THE UNDOING OF ECONOMIC SANCTIONS:
EVIDENCE FROM THE RUSSIA-UKRAINE CONFLICT

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ABSTRACT

We examine the effects of Ukraine's economic blockade of the anthracite-rich Donbas region, to demonstrate how trade sanctions' efficacy can be undermined by trade through non-participatory nations. We document that after the blockade was imposed in March 2017, Russia reported a sharp increase in anthracite imports from Ukraine, while Ukraine reported no exports to Russia at all. We interpret this gap in "mirror statistics" as reflecting a shift in Donbas trade through Russia. Concurrently, Ukraine anthracite imports from Russia increased sharply (from near-zero), indicating that some of the increased supply of anthracite in Russia was exported back to Ukraine. We provide suggestive evidence that Russian traders benefited from monopsony rents, buying low-priced anthracite from Donbas while Russia sold anthracite to Ukraine at prices comparable to other export markets. Overall, our findings highlight some of the economic and geographic features that may raise the cost and limit the efficacy of sanctions.

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1 Introduction

Economic sanctions aim to exert pressure on a target nation or region to induce policy reforms or regime change. Their efficacy depends on whether the target of sanctions (especially the targeted elite) faces economic pain as a result. This in turn depends on a number of factors. For trade sanctions, how readily can a sanctioned nation substitute away from needed imports? How much do countries that impose sanctions rely on trade with a sanctioned partner? And to what extent may either side rely on entrepôt nations outside the sanctioning blockade to evade trade restrictions?

In this paper we document the undoing of sanctions against the breakaway Donbas region of Ukraine, which presents an unusual opportunity to explore the ways that an economic blockade may be undermined. These distinct features allow us to highlight the challenges in successfully imposing economic sanctions in general. We show that a combination of opportunities for entrepôt trade and economic imperatives led to a de facto reversal of Ukraine's sanctions. We further provide suggestive evidence that the blockade likely allowed Russian businesses to extract monopsony rents from Donbas coal production, while the increased supply of coal resulted in Russia exporting anthracite back to Ukraine, which was forced to buy it because of its power sector's continued reliance on anthracite coal.

The events we study are centered on Donbas, a region in eastern Ukraine that borders Russia. Importantly, Donbas contains virtually all of Ukraine's anthracite coal deposits. In February 2014, following the Maidan Revolution that ousted pro-Russian president Viktor Yanukovych, pro-Russia protests broke out in Donbas. By May, secessionists had seized government buildings and declared independence from Ukraine. The resulting war between Ukraine and the secessionists continued until Russia invaded Ukraine in 2022. Of particular relevance for our paper, following a failed ceasefire attempt in March 2017, the Ukrainian government banned trade with landlocked Donbas.

There are several features of our empirical setting that make it particularly straightforward to document the impact of this economic blockade. Most importantly, since Donbas contains almost all of Ukraine's anthracite deposits, we can attribute any recorded trade in Ukrainian anthracite to the region. Second, since Donbas is surrounded by Ukraine on one side and Russia–which did not support the blockade–on the other, any post-blockade trade in Donbas anthracite had to go through Russia, making it relatively simple to observe trade displacement via Russia, and infer whether Russia's increased anthracite access then led to increased exports to Ukraine and/or the rest of the world. Finally, Ukraine had relied on Donbas anthracite for much of its energy needs– thus, while the blockade cut off Donbas from access to markets in Ukraine and beyond, it also meant that Ukraine could no longer purchase internally the coal that had previously fed its power plants, which had been designed specifically to burn anthracite coal. These features are present to varying degrees in many attempts at economic embargo. Notably, attempts at sanctioning Russia and its elites after its 2022 invasion of Ukraine have been undermined by some of its neighbors, both big and small,

which have facilitated trade into and out of Russia.[1] Similar stories have emerged about earlier efforts at sanctions, for example against Iran,[2] against Venezuela,[3] and South Africa..[4] These other cases share with our current study the emphasis on commodity trade involving harder-to-trace output and inelastic demand, most notably oil in the recent embargo against Russia (Adolfsen et al., 2023).

Our main empirical analyses use UN Comtrade data, which provide monthly bilateral import-export flows at a highly disaggregated level. These data allow us to study trade in anthracite coal from 2010 until the onset of the Russian-Ukraine conflict in early 2022, to explore the blockade's consequences.

We first show that reported Ukraine anthracite exports dropped sharply through the first half of 2014, as secessionists took control of Donbas. During this period, it appears that any production was either used or stockpiled internally by Ukraine. As we show, for the anthracite that was exported from Ukraine, a disproportionate share went to Russia.

More interestingly, when the blockade shut off the direct flow of anthracite from Donbas into Ukraine in 2017, we observe a three-fold increase in Russia's reported imports of Ukrainian anthracite, and a commensurate increase in Russia's reported anthracite exports to Ukraine (which had previously not imported anthracite from Russia) and the rest of the world. Ukraine, by contrast, reported no anthracite exports to Russia at all during this period. The divergence between Ukraine-reported exports to Russia and Russia-reported imports from Ukraine indicates that Donbas anthracite–no longer controlled by Ukraine–was the source of Russian imports.

The timing of Russia's increased imports of anthracite and concurrent Russian exports to Ukraine suggests that Ukraine was purchasing anthracite the increased supply available in Russia as a result of access to Donbas coal. We observe a similar shift in trade with other countries–those that previously imported Ukrainian anthracite increased their imports from Russia post-blockade. Overall our analysis provides evidence that Russia effectively served as an entrepôt for Donbas anthracite, with Russian anthracite exports even ending up in Ukraine, which had initially imposed the blockade.[5]

Finally, we provide suggestive evidence on the parties that extracted economic benefits from this ar-

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[1]See, for example, "Russia Sidesteps Western Punishments, With Help From Friends", *New York Times*, February 1, 2023; "West probes potential sanction dodging as exports to Russia's neighbours surge", *Financial Times*, February 23, 2023.

[2]"China Is Buying the Most Iranian Oil in a Decade, Kpler Says", *Bloomberg*, August 23, 2023; Turkey Allegedly Had Role in Helping Iran Dodge Sanctions, *VOA*, August 15, 2015.

[3]"Russian oil firm shuffles Venezuela assets as sanctions bite", *Reuters*, March 29, 2022.

[4]"South Africa Acts to Bust Sanctions", *Washington Post*, October 9, 1986.

[5]As we discuss in subsection 4.2, we cannot definitively conclude that it was coal originating in Donbas that ended up back in Ukraine. But, given the fungibility of anthracite coal, it makes little difference – regardless, access to Donbas coal increased the supply of anthracite in Russia, much of which was sent to Ukraine and other export markets previously supplied by Ukraine. There is descriptive evidence, however, that it was in fact Donbas coal that was re-exported to Russia that ended up back in Ukraine. Specifically, Donbas coal was bought by traders across the border in Rostov, and this coal was then sent on to ports near Odessa to be used by Ukrainian power plants (after, some accounts suggest, being mixed with Russian anthracite to obscure its origin; see International Crisis Group, 2020).

rangement. In particular, we proxy for Russian monopsony profits by comparing the price at which Ukraine sold anthracite to Russia to a world price benchmark (i.e., were Ukraine's exports to Russia under-priced?) and for Russia's monopoly profits by comparing the price of Russia's exports to Ukraine to the world price (were Russia's exports to Ukraine over-priced?). We find that monopsony profits increased sharply under the embargo, while monopoly profits were flat or declined. We interpret these patterns as suggestive evidence that Russian traders exploited their monopsonist position to profit from trade with blockaded mines, whereas Russian export prices were limited by Ukraine's outside options.

Most directly, our work highlights how economic sanctions can be undermined by displacement and/or illicit trade. Earlier contributions include Hsieh and Moretti (2006), which argues that Iraq under-priced oil exports to extract kickbacks from trading partners and thus evade the constraints imposed by the Oil for Food Program, and DellaVigna and La Ferrara (2010), which documents positive stock market reactions among arms producers in response to worsening conflicts, even in embargoed countries. Two papers, concurrent with our own, also look at entrepôt trade resulting from the imposition of sanctions. Chupilkin, Javorcik, and Plekhanov (2023) shows that, accompanying the steep drop in Russian exports to the European Union as a result of 2022 sanctions, Russian exports to Armenia, Kazakhstan and the Kyrgyz Republic (all part of the Eurasian Customs Union) increased sharply; Chupilkin, Javorcik, Peeva, et al. (2023) shows an impact of these sanctions on currency invoice decisions, with greater use of yuan to avoid the American banking system. We similarly demonstrate the role of third countries in evading sanctions, while also emphasizing the economic consequences for sanctioning entities (via higher prices) and intermediary nations (via economic rents) particularly for goods without ready substitutes.[6]

More generally, we contribute to the economics literature on the determinants and effects of sanctions. This literature includes theoretical work such as Eaton and Engers (1992) which, relevant for our research, shows how the incidence of costs impacts embargo decisions; notable empirical contributions have explored the determinants (rather than the effects) of sanctions based on terrorism financing (Limodio, 2022), and the consequences of sanctions for leaders and citizens in the targeted country (e.g., Marinov, 2005; Daponte and Garfield, 2000).

While these papers detect the *existence* of sanctions evasion, we highlight the geopolitical challenges in implementing sanctions if there is incomplete support for a blockade. In our case, we show how sanctions are circumvented as a result of an ally that serves–to its own financial benefit–as an entrepôt for indirect trade. In this sense, our work links to the literature on transshipment in general (e.g., Ganapati et al., 2024), and, in particular, on transshipment to facilitate illegal or quasi-legal trade flows (Fisman et al., 2008).[7]

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[6]Haidar (2017) also demonstrates export "deflection" in response to sanctions against Iran, with output shifting to non-sanctioning nations. As with Hsieh and Moretti (2006), they find a cost for exporters through lower prices. More recently, Babina et al. (2023) provide descriptive evidence on how Russia redirected oil exports towards new markets following the imposition of oil sanctions by the EU and the G7.

[7]Given our focus on the impact of conflict on trade within Ukraine specifically, our work also connects to Korovkin and Makarin (2023), who study the impact of the war on interfirm trade.

Finally, our results highlight the relevance of the type of product targeted with sanctions. Ukraine's dependence on anthracite and its difficulties in finding new suppliers forced the country to effectively undermine their own blockade, a result that echoes the "backfire effect" found by Amodio et al. (2020) in the imposition of security-related sanctions on the West Bank and the subsequent increase in violence. Our work sheds light on the factors that undermine sanctions' efficacy, which include (a) the presence of a trading partner that does not participate in sanctions, (b) the inelastic supply of the targeted input to the sanctioning country, and (c) the importance of the sanctioned input in the sanctioning entity's economy.

Turning to wider geopolitical implications, our paper suggests the need for broad participation in sanctions in ensuring their effectiveness and for adequate monitoring in implementation. This was a central consideration in the case of Donbas, and is also highly relevant for sanctions against Russian oil and gas–ongoing at the time of writing–that has reportedly been purchased in large part by buyers in China and India.[8]

The paper is organized as follows: Section 2 describes the setting and the blockade Ukraine imposed on Donbas, Section 3 describes the data we use in our analysis, Section 4 provides evidence on the role of Russia in helping Donbas circumvent the blockade and on the consequences of the blockade for Ukraine, and Section 5 concludes.

2 Context: the Donbas Conflict

Donbas is a region in Ukraine which shares economic and cultural ties with Russia (Figure A1). In the mid-eighteenth century, Donbas was part of the Russian empire. By the end of the nineteenth century, almost a third of the population was ethnically Russian. Of central importance for our paper, Donbas contains almost all of Ukraine's anthracite mines, a mineral for which Ukraine is among the major world producers and exporters (Figure A2).

