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OUTLOOK

Trade off: an economic analysis of North Korean-Russian relations

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Summary

Russia and North Korea have set up an extensive system for transshipments of strategic goods, such as military materiel for Russia and oil and food for North Korea.

Between September 2023 and February 2024, North Korea delivered munitions and rockets worth between USD 4.3 billion and USD 4.8 billion to Russia.

Both countries can be expected to maintain their cooperation in the short to medium term. North Korea will provide Russia with military supplies and labour, while Russia will supply petroleum products, minerals, fertilizers and possibly nuclear and military know-how.

NATO and its member states would be well advised to cooperate more closely with regional enforcement efforts via the Indo-Pacific Four (IP4).

Isolated by a Western-led coalition of nations, Russia has intensified its partnerships with non-Western states, including the Democratic People's Republic of Korea (DPRK). Moscow's relationship with Pyongyang is driven by Russia's urgent need for artillery munitions, Rocket-Propelled Grenades (RPGs), missiles and other military equipment. Although often labelled as "aged" and "malfunctioning" by the West and considered of inferior quality, these munitions still appear effective

enough to cause significant damage on the Ukrainian battlefield and in the Kursk region.[1]

More recently, the DPRK has also dispatched troops to aid Russia's war effort – a dramatic development marking the expansion of the Russo-Ukrainian war to include foreign manpower.[2] In exchange, Russia is providing substantial support to Kim Jong Un's regime, including oil.[3]

The tactical, logistical and economic rationales for the partnership are increasingly evident. Russia is not only able to secure weapons for the strategic bombing of Ukrainian civilian and critical infrastructure and shelling of Ukrainian frontlines but also additional soldiers for its war effort. In return, North Korea receives critical natural resources, including sanctioned oil, from Russia, and – potentially – nuclear and missile know-how.[4]

This report examines the strategic costs of cultivating such a partnership from a military-logistical perspective. Building on an OSINT-based quantitative analysis, it examines recent Russian-DPRK shipments of weapons and estimates their monetary value. The study concludes with an assessment of the risks that the Russo-North Korean alignment presents for NATO and its regional partners and suggests ways to mitigate them.

Russia and North Korea: a marriage born of desperation

Historically, Russia has been highly aware of the strategic significance of the Korean peninsula (Figure 1). During the Cold War, the USSR sent economic, military and technical aid to bolster North Korea's industrialization (Figure 2) and assisted Pyongyang in its nuclear programme at the Yongbyon Nuclear Scientific Research Centre (녕변원자력연구소).[5]

An alliance of outcasts

After the dissolution of the USSR, Pyongyang re-aligned with China to compensate for the loss of Soviet military and economic support. Yet it still relied on Soviet missile launchers for the nuclear warheads under development. Over time, Pyongyang was able to successfully test several nuclear devices (in 2013, 2016 and 2017) and to launch multiple intercontinental ballistic missiles (ICBMs).[6]

Currently, North Korea uses both Soviet- and Chinese-designed equipment such as the WS51200 single-use transporter-erector-launchers,[7] armoured trains[8] and Gorae Romeo-Mod class submarines[9] to move its missiles. All of these vehicles run on diesel or other oil products, which explains Pyongyang's desire to strengthen ties with Russia – a global energy powerhouse.

Cooperation with Moscow became even more urgent after the COVID-19 pandemic. To address its plummeting foreign trade,[10] deadly food shortages[11] and the impending collapse of its economy and healthcare system,[12] Pyongyang called on Moscow for help.[13] In June 2022, Russia vetoed new sanctions against the DPRK at the United Nations (UN).[14] A month later, North Korea recognized the independence of the so-called Donetsk People's Republic and Luhansk People's Republic.[15] In turn, the Kremlin became more vocal in defending the North Korean regime.[16] In September 2022, as a sign of growing economic ties, the DPRK opened up to Russia's trade through the Tumangang Rail Facility (Figure 3).

In October 2022, U.S. intelligence reported that economic agreements between Russia and North Korea extended to artillery and missiles, for the first time. Following a summit meeting between Russian President Vladimir Putin and North Korea's supreme leader Kim Jong Un at Russia's Vostochny Cosmodrome space centre in 2023, the

