of observations.

Source: own calculations.



**Figure 5: Cumulative effect when excluding the non-sanctioned sector**



Notes: Cumulative treatment effects (1 percentage point in export exposure) estimated with Equation (1) for all sectors (solid lines) and excluding the non-sanctioned sector (dashed lines). Note that the first period covers the last five days of February (plus the whole of March), hence  $\beta_1$  is multiplied by  $(1+5/28)$ .

Source: own calculations.

## 4 Conclusion

The trade shock created by the war in Ukraine was abrupt and unexpected. We study German sales at the sectoral level and find that the sharp reduction in exports to Russia after the beginning of the war was accompanied by higher sales to the eurozone and domestic markets, implying that exports were redirected. This result is in line with the firm-level evidence presented by Görg/Jacobs/Meuchelböck (2022), namely that 68 per cent of German exports to Russia are made by enterprises for which Russia comprises no more than 10 per cent of their total exports. This implies that the majority of German exporters are well diversified and would find it relatively easy to redirect the goods to other existing markets.

What is more, we do not find that export exposure to Russia led to a reduction in production after the war began. The redirection of exports from Russia to other markets almost disappears until the fifth month after the beginning of the war. It would be interesting for future research to analyse the medium- and long-term effects of the trade shock based on more data.

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