The conflict we study began in February 2014, following the removal of the pro-Russian president, Viktor Yanukovych, and the occupation and subsequent annexation of Crimea by Russia. Pro-Russian protests took place in parts of Ukraine, and in May 2014, Donetsk and Luhansk declared independence from Ukraine and proclaimed themselves the Donbas Republic. As a consequence, the Ukrainian government in Kyiv lost control of the country's anthracite which, as noted above, was situated almost entirely in the Donbas region, in the part held by pro-Russian secessionists.

Conflict erupted between pro-Russian independentist and Ukrainian forces, which continued largely unabated until the Russian invasion of Ukraine in 2022. Returning to the events of 2014, in the months that followed the declaration of independence, representatives of Ukraine, Donbas, Russia and the Organization for Security Co-operation in Europe (OSCE) came to an agreement–the Minsk Protocol–to halt the Donbas

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[8]E.g., Reuters, "India and China snap up Russian oil in April above price cap," `https://www.reuters.com/business/energy/india-china-snap-up-russian-oil-april-above-price-cap-2023-04-18/`.

conflict. The agreement led to a temporary truce in February 2015, but the lull in the conflict was short-lived, and hostilities escalated soon afterward.

In December 2016, Ukrainian veterans blocked railways to Donbas, demanding the freedom of prisoners in the breakaway region and threatening a blockade if their demands were not met. The independentists refused, setting off an unofficial blockade. Ukraine's president initially opposed sanctions, given the potentially high economic cost that would result from an energy shortage that would impact employment and foreign exchange earnings.[9] Furthermore, the government was afraid that the blockade would prevent Europe from imposing further sanctions on Russia.[10] After failed attempts to halt the blockade and faced with mounting popular support for the veteran activists, the government acceded to their demands. In March 2017, the National Security and Defense Council of Ukraine imposed an economic blockade on Donbas: transportation of any rail or road cargo to or from the separatist-occupied regions was shut off (Kostanyan and Remizov, 2017). In response, Donbas separatist forces took over major companies in their region. Most of the affected enterprises were anthracite processors, coal mines, and energy companies that were of strategic importance for the region and were especially important for local employment.

The sanctions had two government-stated objectives: political and economic. Politically, the sanctions sought to pressure compliance with the Minsk II agreement to a ceasefire and the withdrawal of heavy weapons. Economically, it aimed to end what was termed the "bloody trade" between Ukraine and the occupied territories.[11]

Ukraine had hoped to find other sources of anthracite to avoid importing it from Russia. In February 2017, Ukraine's Minister of Energy and Coalmines stated on national television: "I am confident consideration of electric power imports from Russia are out of place because we won't be importing it. Instead, we'll be doing everything in our power to give it up altogether."[12]

But many of Ukraine's power plants could burn only anthracite coal.[13] As a result, the loss of access to Donbas anthracite forced western Ukraine to import anthracite to avoid power outages. In the short-run, it was hoped that some of this need was could be filled by imports from South Africa and the conversion of generating capacity to use other forms of coal. However, South African imports were costly, and power plant conversion required high upfront investments and would take at least 1.5 years. Thus, neither solution was

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[9]Kyiv Post, "Musk says he can help Ukraine tackle energy crisis, Groysman promises to mull deal," https://www.kyivpost.com/technology/musk-can-build-energy-storage-ukraine-groysman-promises-think.html

[10]Ukrinform, "Yeliseyev: Blockade of ORDLO prevents EU from imposing new sanctions on Russia," https://www.ukrinform.net/rubric-economy/2191887-yeliseyev-blockade-of-ordlo-prevents-eu-from-imposing-new-sanctions-on-russia.html

[11]BBC News, "Ukraine conflict: Kiev's economic blockade of rebel-held east," https://www.bbc.com/news/world-europe-39113585

[12]As stated on the Ukrainian news channel ICTV, and subsequently reported by Russia's state news agency, Tass News: "Minister says Ukraine will not import electric power from Russia," https://tass.com/world/930690.

[13]Financial Times, "Rail blockade by Ukraine patriots creates headache for Kiev," https://www.ft.com/content/9fac31cc-0266-11e7-ace0-1ce02ef0def9

viable in the short-run (Voytyuk, 2019).[14] By the end of 2017, the surging costs of imports and the growing risk of an energy crisis pushed the Ukrainian Ministry of Economy to rely more on Russia, lifting sanctions it had initially imposed against Russian anthracite suppliers.[15] Russia's close proximity meant anthracite could be imported at a lower cost than other options.[16] During this period, Russia may have rebranded Donbas-mined coal and sold it to other consumers, including Ukraine, a claim that we will investigate more rigorously in our analysis.[17]

We conclude this section by emphasizing the features of the Ukrainian context that may have made it difficult to set up an effective blockade. First, Ukrainian demand for anthracite coal was inelastic in the short-run, with no realistic alternative sources of coal available. Further, Donbas had a political ally – Russia – as an immediate neighbor, which allowed Donbas to use transshipment to circumvent the blockade. Both features – lack of alternative sources and absence of unified global participation in sanctions – are likely present to some degree in any boycott, and thus emphasize the need to consider both economic and political conditions in assessing the difficulties in imposing sanctions.

We also observe, as context, that trade with Donbas was only illegal for Ukrainian entities. While trade with other countries was not banned directly, there was nonetheless broader support among European nations to isolate Donbas separatists.[18] This support was bolstered by concerns that, given the nationalization of Donbas mines, trade in its anthracite was legally ambiguous, as it could be labeled as stolen. Additionally, much of the trade was executed by companies linked to Serhiy Kurchenko, who was on U.S. and EU sanction lists[19] (OFAC E.O. 13660; UE Implementing Regulation 2018/326). For these various reasons, most nations avoided any trade in Donbas anthracite, which effectively extended the blockade to a much wider set of trading partners. An exception was Russia, which openly reported imports from Donbas; we will utilize this openness in our analysis below.

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[14]The situation of Ukraine, therefore, differs from the energy crisis the European Union encountered following the 2022 Russian invasion of Ukraine. The European Union could rely on partnerships with other states and exploit its market and political power to find sources of imports, implement a plan to reduce gas demand, and had funds to invest in the infrastructure required to ensure that member states could receive energy from at least two different origins.

[15]See Tass, "Kiev lifts sanctions from Russian coal supplier," `https://tass.com/economy/985214`

[16]See, e.g., "Ukraine Survives Without Coal From Russia-Controlled Donbas," *Eurasia Daily Monitor*, 14(67).

[17]Washington Post, "Dirty Fuel," `https://www.washingtonpost.com/national-security/2020/06/12/dirty-fuel-ukrainian-separatists-sell-pilfered-coal-keep-war-economy-rolling/?arc404=true`"

[18]As reported in the Central European University Podcast "Funding Russian Separatists in Ukraine: Smuggling coal into the EU," `https://podcasts.ceu.edu/content/funding-russian-separatists-ukraine-smuggling-coal-eu`

[19]See, e.g., the report "Black Earth," from the data analytics NGO C4ADS, `https://c4ads.org/commentary/2020-5-26-black-earth/`

3   Data

We use official statistics from the United Nations' Comtrade database to track trade in anthracite and other minerals. The United Nations Statistical Division collects comprehensive information on bilateral trade, including values and quantities of products and services exchanged for almost 200 countries. Comtrade provides monthly data at the 6-digit Harmonized System (HS) level. This allows us to identify, to a high level of specificity, trade in anthracite coal (HS code 270111, distinct from non-anthracite coal, HS 270112 and HS 270119) at high frequency.

While the data on export and import values have fewer missing values than that of quantities, we focus on the latter in our main analysis, to remove the effects of price movements that may themselves be caused by the conflict. When quantity values are missing, we make the following imputation: we calculate the median world price of anthracite as the ratio between the values and the quantities reported for anthracite trade overall, and recover the amount traded for the missing country by dividing the reported value for the calculated median world price. Our results, however, do not rely on this imputation and remain unchanged when restricting the sample to non-missing values.[20]

Russia does not report any trade in anthracite before 2013. We therefore set 2013 as the starting period. We implement a difference-in-differences methodology, comparing exports of Ukrainian anthracite to Russia against trade flows of Ukrainian anthracite to other countries. Our assumption is that, had no blockade occurred, anthracite export flows to Russia would have followed the same trend as exports of anthracite to other countries.[21] Given that Donbas declared independence in May 2014, and UN Comtrade provides data at a monthly frequency, we inspect the hypothesis of no pre-trends visually for the 16 months prior to Donbas's declaration of independence.

When Ukraine lost control of Donbas's anthracite mines in May 2014, it stopped reporting any anthracite exports. We therefore rely on other countries' imports of anthracite from Ukraine – primarily Russia – to proxy for Ukraine's export figures. We infer exports from Donbas to Russia based on these data.

4   Evidence on the effects of sanctions

We present three sets of results. First, we show that Russia reported a steadily increasing level of imports from Ukraine following the onset of hostilities, and a corresponding increase in exports once the blockade was imposed in March 2017. We take these patterns as evidence of Russia's role as an entrepôt for Donbas anthracite. We next document that much of Russia's increased exports go to Ukraine itself, indicating that

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[20]We do not generally fill in missing information on import and export values with zeros, since our reading of the data is that this would not be appropriate. For example, China reports exports of anthracite only prior to 2013 and again in 2016, but not in the intervening years. Similarly, Belarus does not report exports between 2013 and 2015. Imputing zeros in such cases would likely introduce bias.

[21]In additional analyses below (Appendix F), we further implement a triple-difference analysis to compare anthracite to trade in other minerals.

(a) Anthracite imports from Ukraine   (b) Exports of anthracite by country of origin
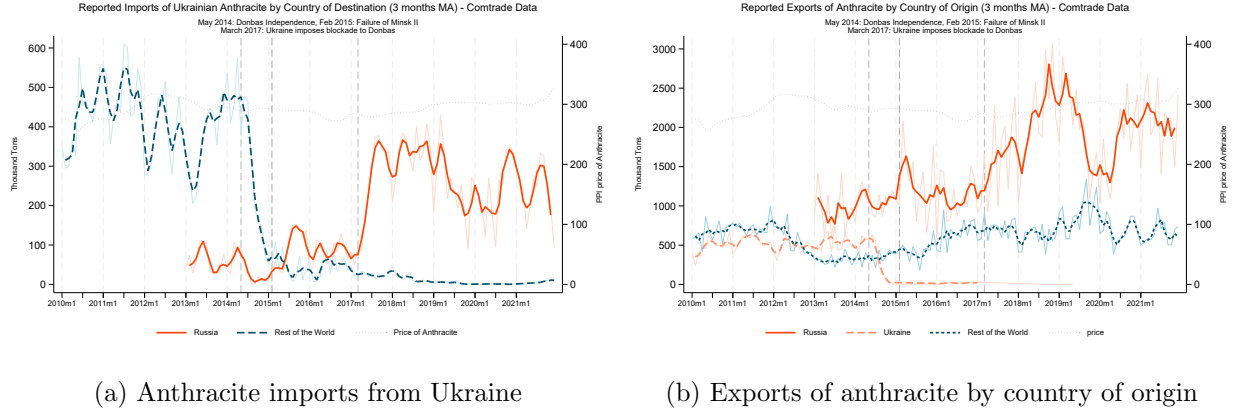
Figure 1: (a) Imports of anthracite from Ukraine: Russia versus other countries; (b) Exports of anthracite by country of origin: Russia, Ukraine and other countries.

economic imperative dictated that Ukraine buy anthracite from Russia's supply that expanded as a result of Ukraine's own blockade. Finally, we examine how the price at which Russia imported Ukraine's anthracite and the price at which Ukraine imported Russia's anthracite compared to the mean world price; we argue that this last set of results provide suggestive evidence on the economic beneficiaries of sanctions.