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3 Fyodor Tertitskiy, "Why is North Korea Sending Troops to Fight for Russia?", Carnegie Endowment for International Peace, 7 November 2024, https://carnegieendowment.org/russia-eurasia/politika/2024/11/russia-north-korea-new-allies?lang=en.
4 Natasha Bertrand, "North Korea Likely to Ask for Nuclear Technology from Russia in Exchange for Troops, South Korea says," CNN, 30 October 2024, https://edition.cnn.com/2024/10/30/politics/north-korea-russia-nuclear-technology-troops/index.html
5 NTI, "Yongbyon Nuclear Research Center," Nuclear Threat Initiative, 2021, https://www.nti.org/education-center/facilities/yongbyon-nuclear-research-center/.
6 Columbia Law School, "North Korea's Nuclear Program: A History," *Center for Korean Legal Studies*, updated 2023, https://kls.law.columbia.edu/content/north-koreas-nuclear-program-history.
7 Jeffrey Lewis, "That Ain't My Truck: Where North Korea Assembled Its Chinese Transporter-Erector-Launchers," *38North*, March 2014, https://www.38north.org/2014/02/jlewis020314/.
8 Joseph S. Bermudez, "What Is the Significance of North Korea's Rail-Mobile Ballistic Missile Launcher?," CSIS, September 2021, https://www.csis.org/analysis/what-significance-north-koreas-rail-mobile-ballistic-missile-launcher.
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10 Ethan Jewell, "North Korea-China Trade Crashes to Lowest Level in Decades in 2021: Data," *NK News*, January 2022, https://www.nknews.org/2022/01/north-korea-china-trade-crashes-to-lowest-level-in-decades-in-2021-data/.
11 Ha Yuna, "Lack of Food Leads to Deaths from Hunger in Sinuiju," *The Daily NK*, April 2022, https://www.dailynk.com/english/lack-food-leads-deaths-hunger-sinuiju/.
12 "North Korea Trade Sinks 17.3% in 2021 on sanctions, pandemic," *The Korea Times*, July 2022, https://www.koreatimes.co.kr/www/nation/2022/07/103_332740.html?fl.
13 Jung Min-ho, "North Korea Asks China, Russia for Help Amid COVID Crisis: Reports," *The Korea Times*, May 2022, https://www.koreatimes.co.kr/www/nation/2022/05/103_329374.html?fl.
14 "China, Russia Defend N Korea Vetoes at UN General Assembly," *Aljazeera*, June 2022, https://www.aljazeera.com/news/2022/6/9/china-russia-explain-n-korea-vetoes-at-un-meeting
15 "North Korea Officially Recognizes Independence of 2 Separatist Regions in Ukraine," *Korea Times*, July 2022, https://www.koreatimes.co.kr/www/nation/2022/07/103_332710.html?fl.
16 "Moscow Accuses U.S. of Testing North Korea's Patience," *Korea Times*, August 2022, https://koreatimes.co.kr/www/nation/2022/11/103_340107.html.

Figure 1. North Korea as seen from Russian Far East
Source: Kepler.GI, authors.