4.1 Evidence on Russian anthracite reexports

In this subsection, we compare anthracite trade flows from Ukraine and from Russia to provide evidence of the role of Russia as an entrepôt.

We begin with graphical evidence using the raw data in Figure 1. The left panel plots imports of Ukrainian anthracite as reported by Russia versus imports as reported by the rest of the world. We observe a sudden drop in reported imports of Ukrainian anthracite by the rest of the world, starting in early 2014 with the onset of hostilities. Russia reports a modest rise in 2014, and then a sharp increase – as much as nearly 300 percent –that coincides with the 2017 blockade.[22]

Importantly, if Ukraine did export anthracite from pre-existing stockpiles after losing access to Donbas, this would bias our results against finding a treatment effect. Such exports would artificially inflate "exports from Ukraine" in the post-blockade period, making it harder ——not easier– to detect the re-routing of Donbas coal through Russia.

We may compare these patterns describing imports *from* Ukraine to exports reported by Ukraine, Russia, and the rest of the world, which we present in the right panel of Figure 1. The first noteworthy fact is that, while we saw in the left panel that Russia reports substantial imports from Ukraine, particularly after

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[22]It may seem puzzling that other countries continue to report imports from Ukraine even after Ukraine itself reports no exports. We believe this is best explained by stockpile effects (i.e., anthracite shipped before the blockade but only later recorded by partner countries) and small residual trade flows. Note, though, that Russian imports post-blockade are orders of magnitude larger than any other country – the second-highest reporter of imports was Bulgaria, with imports 50 times less than that of Russia.

2014-2017, Ukraine reports near-zero anthracite exports by 2015. The discrepancy, we assert, plausibly corresponds to anthracite that is exported to Russia from Donbas–by 2017, Ukraine's eastern border was no longer monitored by Ukrainian officials, so that trade through it was not reported by Ukraine in the Comtrade data. Interestingly, Russian anthracite exports–also seen in the right panel–increase substantially at roughly the same time that Russia reports higher imports from Ukraine. The rest of the world also reports marginally higher exports between 2014 and 2017, a point we return to shortly.

In Appendix Figure B1, we show that these patterns are unique to anthracite, rather than reflecting a general response of trade in the region to the emerging Donbas conflict.

We conclude this section by showing that the changes in anthracite trade documented above involve statistically significant shifts after the onset of conflict, relative to trade with other countries, and relative to trade in other minerals.[23]

In our main results, we use a standard difference-in-differences framework, based on the following specification:

$$log(1 + Imports_{jt}) = \sum_{t \geq 2013q1, \neq 2014q1}^{t \leq 2019q4} \beta_t \times Q_t \times Russia_j + Q_t + \eta_j + \gamma log(Pop_{jt}) + \delta log(GDP_{jt}) + \epsilon_{jt} \quad (1)$$

where $log(1 + Imports_{jt})$ is the logarithm of (one plus) the quarterly average of anthracite imports from Ukraine in quarter t by country j.[24] We use a two-way fixed-effects model that includes indicators for each quarter (Q_t) and for each importing country (η_j). Finally, we include (time-varying) controls for population and income that are standard in trade models ($log(Pop_{jt})$ and $log(GDP_{jt})$; see Anderson, 2011). Our main interest is in how imports reported by Russia evolve relative to other countries, as captured by an indicator for Russian imports, $Russia_j$, interacted with time dummies, Q_t. The coefficients on these terms, β_t, capture the difference between Russian imports of Ukrainian anthracite versus other countries' imports of Ukrainian anthracite over time. We take Donbas's declaration of independence in Q2, 2014 as a reference period.

We use a similar framework to evaluate how Russian anthracite exports changed after the onset of

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[23]In theory, the parallel trends assumption for this analysis could be challenged by broader political tensions between Ukraine and Russia following 2014, that may have led to a general decline in Russian imports from Ukraine. However, we believe this concern is less problematic in our specific context. Most importantly, the difference-in-differences design we employ here compares anthracite exports to Russia with anthracite exports to other countries. The identifying assumption therefore relates specifically to anthracite, not to trade patterns more generally. Since there was virtually no anthracite trade between Ukraine and Russia prior to 2014, using other commodities as a control group would raise more serious concerns about broader sanctions and political dynamics, but our design avoids this by focusing on a single commodity; in fact the concern raised would be more relevant to a specification comparing anthracite with other Ukrainian exports to Russia. Below, we explore how trade in iron – another major Ukraine export, but not one for which extraction was centered in Donbas – evolved around the sanction dates, and find that the patterns we document here are quite specific to anthracite.

[24]We use the $log(1 + X)$ transformation as a simple and transparent way of dealing with zero trade values. In Appendix Figures Figure K1 and Figure K2 we present results using both the inverse hyperbolic sine (IHS) and Poisson pseudo-maximum likelihood (PPML) approaches, as two alternative approaches for dealing with zeros, and both yield very similar results to those that appear in our main analysis below.

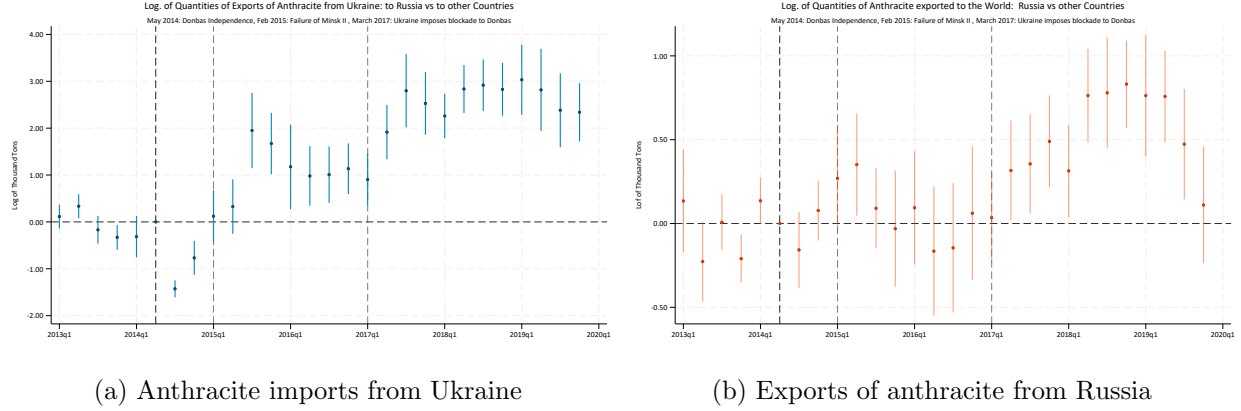(a) Anthracite imports from Ukraine   (b) Exports of anthracite from Russia

Figure 2: Event study evidence on imports of anthracite from Ukraine (to Russia versus to other countries) and exports of anthracite (from Russia versus from other countries).

conflict, as compared to anthracite exports from other countries. In this case, $Russia_j$ indicates that Russia is the export source, and η_j is a set of fixed effects for exports' country of origin. We exclude exports from Ukraine in this case, to avoid overestimating the effect.[25]

Figure 2 presents results from both analyses via event plots which show the interaction term coefficients from Equation (1). In Figure 2a, the point estimates capture the differential shift in Russia's reported imports of anthracite relative to other Ukrainian anthracite importers. As expected given the patterns in the raw data, there is an increase following independence in 2014, and a further sustained increase following the blockade in 2017. For Russian anthracite exports (benchmarked against exporters other than Ukraine), we observe a significant relative increase only after 2017, coinciding with the blockade.

The implied magnitudes in both cases are very large. The point estimates imply as much as a three-fold relative increase in imports reported by Russia after the blockade's imposition.[26] For Russian exports relative to other anthracite exporters, the implied increase is 50-75% (Figure 2b). Given the baseline rate of Russian anthracite imports of 75,000-100,000 tons, and the baseline rate of Russian anthracite exports of 1 million tons, the overall implied changes are 250,000-300,000 and 750,000-900,000 tons respectively. We do not expect these figures to coincide precisely: before the conflict, Ukraine was a net exporter of anthracite, and the gap between the two – approximately 500,000 tons–is similar to the decline in Ukraine's anthracite exports that coincided with the Donbas conflict, as observed in Figure 1.

Finally, to ensure that we are not picking up general shifts in trade from the conflict, we exploit our full commodity- and country-level dataset to conduct a triple-difference analysis: comparing trade flows in anthracite to and from Russia to trade flows in other commodities to and from other countries. These

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[25]Ukrainian exports would enter our control group and, given the lack of reporting from Ukraine over this period as shown in Figure 1b, they would show an artificial decline.

[26]The $log(1 + X)$ transformation we use to accommodate zeros complicates this interpretation slightly. However, since few (non-zero) values are close to zero, the elasticity interpretation is roughly correct, as may readily be seen from the patterns in the raw data Figure 1.

analyses, presented in Appendix F, align with the results of our difference-in-difference analyses presented above.

There are missing data for some country-pairs in some months. It is difficult to assess with certainty whether non-reported months are zeros or unreported positive amounts. To address this potential concern we adopt two approaches: i) we interpolate the data to impute missing values; ii) we restrict the sample to countries that had no missing values for at least six pre-blockade quarters and impute zeros for missing values. Finally, on these two samples, we run both two-way fixed-effects and also a Poisson estimation to deal with zeroes. In Appendix G, Figure G1 and Figure G2 show estimates on the interpolated sample, while Figure G3 and Figure G4 show results for the subsample selected on non-missing values pre-blockade. The graphs show patterns that are very similar to the main estimates reported in Figure 2.

In summary, the blockade led to increased Russian anthracite imports from Ukraine and increased Russian exports. We now explore in greater detail the destinations of Russian exports and the prices at which trade occurred, to better understand who bore the cost of sanctions.

4.2 The blockade's undoing

As noted earlier, Ukraine's economy is heavily coal-dependent and many of its power plants were designed to burn anthracite specifically. In 2013, coal supplied approximately 40% of the country's energy needs (Appendix Figure C1). While this figure subsequently declined by several percentage points, coal remained by far its most important energy source (Kostanyan and Remizov, 2017).

Until 2013, most of Ukraine's coal was sourced from domestic production. For example, in 2013 the country reported coal production and consumption of 71 and 78.6 million tons respectively; by 2016 consumption had fallen to approximately 60 million tons, but domestic output, in large part because of the loss of Donbas production, dropped below 39 million, requiring a substantial increase in imports.[27]

Initially, the consumption-production gap was partially filled by South African coal, reflected in a short-term increase in Ukraine's reported imports (Appendix Figure D1). However, these efforts proved short-lived due to contracting difficulties, high prices, and insufficient port capacity. So, as is already apparent in Figure 3, Ukraine began importing large quantities of Russian-sourced anthracite, which could be delivered to ports near Odessa at relatively low cost.[28]

Given the fungibility of coal as a commodity, whether the coal imported by Ukraine from Russia originated in Donbas or was sourced from Russian mines is of limited economic relevance. Access to Donbas anthracite increased Russia's supply, and much of it ended back in Ukraine (and also former export markets for Ukraine). In either case, our results show that (a) Russia imported anthracite from Donbas, thus par-

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[27]Reduced consumption required significant limits on electricity use, and there was limited flexibility to manage the shortfall further on the demand side.

[28]Appendix Figure E1 shows that there was no comparable increase in imports of other commodities from Russia.
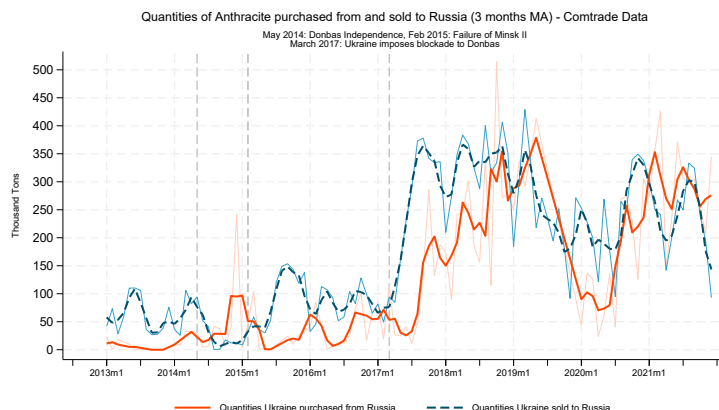
Figure 3: Ukrainian re-imports of anthracite from Russia.

tially relieving the economic pressure the blockade had imposed on the breakaway region; and (b) Ukraine remained reliant on "local" anthracite after the blockade and was unable to fully substitute away from it (e.g., by importing South African coal or switching energy sources).

While it is theoretically possible to discern the source of anthracite through chemical testing, little was done to determine the origin of Russia's exports.[29] Still, there are reasons to believe that Donbas was the most likely origin of Ukraine's imports from Russia. First, nearby anthracite sources within Russia had largely been depleted, and most of Russia's operating anthracite mines were located in Siberia, at the opposite side of the country. Second, according to investigative journalists who accessed records from Russia's Federal Custom Service, Rostov, a Russian city bordering Ukraine, had become a major importer of anthracite from the occupied territories as well as the main exporter of anthracite to Ukraine.[30] In fact, in the immediate aftermath of the blockade, the ports of Rostov-on-Don and Azov experienced an increase in exports of high-grade coal by 50 and 100% respectively.[31]

4.3   Resulting economic consequences and division of rents

Our final set of results provides suggestive evidence on the beneficiaries from the routing of trade from Donbas to western Ukraine via Russia.

There were several factors that potentially allowed Russian businesses to earn economic rents as a result of sanctions. First, the blockade gave Russia monopsony power in purchasing anthracite given the lack of

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[29]Washington Post, "Dirty Fuel," `https://www.washingtonpost.com/national-security/2020/06/12/dirty-fuel-ukrainian-separatists-sell-pilfered-coal-keep-war-economy-rolling/?arc404=true`"

[30]UA-Energy, "Coal from Russia: is it imported or smuggled from occupied territories?," `https://ua-energy.org/en/posts/02-10-2017-f609397a-ee51-45e3-9d42-9315f0566762`

[31]As reported in the Kennan Institute's blog post, "Cut Off: What Does the Economic Blockade of the Separatist Territories Mean for Ukraine?" `https://www.wilsoncenter.org/blog-post/cut-what-does-the-economic-blockade-the-separatist-territories-mean-for-ukraine`

other export options for Donbas coal. Also related to monopsony rents, the Russian government and its proxies exerted de facto control over anthracite production in Donbas by the time sanctions were imposed, with coal mines reportedly owned by the same traders who were given control over importing Donbas coal into Russia (Milakovsky, 2020).[32] On the demand side, Ukraine's demand for Russian delivery of anthracite may have been inelastic, i.e., Russia may have had a near-monopoly in selling to Ukraine.

A natural approach to examining supply -versus demand- side factors is to compare prices paid for Russian anthracite imports from Donbas and those paid by Ukraine to import anthracite from Russian to a world benchmark price. Intuitively, to the extent that Donbas anthracite was sold to Russia at prices below the world benchmark, it captures monopsony rents extracted by Russia (reflecting a combination of internal pricing mechanisms and monopsony power). The quantity purchased by Russia times the price gap between the benchmark and Russian purchase prices thus measures monopsony rents. Similarly, to the extent that the price Ukraine paid Russia was higher than the benchmark price, it captures monopoly rents, reflecting, for example, the fact that Ukraine could not easily source anthracite from other exporters (as evidenced by their failure to contract for delivery from South Africa). The quantity sold by Russia times the price gap between the Russian sale price and the benchmark price gives a measure of monopoly rents.

We begin by defining a world (benchmark) price of anthracite as follows:

$$Price_{world,t} = \sum_i w_{it} \frac{value_{it}}{quant_{it}} \tag{2}$$

where $value_{it}$ and $quant_{it}$ are the value and quantity of anthracite that country i reported as exports to the world at time t, and w_{it} is i's share of global exports at t.[33]

We first provide a simple comparison of the constructed world price with prices of Russian imports from Ukraine and Russian exports to Ukraine. Figure 4 plots the Russian purchase price (paid to Donbas) in the left panel and Russian sale price (the price of anthracite exports to Ukraine) in the right panel. In both cases we include as reference the world anthracite price as constructed above.[34] We observe that over our sample period (including pre-conflict dates), Russia paid less for anthracite from Ukraine than the world price, but

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[32]In April 2017, the self-proclaimed Donetsk People's Republic appointed Vneshtorgservis as the "temporary administrator" of enterprises seized by separatist forces in the Donbas region. Vneshtorgservis, a holding company registered in South Ossetia, was headed by a former deputy governor of Russia's Irkutsk region and was reportedly controlled by Serhiy Kurchenko, a fugitive Ukrainian oligarch with close ties to Russian interests. In 2018, Gaz Alyans – Kurchenko's company– was granted exclusive rights to export coal from Donbas to Russia (Milakovsky, 2020), thereby strengthening Russia's role as the sole purchaser and underscoring its monopsonistic power over the region's coal trade.

[33]We considered other options—most notably the Rotterdam price—but found that individual time series exhibited substantial idiosyncratic fluctuations. These fluctuations obscured the changes in value that should be attributed to price and quantity shifts caused by the Donbas conflict and resulting sanctions.

[34]In Appendix Figure J1, we show the figure excluding trade that originated from Russia or Ukraine in calculating the world price, and observe near-identical patterns.
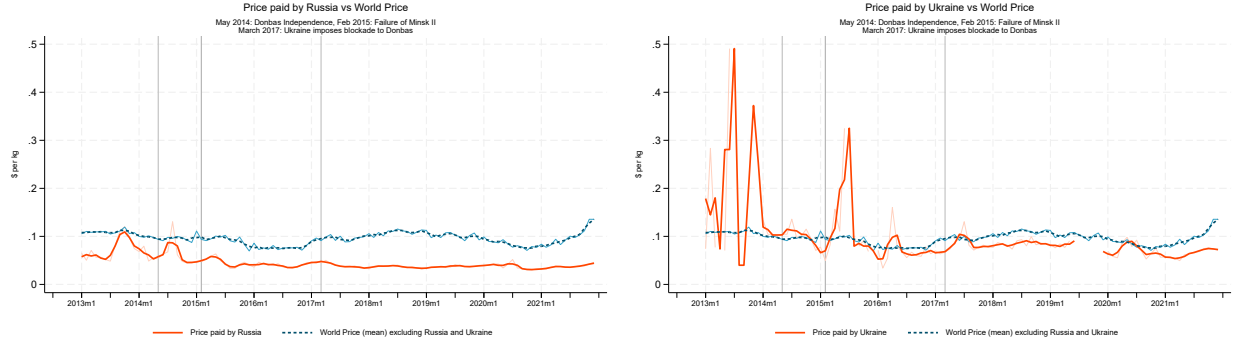
(a) Price paid by Russia vs World Price (b) Price paid by Ukraine vs World Price

Figure 4: Prices paid by Ukraine and by Russia vs World Price

sold to Ukraine at approximately the world price.[35] Moreover, after the blockade, despite the rise in global anthracite prices, the price Russia paid Donbas for anthracite remained low, with the gap between the two widening as a result of higher world prices. By contrast, the price paid by Ukraine for Russian anthracite closely coincides with the world price even post-blockade. We take these patterns as suggestive evidence that Russian traders extracted monopsony rents as a result of the blockade, buying from Donbas at below-market prices. Perhaps because of the availability of alternative suppliers – albeit imperfect substitutes – we see no evidence of monopoly pricing in sales from Russia to Ukraine.

We also note that Figure 4 shows that prices are volatile (and very high) in the earlier part of the sample. This likely reflects in part the very low trade volume in pre-embargo years when Ukraine sourced anthracite through internal trade: Until June 2016, Ukraine bought domestic coal at an average price of USD 0.43 per kilogram (Kostanyan and Remizov, 2017), and very little was sourced abroad.[36]

An alternative interpretation for the patterns in Figure 4 is that the gap in Ukraine's purchase price, which widened with the blockade, might have a cost-based explanation. This could be the case if the marginal production cost in Donbas's mines was particularly low, and even fell during the blockade. Alternatively, the lower purchase price observed in Russia could reflect its geographical proximity to Donbas, while Ukraine's price may align more closely with global market rates due to international competition among producers. Although the lack of reliable data on transportation costs and Ukraine's domestic anthracite purchase prices during this period limits our ability to examine this margin directly, broader contextual evidence –particularly Kurchenko's monopsonistic control over Donbas coal exports– leads us to favor the interpretation that the observed price gap reflects monopsony power. Similarly, it is possible that monopoly rents existed, but are

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[35]While Russia was paying less than the world price even before the conflict, we emphasize that anthracite transactions between Russia and Ukraine before 2014 were extremely low, likely because Russia has rich coal reserves, and is itself a major coal exporter.

[36]In June 2016, when internal anthracite supply was already more difficult, the Ukrainian government introduced the "Rotterdam plus" formula to facilitate import of anthracite and equalize the domestic coal price to international prices.

obscured by a marginal cost gap.

To further explore the plausibility of cost-based explanations, we implement two additional empirical exercises that would likely capture differences in extraction and/or transport costs. First, we examine export prices of anthracite from Ukraine and Russia to other destinations. If the lower anthracite export price we observed earlier resulted from lower production costs, we would expect the export price to be lower for all buyers. As a second approach, we consider trade in iron, the one other commodity for which there is bilateral trade between Russia and Ukraine, to check for the presence of general shifts in border or transportation costs.

We examine anthracite exports to other destinations in Appendix H, Figure H1, which shows prices paid by major importers for anthracite from Ukraine (solid line) and Russia (dashed line), with panel titles indicating pre-independence import shares. Prices from both sources closely track each other, while Russia's purchase price from Donbas (dotted line) is consistently lower—pointing to monopsony power rather than production costs as the likely cause of the gap.