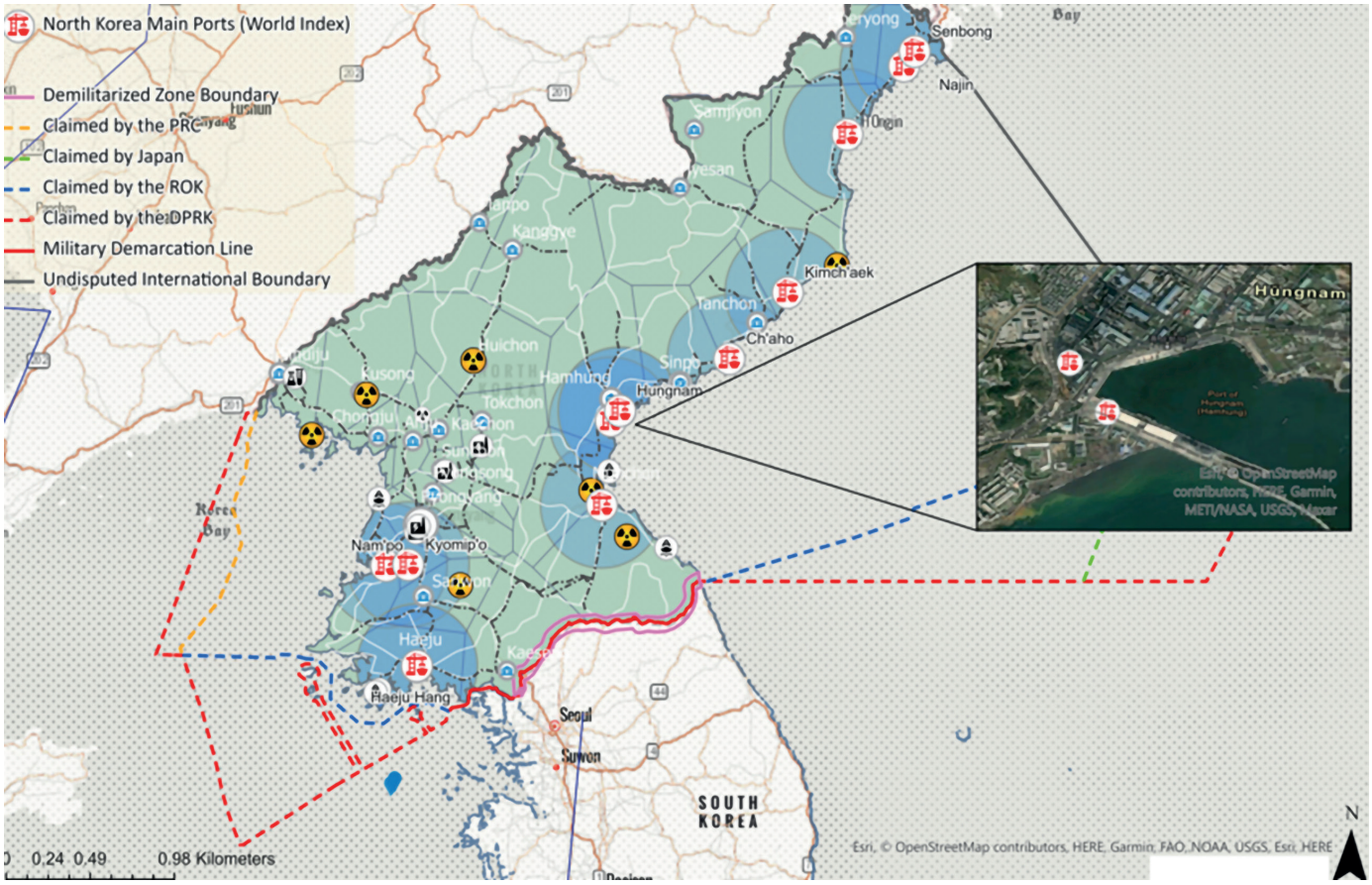

Figure 2. North Korea – Nuclear and civil infrastructure
Sources: Google Earth, CSIS, 38 North, ESRI, authors.

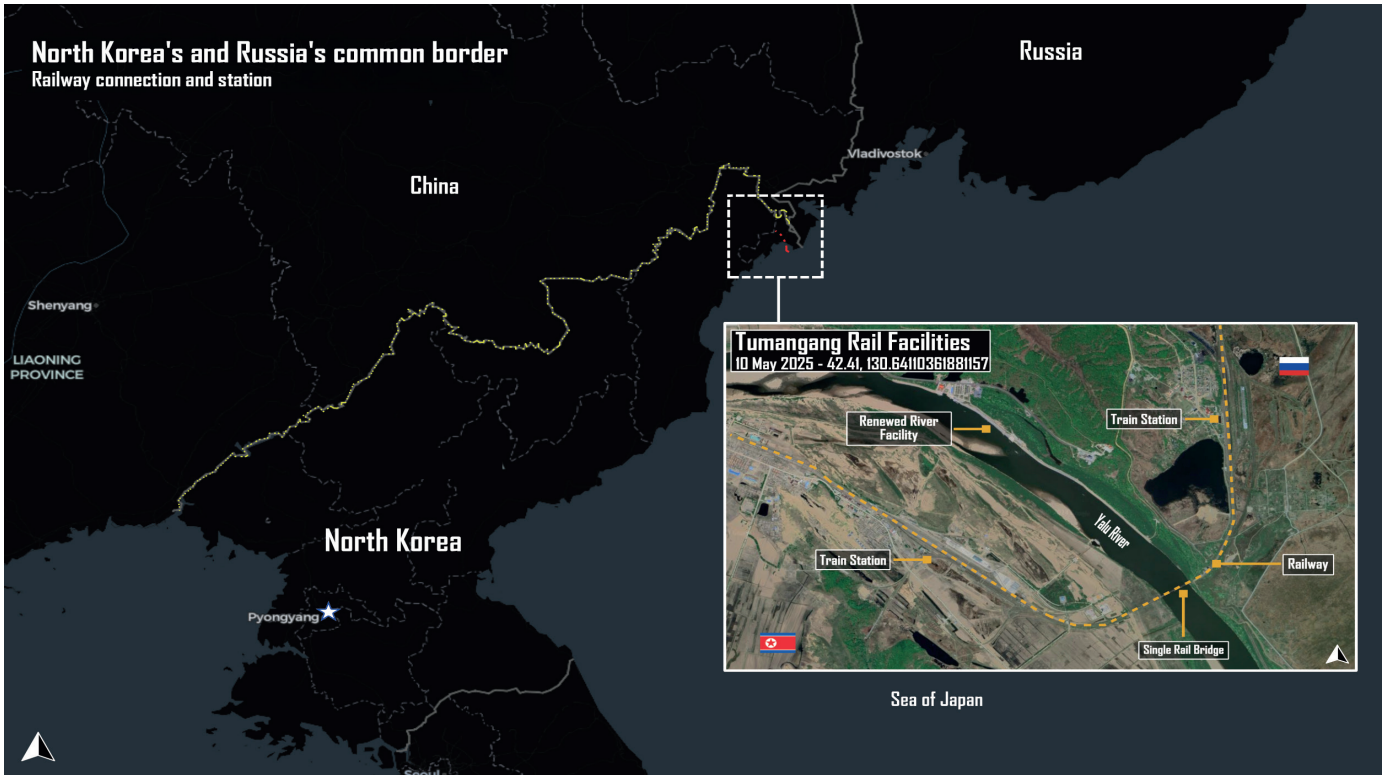

Figure 3. North Korea's and Russia's common border. Railway connection and station
Sources: Google Earth, authors.

only railway connecting the two countries saw a dramatic increase in traffic, reportedly due to artillery transfers.[17] The station has since seen steady improvements and was significantly expanded in 2025.[18]

In the meantime, in violation of UN sanctions, the North Korean Space Agency launched what was reported to be a military surveillance satellite into orbit.[19] It also attempted to launch three more satellites[20] and upgraded the Sohae launching station.[21] Emboldened, Pyongyang also expanded its Pyongsan Uranium Plant Reservoir in January 2023,[22] built a second nuclear reactor[23] and kept a high pace of missile testing, including of ICBMs.[24] Russian-North Korean convergence gathered speed with Russia's refusal to renew the mandate of the UN Panel of Experts on North Korea in 2024.[25] In the same year, Putin and Kim signed a mutual defence pact requiring the two countries to help each other in the event of foreign aggression.[26] Russian units trained North Korean drone operators in Wonsan, and Kim Jong-un attended a military parade in China together with Putin.[27]