We now turn to trade in iron between Russia and Ukraine. We focus on iron for two reasons. First, it was the only other commodity that was traded bilaterally between the two countries over our study period; second, iron extraction and processing were not concentrated in Donbas and were thus unaffected by the blockade. As a result, Russia should not have not been able to exploit its monopsonistic power against Ukraine: if Russia were unwilling to purchase its iron, Ukraine could have targeted buyers in other countries. The left panel of Appendix I, Figure I1 shows the quantities of iron traded between Russia and Ukraine, while the right panel shows the value per unit. While there is a small short-term increase in Russia's reported iron imports after the blockade's imposition, there is no clear change in the price at which iron products trade between the two countries.[37]

We estimate the economic rents associated with the importation of Donbas coal, based on the price differentials in Figure 4 relative to a world benchmark price. We define monopsony rents as the gap between what Russia pays Ukraine and the world price for anthracite, times the quantity of Ukraine-Russia exports (i.e., the extent to which purchases are "underpriced"):

$$MNPSNY\ Rents_t = (Price_{World,t} - Price_{RUS\ pays\ to\ UKR,t}) \times Quantity_{RUS\ imports\ from\ UKR,t} \quad (3)$$

We similarly define monopoly rents as the gap between what Ukraine pays Russia for anthracite, times the quantity of Russia-Ukraine exports (the extent to which purchases are overpriced):

$$MNPLY\ Rents_t = (Price_{UKR\ pays\ to\ RUS,t} - Price_{World,t}) \times Quantity_{UKR\ imports\ from\ RUS,t} \quad (4)$$

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[37]Given that iron (HS code 72 in Comtrade data) includes different subtypes, the aggregates we report in Figure I1 may mask shifts in the type or quality of iron traded. We therefore replicate the graphs above for 4-digit HS subcategories of iron for which there was bilateral trade. These results appear in Appendix Figure I2 and Figure I3; in neither case do we observe any shift in prices around the blockade.
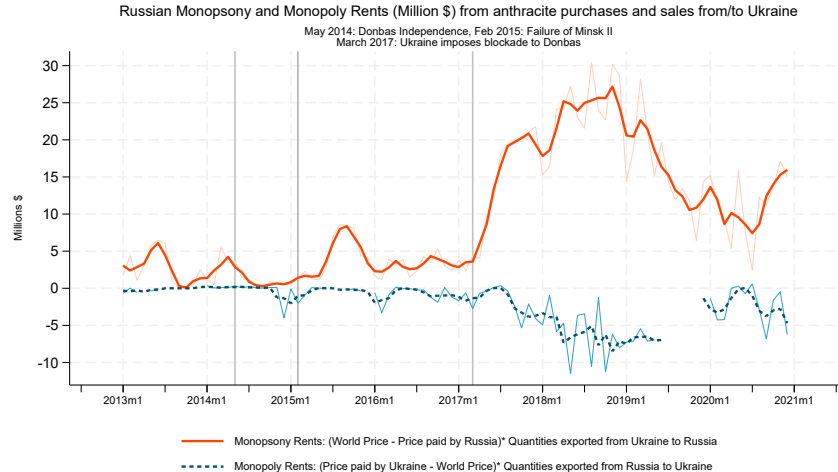
Figure 5: Monopsony vs Monopoly Rents

Figure 5 plots monopsony and monopoly rents over our sample period. As expected given the price gaps documented above, we observe substantial monopoly rents, which increase through a combination of higher prices and higher Russian imports after the onset of sanctions. Overall, estimated monopsony rents almost quadruple within several months post-blockade, with a net increase of over US$12 million per month. By contrast, monopoly rents are low or even negative (reflecting possibly low transport costs between Russia and Ukraine compared to other destinations, though this would also imply that our monopsony estimate is biased downward).

It is beyond the scope of our data to trace the ultimate owners of the importers that benefited from these rents, but there is anecdotal evidence that political connections likely played an important role. Of particular note, in 2018-19, a monopoly on Donbas importation was awarded to Serhiy Kurchenko, a close associate of the deposed pro-Russian president of Ukraine, Viktor Yanukovich. Even in earlier years, a Kurchenko-associated company, Gaz Alyans, was among the dominant anthracite importers in the Russian border province of Rostov.[38]

The blockade was estimated to have caused a loss of at least 1 percent of GDP overall, after accounting for lost taxes from companies nationalized by the independentists, the effect of a state of emergency in the energy sector, and disruptions in mining and metallurgy supply chains (Voytyuk, 2019). The blockade also had negative consequences for Donbas. Some of the mines occupied by the independentists shuttered, increasing unemployment (Kazanskyi et al., 2017). The mines that remained open could no longer rely on state subsidies, wages were halved and, when paid, they were often disbursed with long delays.[39] Strikes and protests followed, but were often silenced by local authorities.[40]

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[38]See the report "Black Earth," from the data analytics NGO C4ADS, https://c4ads.org/commentary/2020-5-26-black-earth/

[39]Regnum, "DPR stops operation of state mines," https://regnum.ru/news/2291558

[40]Hromadske, "Mining Protest Crackdown in Occupied Donbas, Explained," https://hromadske.ua/en/

We conclude this section by noting that, despite the economic consequences, the blockade was popular with Ukraine's citizens (Kostanyan and Remizov, 2017) – if anything, the blockade coincided with a modest increase in the fraction of Ukrainians who felt that the country was headed in the right direction, which was sustained despite increased economic hardship.[41] That is, despite the undoing of sanctions the blockade was politically popular, which explains its maintenance despite its lack of efficacy and cost to Ukraine's own economy.

5 Conclusion

In this paper, we highlight the geopolitical challenges to economic sanctions. We show that Ukraine's blockade of Donbas led to increased anthracite imports by Russia, and a corresponding increase in Russian exports to Ukraine and the rest of the world. Our findings highlight the difficulties in imposing economic costs on a target region. In particular, three factors contributed to the undoing of sanctions: (a) the availability of a trading partner that remained outside of the sanctioning bloc; (b) the high costs and long time horizon required to substitute away from anthracite to fill Ukraine's energy needs; (c) the integration of anthracite in Ukrainian energy production. In our setting, we find that the blockade primarily harmed the country imposing sanctions. Future work may explore, both theoretically and empirically, the broader conditions under which sanctions are more likely to impact targeted economies versus the economies of nations that impose them.

Political observers have also noted that the evasion of sanctions did more than just neutralize their intended economic effect. It also reshaped the geopolitics of the region by consolidating Russia's economic control over the area and deepening the political ties between Russia and Donbas (Lieven, 2022), in line with a well-established view in political science that closer economic relationships foster stronger political links (Keohane and Nye Jr, 1973; Jha, 2013). This more general observation that sanctions can unintentionally strengthen alliances among non-participants (especially when rerouting consolidates control or extractive leverage within such partnerships) also warrants further research in the future.

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posts/mining-protest-crackdown-in-occupied-donbas-explained
[41]Public Opinion Survey of Residents of Ukraine.

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Appendix - for online publication

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A Maps

Figure A1: Map of Donbas. Source: "Dirty Fuel", *Washington Post*, June 12, 2020

Figure A2: Location of anthracite basins in Ukraine. Source: International Energy Agency, 2012

B   Descriptive Graphs: Anthracite vs Other Minerals

(a) Russian imports from Ukraine

(b) Russian exports to the World

Figure B1: Imports and Exports to and from Russia: anthracite versus other minerals

(a) Russian imports from Ukraine
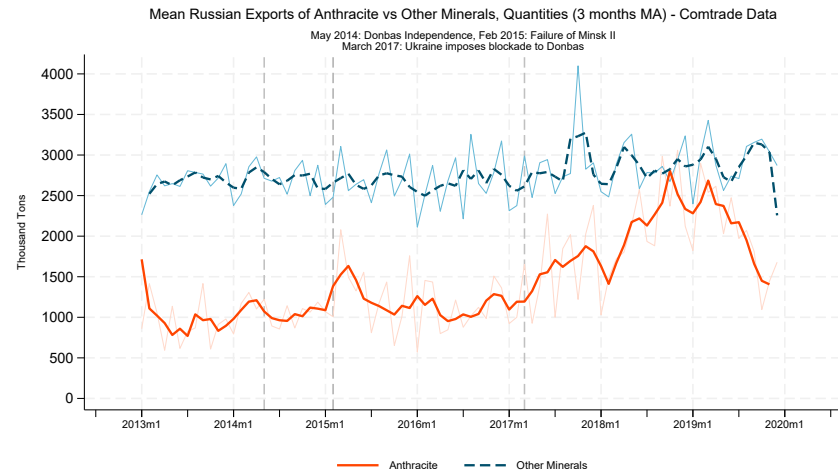
(b) Russian exports to the World

Figure B2: Imports and Exports to and from Russia: anthracite versus other minerals

C   Electricity Sources in Ukraine
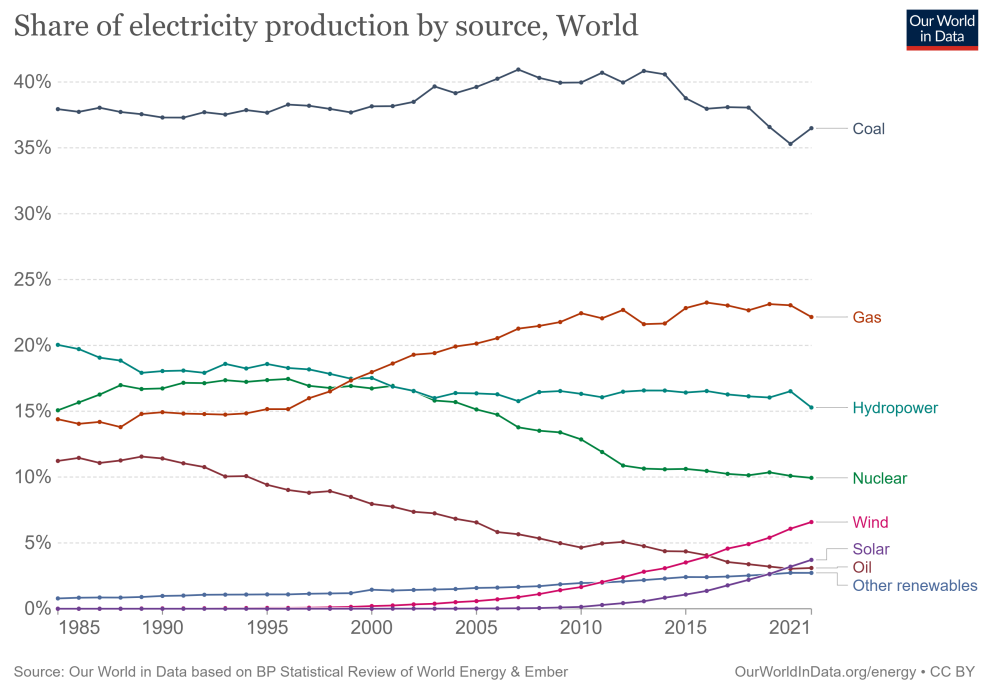
Figure C1: Ukrainian sources of energy over time. The figure is sourced from: "Our World in Data" and is based on BP Statistical Review of World Energy.

D   Imports of Anthracite by Origin to Ukraine
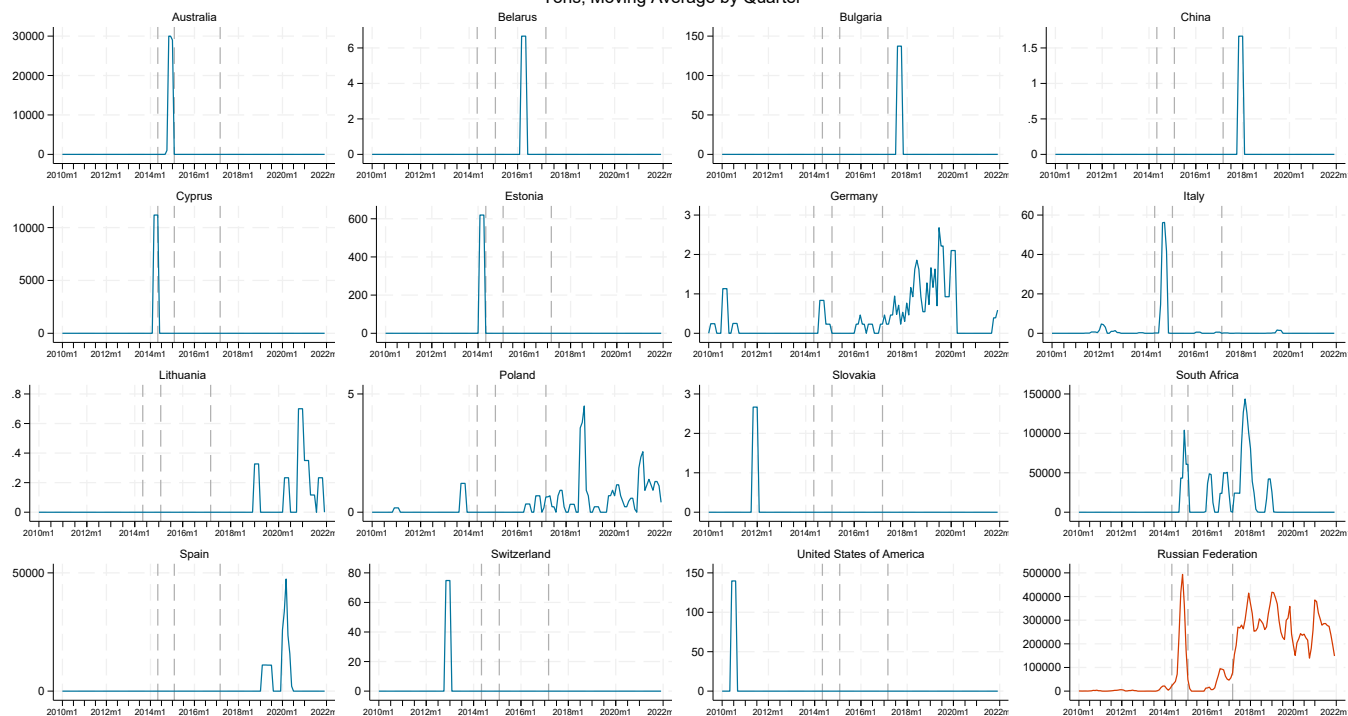
Figure D1: Ukrainian reported imports of anthracite by country of origin

E   Bilateral Trade with Russia by Commodity
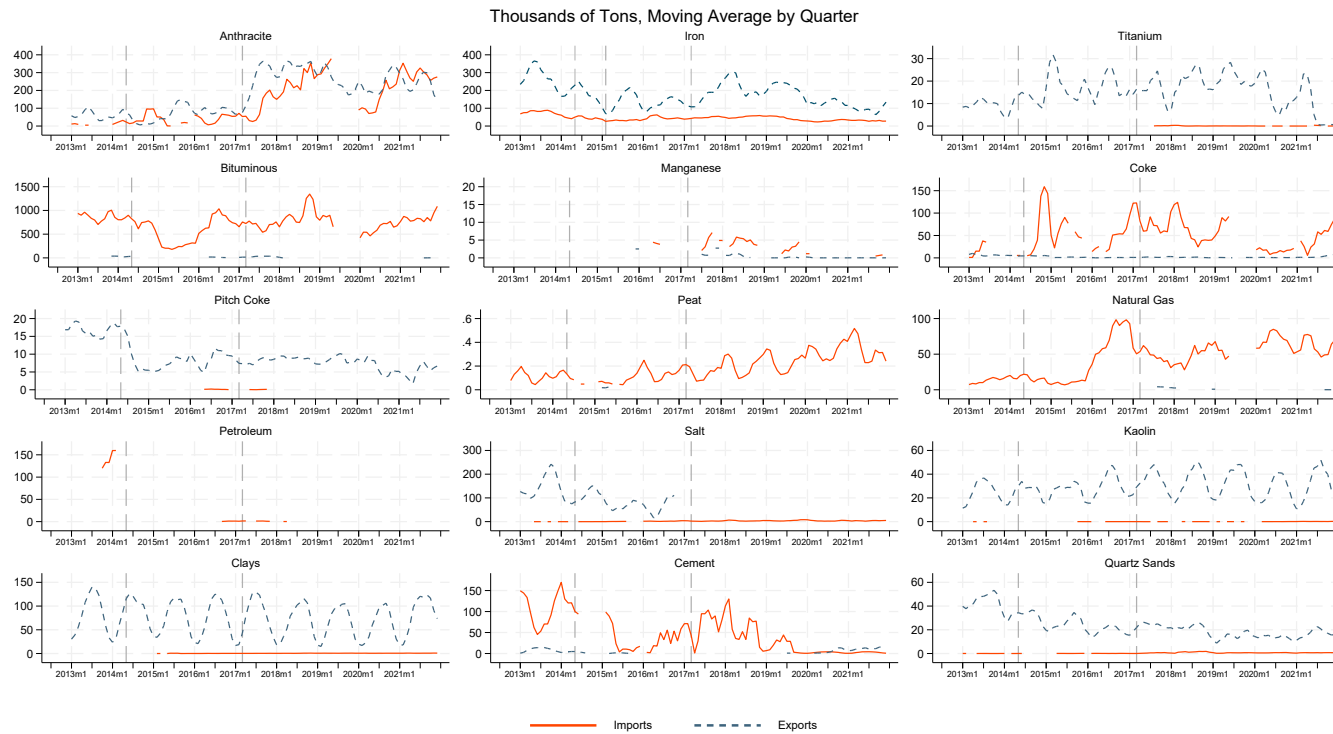
Figure E1: Imports and Exports between Ukraine and Russia by commodity

F   Triple Difference

To ensure that the patterns shown in Figure 2 do not capture a general shift in trade amidst the turbulence created by the Donbas conflict but they rather capture a peculiar pattern in anthracite trade, we extend the diff-in-diff analysis to multiple minerals to run a triple-difference analysis respectively for: I) imports of anthracite from Ukraine versus imports of other minerals from Ukraine and II) exports of anthracite from Russia versus exports of other minerals from Russia.

Specifically, we estimate the following equation for imports:

$$log(1 + Imports_{mjt}) = \sum_{t \geq 2013q1, \neq 2014q1}^{t \leq 2019q4} \beta_t \times Q_t \times Russia_j \times Anthracite_m \tag{5}$$
$$\theta_{tj} + \kappa_{mt} + \lambda_{mj} + \epsilon_{mjt}$$

where $log(Imports_{mjt})$ is the logarithm of the quarterly average of imports of mineral m from Ukraine to country j in quarter t. We include a set of fixed effects for: quarter by importing country θ_{tj}, quarter by mineral κ_{mt} and importing country by mineral λ_{mj}. We are interested in how Russia-reported ($Russia_j$) imports of anthracite ($Anthracite_m$) evolved over time (Q_t) relative to other countries and commodities. The coefficients β_t estimate the difference between Russian imports of anthracite versus other countries' imports of anthracite, and versus other countries' and Russian imports of other commodities from Ukraine. We take as a reference period the second quarter of 2014, when Donbas declared independence from Ukraine.
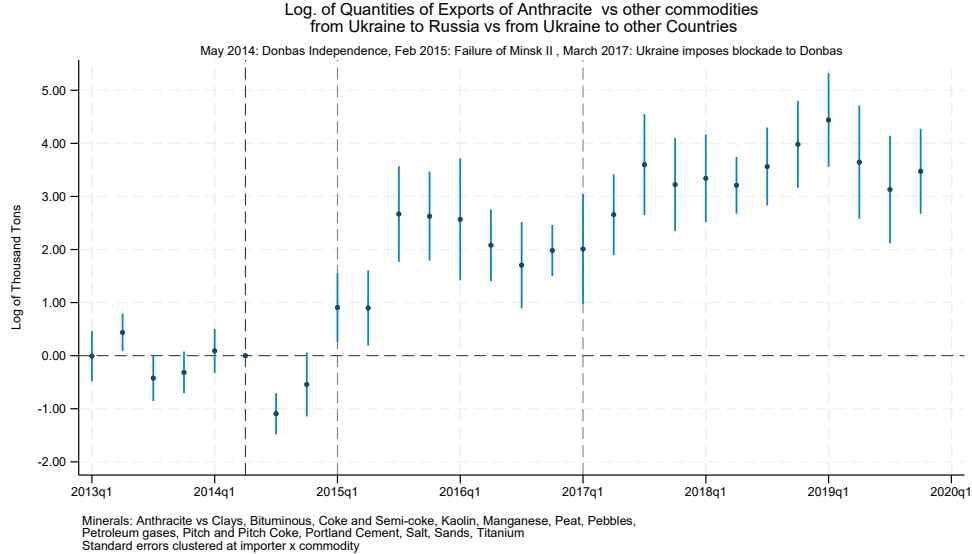
Figure F1: Triple-Difference event study evidence on imports of anthracite from Ukraine (to Russia versus to other countries, anthracite versus other minerals).

We next run an event study as in Equation 5 using as dependent variable the quarterly mean of the

exports of minerals from each country to the rest of the world:

$$log(1 + Exports_{mjt}) = \sum_{t \geq 2013q1, \neq 2014q1}^{t \leq 2019q4} \beta_t \times Q_t \times Russia_j \times Anthracite_m \tag{6}$$

$$\theta_{tj} + \kappa_{mt} + \lambda_{mj} + \epsilon_{mjt}$$
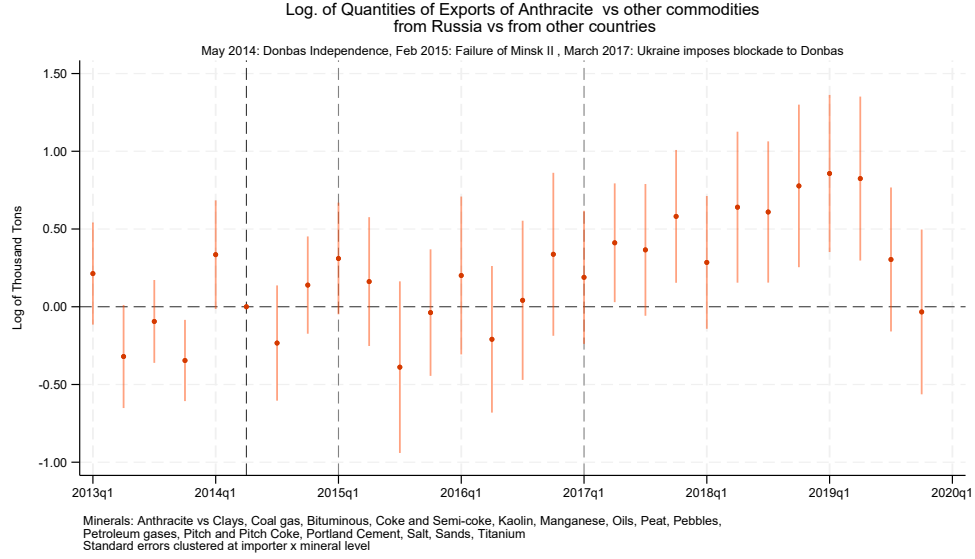
In Figure F2, we plot the coefficients of these estimate.

Figure F2: Triple-difference event study evidence on exports of anthracite from Russia ((versus from other countries, anthracite versus other minerals)

These figures reveal patterns that are very similar to those in our difference-in-differences approach.

G   Addressing missing values in the Comtrade series

Interpolation of Missing Values

(a) Imports of anthracite from Ukraine

(b) Exports of anthracite from Russia

Figure G1: TWFE on the sample of original and interpolated values.

(a) Imports of anthracite from Ukraine
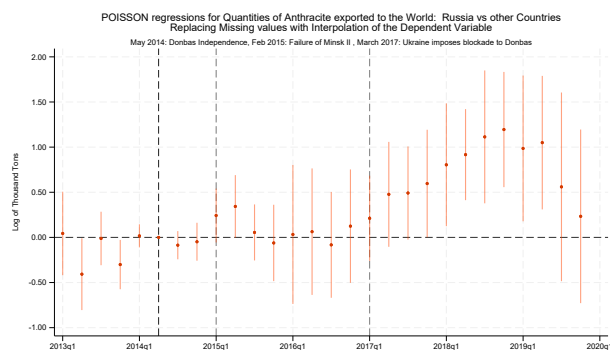
(b) Exports of anthracite from Russia

Figure G2: Poisson on the sample of original and interpolated values.