Still, this rapprochement comes at a price. As Moscow intensifies its relations with Pyongyang, China is seeing its strategic leverage over North Korea diminish. Russia may not be able to afford competition over North Korea in a situation where it depends on Beijing for security on its Asian borders, deliveries of dual-use technology and the transfer of sophisticated equipment needed for the war in Ukraine, e.g. satellite and 5G technology.[28]

17 Joseph S. Bermudez jr., Victor Cha, Jennifer Jun, "Dramatic Increase in DPRK-Russia Border Rail Traffic After Kim-Putin Summit," *CSIS*, October 2023, https://beyondparallel.csis.org/dramatic-increase-in-dprk-russia-border-rail-traffic-after-kim-putin-summit/.

18 Joseph S. Bermudez jr., Victor Cha, Jennifer Junn, "Significant Progress of the North Korea-Russia Road Bridge," *CSIS*, October 2025, https://beyondparallel.csis.org/significant-progress-of-the-north-korea-russia-road-bridge/.

19 Swope et al., "Space Threat Assessment," *CSIS*, April 2024, 28, https://aerospace.csis.org/wp-content/uploads/2024/04/240417_Swope_SpaceThreatAssessment_2024.pdf.

20 "North Korean Spy Satellite Launch Ends in Failure," *Deutsche Welle*, May 2024, https://www.dw.com/en/north-korean-spy-satellite-launch-ends-in-failure/a-69199113?maca=en-rss-en-all-1573-rdf.

21 Swope et al., "Space Threat Assessment."

22 Jacob Bogle, "Pyongsan Uranium Plant Reservoir Expansion," *Access DPRK*, January 2023, https://mynorthkorea.blogspot.com/2023/01/pyongsan-uranium-plant-reservoir.html.

23 "North Korea's Second Nuclear Reactor Seems Operational: IAEA," *Deutsche Welle*, December 2023, https://www.dw.com/en/north-koreas-second-nuclear-reactor-seems-operational-iaea/a-67796399?maca=en-rss-en-all-1573-rdf.

24 "NK Test-Fires Hwasong-17 ICBM in Warning to Enemies Holding Allied Drills," *Korea Times*, March 2023, https://koreatimes.co.kr/www/nation/2023/03/103_347285.html.

25 Arnold, A., "Russia Just Gutted the UN Panel of Experts on North Korea – What Now?", *Royal United Services Institute*, 3 April 2024, available at: https://www.rusi.org/explore-our-research/publications/commentary/russia-just-gutted-un-panel-experts-north-korea-what-now

26 Josh Smith, Ju-Min Park, "Russia's Putin and North Korea's Kim sign mutual defence pact", *Reuters*, June 2024, available at: https://www.reuters.com/world/asia-pacific/putin-kim-agree-develop-strategic-fortress-relations-kcna-says-2024-06-18/.

27 Laura Bicker and Thomas MacKintosh, "Xi, Putin and Kim Show United Front at Huge Chinese Military Parade," *BBC*, September 2025, https://www.bbc.com/news/articles/cp8z83np4xjo.

28 See Roman Kolodii, Giangiuseppe Pili, Jack Crawford, "Hi-Tech, High Risk? Russo-Chinese Cooperation on Emerging Technologies," *Royal United Services Institute*, March 2024, https://www.rusi.org/explore-our-research/publications/commentary/hi-tech-high-risk-russo-chinese-cooperation-emerging-technologies.

Also, North Korea does not have much to offer in economic terms: It is not only one of the poorest countries in the world but also in demographic decline. Finally, the DPRK is still a pariah state for almost the entire international community, which fears that Kim's nuclear sabre-rattling could spin out of control if the regime obtained nuclear technology from Russia.[29]

Trading munitions against oil

Under these circumstances, Russia's alignment with North Korea continues as a marriage born of desperation, mainly dictated by Putin's urgent interest in North Korea's conventional arsenal. And Russia has several commodities to offer in return: money, food, sophisticated engineering and oil – all of which Kim's regime needs to survive.

In 2023, Russia's consumption of munitions had dropped to 7,000–16,000 rounds per day from 60,000 rounds per day a year before, a sign of depleted stockpiles. Bringing in munitions from North Korea allowed Russia to stabilize the front in Ukraine. North Korean artillery munitions, RPGs, missiles and other military equipment were essential for stabilizing the rate of fire across the frontline,[30] enabling Russia to prosecute a prolonged war of attrition. Moreover, by relying on North Korea's readily usable munitions, Russia was able to keep its workforce focused on other critical sectors and procurement chains required for its air force, tanks and energy industry.

Calculating the value of North Korea's armaments deliveries

In a 2023 publication, the Royal United Services Institute (RUSI) analyzed Russian and North Korean transshipments. [31] The report "The Orient Express: North Korea's Clandestine Supply Route to Russia" focused on shipments of North Korean weapons delivered to Russia for use on the Ukrainian battlefield. RUSI's findings were validated by the authors of this study through satellite imagery analysis and further calculations.