Imputing zeros
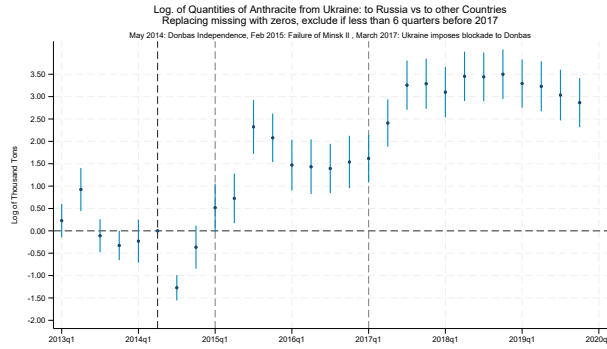
(a) Imports of anthracite from Ukraine
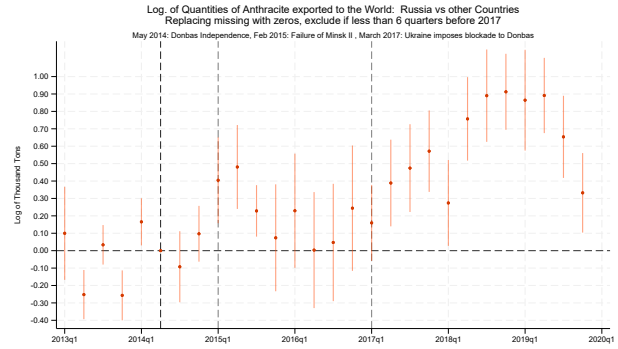
(b) Exports of anthracite from Russia

Figure G3: TWFE on the panel where we imputed zeros for missing values. The sample excludes countries that report for less than 6 quarters in the period before the blockade (2017 q2)
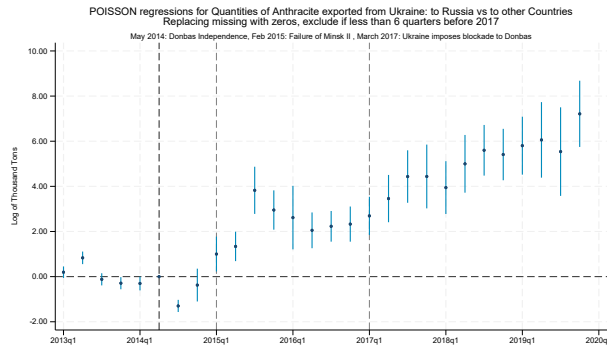
(a) Imports of anthracite from Ukraine
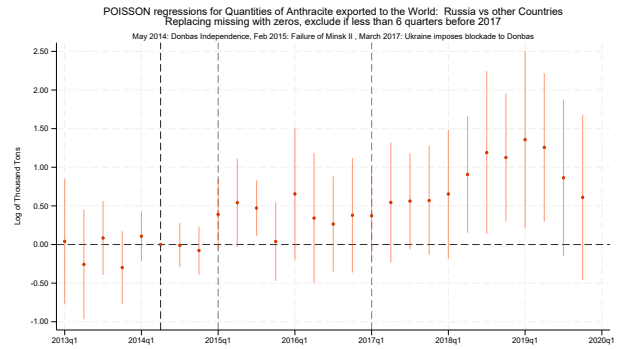
(b) Exports of anthracite from Russia

Figure G4: Poisson on the panel where we imputed zeros for missing values. The sample excludes countries that report for less than 6 quarters in the period before the blockade (2017 q2)
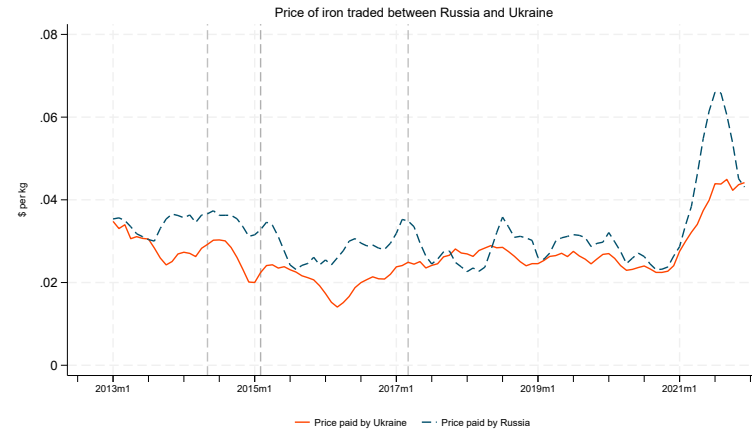
H   Price of imported anthracite
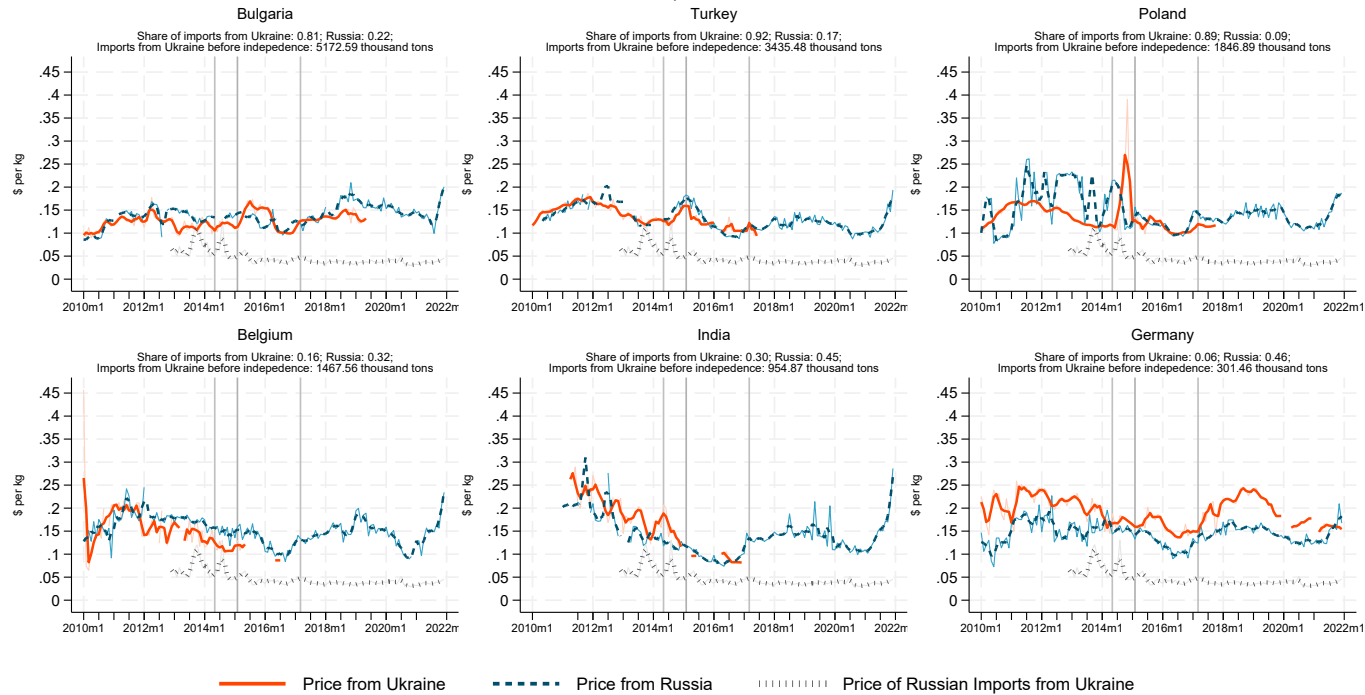
Figure H1: Price of imports from Ukraine versus price of imports from Russia for major pre-independence importers from Ukraine. The gray dotted line is the price of imports from Ukraine to Russia.

I   Trade in Iron between Ukraine and Russia
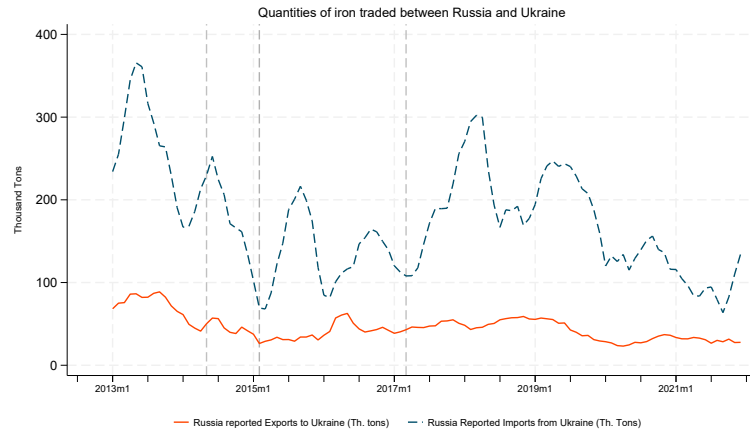
(a) Quantities

(b) Prices

Figure I1: Quantities and value per unit of iron traded between Russia and Ukraine

The panels of Figure I2 show the pattern in the trade of subcategories of iron (HS 4 digit categories) between Ukraine and Russia over the period of study. The panels of Figure I3 plot the value per unit over time of the same subcategories. As both figures show, the value per unit of the subcategories of iron change following the blockade.
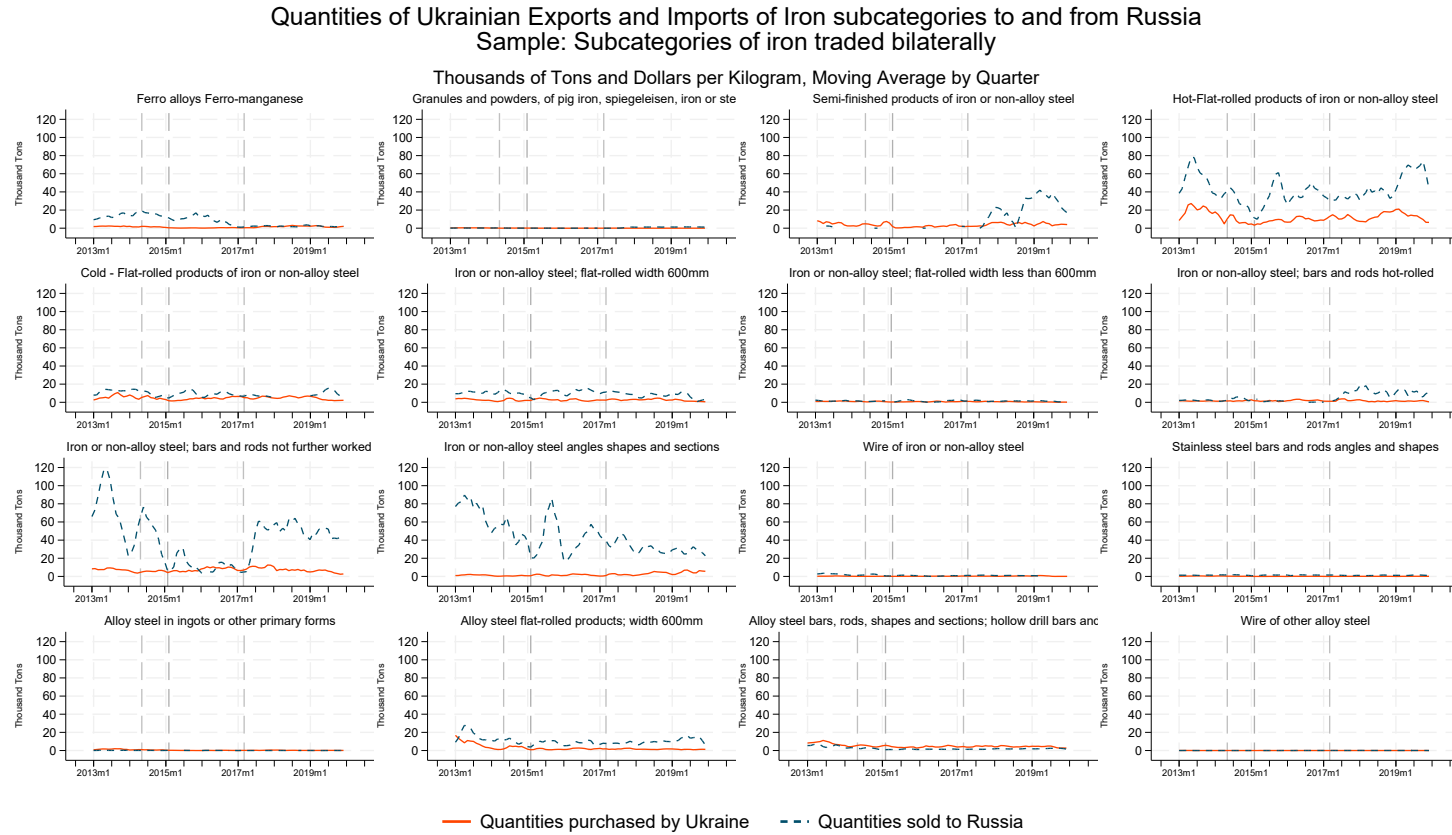
Figure I2: Quantities of subcategories (HS - 4 digits) of iron traded between Ukraine and Russia.