In October 2023 alone, five transshipments were delivered.[32] Frontelligence Insight reported that those shipments contained different typologies of ammunition, "including 152mm, 125mm, and 122mm, along with smaller ammunition like hand grenades, VOG grenades and PG-7 (RPG-7 ammo)" in excess of 500,000 rounds.[33]

Transport by sea

The ships ANGARA (IMO: 9179842) and MARIA (IMO: 8517839)[34] were used to transport the cargo by sea from the North Korean port of Rajin to the Dunai military facility in Russia. Satellite imagery and geospatial analysis show the arrival of the containers by train at Tikhoretsk in Russia's Krasnodar region (see Figure 4).[35] Other vessels involved in shipments in 2024 were MAIA 1 (IMO: 9358010)[36] and LADY R (IMO: 9161003).[37] All four ships are currently sailing under Russian flag.

According to the U.S. Department of State, between September 2023 and February 2024, the DPRK supplied more than 10,000 containers of munitions or munitions-related materiel to Russia.[38] This number circulated in the media and is in line with South Korean intelligence data.[39] Considering that ships like the MARIA and ANGARA can carry up to 261 containers each at 90% of capacity, this would amount to 38.3 transits.

We began our calculations by identifying a unit of measurement for the approximate amount of munitions shipped in the five operations in October 2023. We limited ourselves to these transshipments as they are the most extensively covered and verified by satellite imagery, which allows us to understand how many containers can be moved by a single ship. In a second step, we then calculated the costs associated with these shipments to get a sense of their economic value expressed in monetary terms.

To simplify comparisons, we based our concept on a shipment unit consisting of a single container and its content. We then scaled up our numbers based on how many containers a single ship can carry. This made it possible to do overall calculations for multiple shipments, in this case five cargo ships, each carrying an estimated 290 standard containers measuring 5.90m in length, 2.35m in width, and 2.39m in height.

Once we had calculated the average capacity of a container, obtained by combining volumetric and weight container load, we looked at the overall composition of cargo for a single ship. For safety and security reasons, we assumed that the cargo would not exceed 90% of the

29 Stuart Lau, "China's Xi Warns Putin Not to Use Nuclear Arms in Ukraine," *Politico*, 4 November 2022, https://www.politico.eu/article/china-xi-jinping-warns-vladimir-putin-not-to-use-nuclear-arms-in-ukraine-olaf-scholz-germany-peace-talks/.

30 Frontelligence Insight, 2023, "Counting the Rounds: North Korean Ammo Transfers to Russia," *UA*, 5 November 2023, https://frontelligence.substack.com/p/counting-the-rounds-north-korean

31 James Byrne et al., "The Orient Express: North Korea's Clandestine Supply Route to Russia," *Royal United Services Institute*, October 2023, available at: https://rusi.org/explore-our-research/publications/commentary/report-orient-express-north-koreas-clandestine-supply-route-russia.

32 Ibid.

33 Ibid.

34 Ibid.

35 Frontelligence Insight, 2023, "Counting the Rounds: North Korean Ammo Transfers to Russia."

36 Joseph Bermudez Jr. et al, "Major Munitions Transfers from North Korea to Russia", *CSIS*, February 2024, https://beyondparallel.csis.org/major-munitions-transfers-from-north-korea-to-russia/.

37 Anton Sokolin, Colin Zwirko, "Russian Ship in South Africa Arms Row Appears to Aid North Korea Weapons Trade," *NK News Pro*, October 2023, https://www.nknews.org/pro/russian-ship-in-south-africa-arms-row-appears-to-aid-north-korea-weapons-trade/.

38 Office of the Spokesperson, "Responding to Two Years of Russia's Full-Scale War On Ukraine and Navalny's Death", *U.S. Department of State*, February 2024, https://2021-2025.state.gov/imposing-measures-in-response-to-navalnys-death-and-two-years-of-russias-full-scale-war-against-ukraine/.

39 Soo-Hyang Choi, Bloomberg, "North Korea Sent Russia Millions of Artillery Shells, South Korea Says," *The Time*, June 2024, https://time.com/6988568/north-korea-russia-artillery-shell-south-korea-defense-minister/.

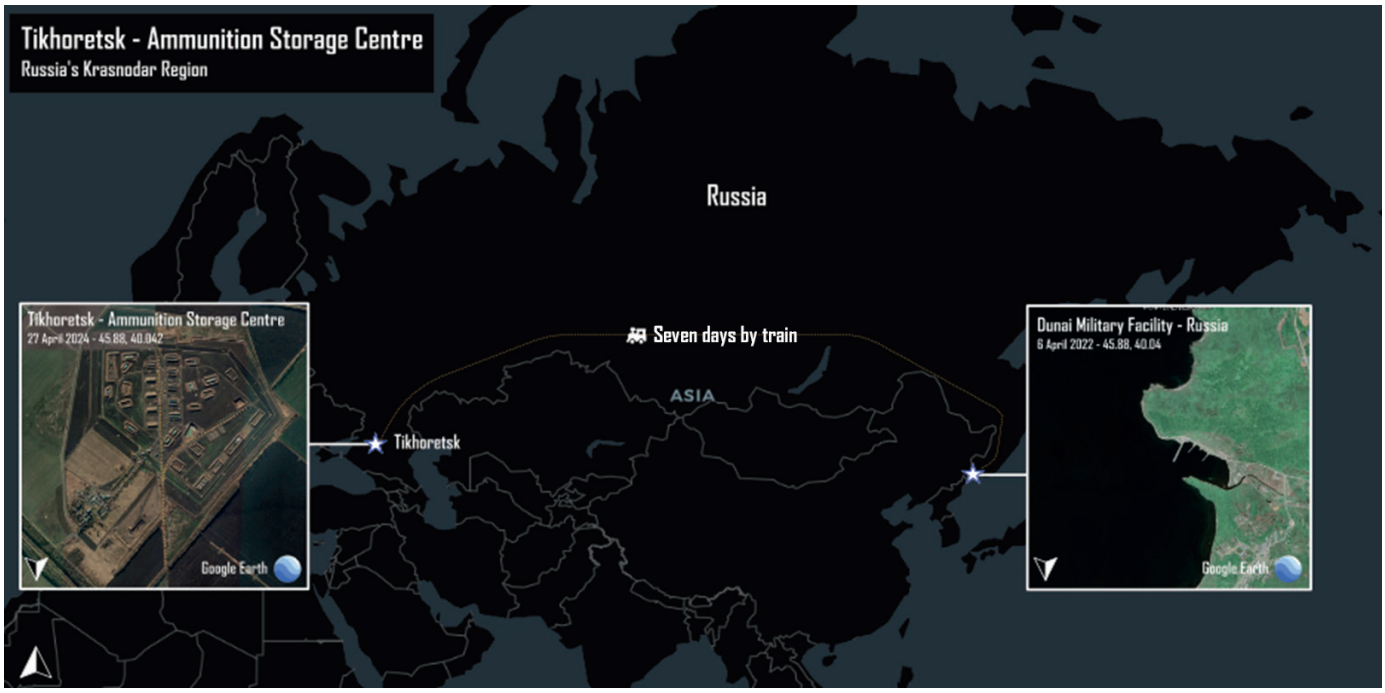

Figure 4. Tikhoretsk in Russia's Krasnodar region
Sources: RUSI, Google Earth, Kepler.Gl, Authors.

ship's capacity. On this basis, we designed a calculator for single and multiple shipments.

At 90% of capacity, the MARIA could carry an estimated 261 containers. We further assumed that 25% of all containers were loaded with RPG-7 ammo boxes weighing 30 kg each. Another 25% of containers contained Grad rockets (122mm, 9M22) while the remaining 50% contained 122mm artillery munition (volume: 820x445x235, 85 kg).

Based on these estimates, the total number of weapons and munitions moved in a single shipment by the MARIA would amount to 101,577 at 90% capacity and 56,431 at 50% capacity. As a result, five shipments of this kind – the number observed in October 2023 – would account for 507,885 at 90% and 282,155 at 50% capacity.

The results of our calculations are very close to what Frontelligence Insight estimated at 500,000 rounds. Our assumptions on the distribution of the cargo (50% artillery munitions and 25% RPGs and Grad rockets each) are based on what can be observed on the battlefield, namely Russia's preference for artillery munitions. While actual figures may differ, this estimate can at least provide some sense of the proportions involved. Moreover, we can always adapt our calculator once details become available about different cargo proportions.

Transport by train

Once the containers were unloaded at the Russian port facility, they were moved mainly, if not exclusively, by train, which is the cheapest and least risky form of transportation in Russia (though even then, multiple sabotage attacks were reported in the days following the ANGARA, MARIA, and LADY R movements).

For train cargo in Russia, we assumed a load capacity of up to 50 containers, far less than would be normal in the United States, where a single train can move up to 120 containers. Moving an entire ship's cargo then requires approximately 6 journeys. According to several estimates, each train journey takes up to seven days even under ideal conditions. As the cargo needs to be handled by the Russian military's specialized logistics battalions, this part of the operation is quite costly and subject to risks, including bottlenecks and sabotage.

Estimating cargo values

How can we now calculate the value of a ship and its cargo? The market value of each ship is estimated at USD 10–15 million,[40] while a second-hand ship would typically cost USD 3–8 million.[41] For the purpose of this study, we will assume the use of a representative second-hand ship worth USD 9 million.

40 This estimate is based on public information regarding the market value of cargo ships in Asia. The data used were aggregated from: GEG Calculators, "What's the Cost of a Normal Cargo Ship?," *GEG Calculators*, August 2024, https://gegcalculators.com/whats-the-cost-of-a-normal-cargo-ship/; "Global Containership Fleet to Exceed 30 Million TEU Mark in 2024," *Marine Insight*, August 2023, https://www.marineinsight.com/shipping-news/global-containership-fleet-to-exceed-30-million-teu-mark-in-2024/; Mike Shuler, "Record Wave of New Containerships in 2024," *GCaptain*, August 2023, https://gcaptain.com/record-wave-of-new-containerships-in-2024/; Markus Hand, "Container Shipping Market Outlook 2024," *Seatrade Maritime*, August 2023, https://www.seatrade-maritime.com/containers/container-shipping-market-outlook-2024; "Container Shipping Market Forecast for 2024,"*Gava*, August 2023, https://gava.com/container-shipping-market-forecast-for-2024/; MoverDB, "Container Shipping", Wright, I., August 2023, available at: https://moverdb.com/container-shipping/; iContainers, "Ocean Freight Calculator", *iContainers*, August 2023, available at: https://www.icontainers.com/ocean-freight-calculator/.