Prices of Ukrainian Exports and Imports of Iron subcategories to and from Russia
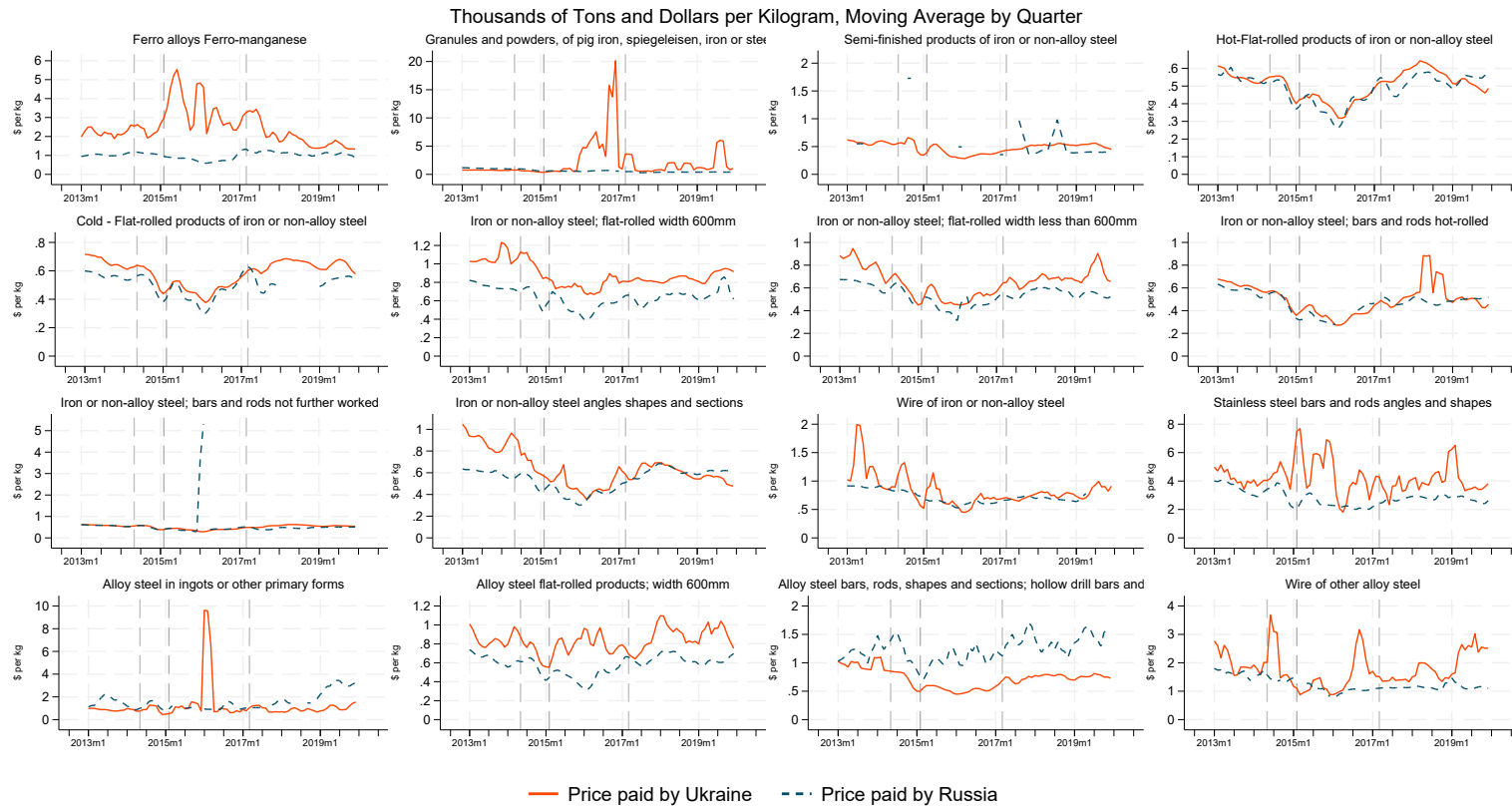Sample: Subcategories of iron traded bilaterally

Thousands of Tons and Dollars per Kilogram, Moving Average by Quarter

Figure I3: Value per unit of subcategories of iron traded between Ukraine and Russia.

J Exclude Russia and Ukraine from world price

The left panel of Figure J1 shows the difference between the price Russia paid to Ukraine for anthracite and the world price; the right panel plots the price Ukraine paid to Russia for anthrhcite and the world price.

We exclude the values of the exports from Russia or Ukraine when computing the world price. That is:

$$Price_{world,t} = \sum_{j \neq Russia, Ukraine} w_{jt} \frac{value_{jt}}{quant_{jt}} \tag{7}$$
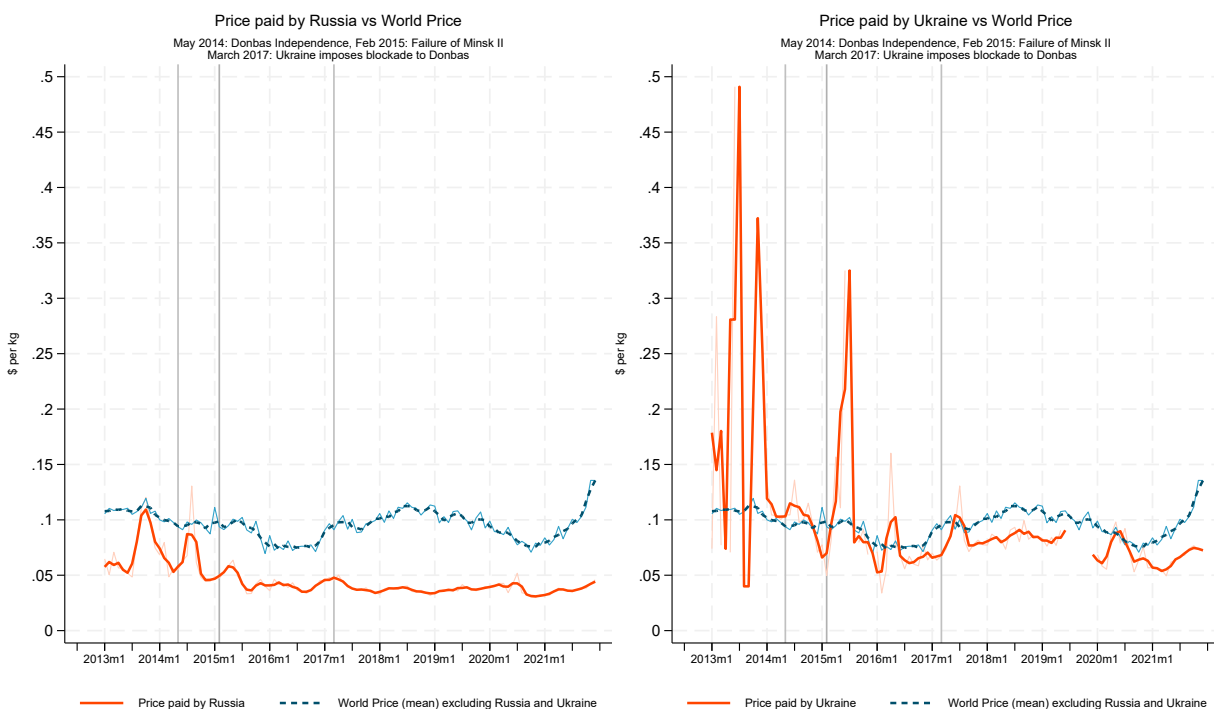

Figure J1: Monopsony vs Monopoly Prices

K   Alternative transformations of the dependent variable

We replicate the analysis shown in Figure 2 using respectively an Inverse Hyperbolic Sine transformation of quantities in Figure K1 and a Poisson transformation in Figure K2.

(a) IHS imports of anthracite from Ukraine

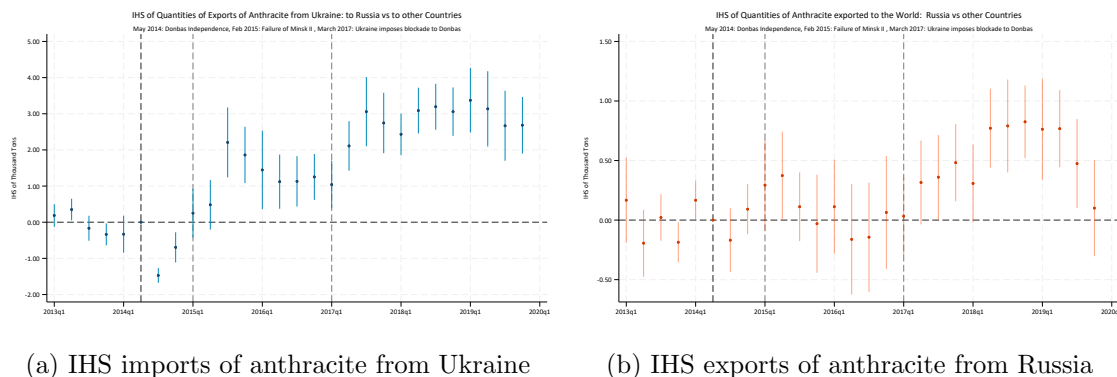(b) IHS exports of anthracite from Russia

Figure K1: Two-way fixed effects: event study evidence on imports of anthracite from Ukraine (to Russia versus to other countries) and exports of anthracite (from Russia versus from other countries). The dependent variable is inverse hyperbolic sine transformation of quantities.

(a) Poisson of imports of anthracite from Ukraine   (b) Poisson of exports of anthracite from Russia
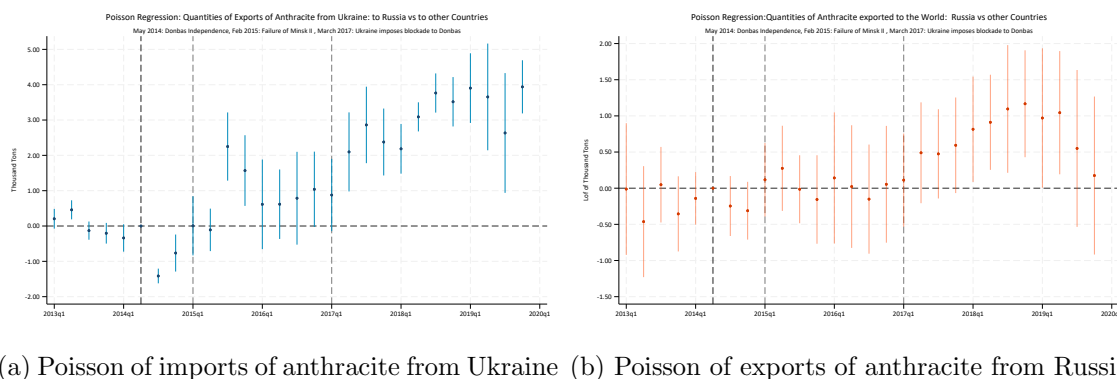
Figure K2: Poisson estimates: event study evidence on imports of anthracite from Ukraine (to Russia versus to other countries) and exports of anthracite (from Russia versus from other countries). The dependent variable is poisson transformation of quantities.