41 For example: Petronav, "Container Ships for Sale", *Petronav*, August 2024, available at: https://petronav.net/container-ships-for-sale.

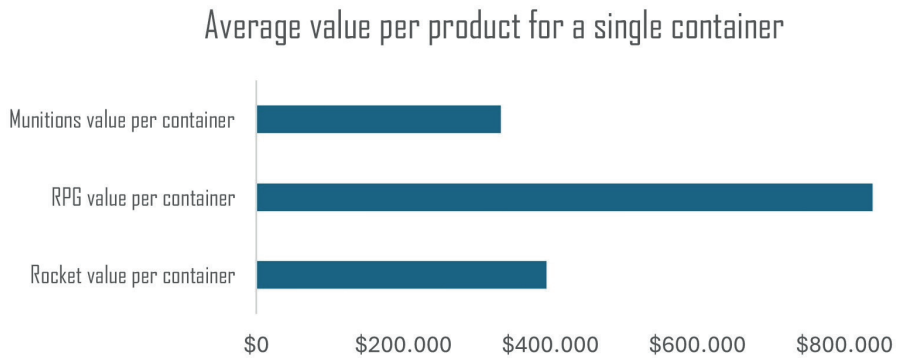

Figure 5. Estimated value per container
Source: Authors.

A similar logic applies to containers: While new units are valued between USD 2,000 and 4,000, used containers range from USD 1,000 to 2,500.[42] We assume that our representative ship has an operational capacity of 261 containers (90% of a nominal capacity of 290 containers) worth a total of USD 522,000.

We have now defined the baseline capital exposure per voyage prior to cargo loading. These values define the maximum capital embedded in each containerized load, which constitutes the relevant metric for evaluating exposure under interdiction-prone maritime conditions.

For methodological consistency with transport-cost reasoning and to avoid overstating cumulative losses, the valuation framework adopted in the following calculations excludes the capital value of the vessel itself and focuses instead on the monetary value of transferred military materiel together with the reusable container stock associated with each shipment. This approach allows the analysis to remain anchored in observed logistical flows and replacement-relevant assets rather than in the full residual value of transport platforms that are operationally reused across voyages.

As for the military materiel, Grad rockets (122mm, 9M22) have an estimated unit cost of USD 1,500, while the cost of an RPG-7 NK is estimated at USD 2,000 (USD 400 per unit). Artillery munitions (122mm) have an estimated unit cost of USD 1,000.[43]

To estimate the total value of cargos, we have drawn up three scenarios based on the distribution of the cargo: In scenario 1, the cargo is equally distributed (33% each) between RPG-7, artillery munitions and Grad rockets. Scenario 2 is based on the following cargo distribution: RPG-7 (25%), 122mm artillery munitions (25%) and Grad rockets (50%), while in the third scenario, 25% of the containers are loaded with RPG-7, 50% with artillery munitions and 25% with Grad rockets.

	SCENARIO 1	SCENARIO 2	SCENARIO 3
RPG-7	USD 72,906,000	USD 55,308,000	USD 54,470,000
Artillery munitions	USD 28,884,000	USD 21,248,000	USD 43,492,000
Grad rockets	USD 34,321,500	USD 51,679,500	USD 25,642,500
Total value of weapons	**USD 136,111,500**	**USD 128,235,500**	**USD 123,604,500**
Cost of containers	USD 522,000	USD 522,000	USD 522,000
Total costs	**USD 136,633,500**	**USD 128,757,500**	**USD 124,126,500**
Value of weapons for 5 shipments	USD 680,557,500	USD 641,177,500	USD 618,022,500
Total cost of 5 shipments	**USD 683,167,500**	**USD 643,785,500**	**USD 620,632,500**
Value of weapons for 35 shipments	USD 4,763,902,500	USD 4,488,242,500	USD 4,326,157,500
Total cost of 35 shipments	**USD 4,782,172,500**	**USD 4,506,512,500**	**USD 4,344,427,500**
Total cost of 35 shipments (rounded)	USD 4.8 billion	USD 4.5 billion	USD 4.3 billion

Figure 6: Scenarios 1-3, a comparative analysis[44]
Sources: Authors.

42 This estimate is based on a likely decrease in value over time. See:, "How Much Does a Shipping Container Cost?," *Container Management*, August 2024, https://www.containermgt.com/how-much-does-a-shipping-container-cost; "20ft Standard New One Trip Shipping Container," *Conex Depot*, August 2024, https://www.conexdepot.com/product/20ft-standard-new-one-trip-shipping-container/; "How Much Does a Used Shipping Container Cost?," Container Addict, August 2024, https://www.containeraddict.com/how-much-does-a-used-shipping-container-cost/; "20 Foot Shipping Containers", On-Site Storage, August 2024, https://onsitestorage.com/20-foot-shipping-containers/.

43 All estimates of the costs of armaments are derived from comparing two research tools based on artificial intelligence. Identical questions were posed, the results compared and the sources verified. Nevertheless, the estimates are based on approximations and deductions related to price trends of similar products.

44 The numerical values reported in the scenario analysis table are intended solely as order-of-magnitude estimates. They are provided for illustrative and comparative purposes and should not be interpreted in a strict or literal sense. The cost of the ship is excluded.

For our final calculations, we assume that the 10,000 figure for the total number of containers moved between September 2023 and February 2024 as reported by the U.S. Department of State is correct. Our initial estimates then account for approximately one-seventh of the total value of cargo delivered from North Korea to Russia during that time. Depending on the distribution of cargo, the value of the shipments is between USD 4.3 billion and USD 4.8 billion.[45] (Figure 6).

This is an astounding sum for a country like North Korea, even if it does not represent cash income. The total value of shipments is three times higher than North Korea's estimated defence budget for 2023[46] and 135 times higher than Russia's official trade with North Korea during that same year.[47] This operation therefore requires a level of investment that makes it strategically important within and beyond the context of Russian-DPRK relations.

Independently of RUSI and the U.S. State Department, a study by Olena Guseinova, based on several different assumptions, arrives at similar conclusions.[48] Indeed, if Guseinova's key figure of 20,000 containers is accurate, then our estimate is very conservative. Also, if the two countries pursued a more diverse weapons exchange, as suggested by Guseinova and confirmed by a report by The *Wall Street Journal* and other recent publications,[49] they could already have reached a much closer economic and military alignment.[50]

Estimated value of later shipments

Deliveries of munitions and rockets continued in 2024 and 2025. We estimate that additional armaments worth more than USD 3 billion were delivered up to April 2025. According to NK Insight, satellite imagery shows that Rajin Port's Pier 2 exported around 6,500 containers to Russia between June 2024 and February 2025.[51] A recent analysis by Reuters indicates that the scale of arms shipments could be even larger than that: According to their findings, between September 2023 and March 2025, approximately 15,800 containers were transferred from Rajin Port in North Korea to the Russian ports of Dunai and Vostochny.[52] Reuters made a conservative estimate that these shipments included four to six million artillery shells, alongside other military supplies.

Based on NK Insights' data for June 2024 to February 2025 and our evaluation regarding the size and weight constraints of standard shipping containers, we estimate that the 6,500 containers shipped during this nine-month period may have contained approximately 400,000 RPG-7s, 200,000 Grad rockets, and 500,000 artillery munitions (assuming a mix of cargo). According to our calculations, the contents of these 6,500 containers would be worth approximately $3.25 billion.

What did North Korea receive in return for all the rockets and munitions? Given the UN trade sanctions, no accurate numbers are available. However, according to RUSI, North Korea recently received shipments of petroleum products accounting for nearly one-fifth of its oil needs: "These five tankers could have moved approximately 125,000 barrels of refined petroleum products – roughly a quarter of the UN-imposed annual oil cap – had they loaded at full capacity."[53] More updated figures resulting from a joint investigation between the BBC and the Open Source Centre of London indicate that at least one million barrels of oil were delivered.[54] At approximately USD 60 per barrel, that oil would be worth around USD 60 million. This does not seem implausible as Kim's regime also needs other commodities, including food, hard currency and satellite technology. Personal gifts and sanctioned luxury goods, including 24 purebred horses, may also have been part of the agreement.[55]

Outlook

Given the military value of artillery shells for Russia and the political importance of oil for the DPRK, both countries can be expected to maintain their cooperation in the short to medium term. As long as the war in Ukraine continues, their strategic convergence will progress in multiple domains, including circumventing Western sanctions and illicitly procuring Western technology.

Even if the war ends, Russia is likely to continue with its shipments to North Korea because, according to the data available, its deliveries to date are not sufficient to cover the value of the munitions it has received. At the same

45 These two numbers are obtained by multiplying the two figures for five shipments per seven (and not 7.7, which would be the more accurate number, but we prefer to err on the conservative side).

46 The estimated 2023 DPRK defence budget is USD 1.4 billion according to open sources (see "North Korea set for modest increase in defence spending," *Janes*, 17 January 2024, https://www.janes.com/osint-insights/defence-news/industry/north-korea-set-for-modest-increase-in-defence-spending).

47 Russia's trade turnover with North Korea amounted to USD 34 million in 2023 (see "Trade turnover between Russia, North Korea up 9 times in 2023 — Russian presidential aide," *TASS*, June 17, 2024, https://tass.com/economy/1804561).

48 Oleva Guseinova, "Putin's Partner – North Korea's Cooperation with Russia Amid the War Against Ukraine," *Friedrich Naumann Stiftung for Freedom Korea*, October 2024, https://shop.freiheit.org/#!/Publikation/1807, in particular see pages 9-13.

49 Dasl Yoon, Matthew Luzmoore, "Satellite Images Show North Korea Boosting Arms Flow to Russia," *The Wall Street Journal*, December 2024, https://www.wsj.com/world/russia-north-korea-weapons-shipment-676d7f52.

50 Guseinova, "Putin's Partner – North Korea's Cooperation with Russia Amid the War against Ukraine," page 13.

51 SI Analytics, "Increased Export Activities Observed at Rajin Port, More Weapons for Russia?," 13 March 2025, https://si-analytics.ai/en/increased-export-activities-observed-at-rajin-port-more-weapons-for-russia-%e2%80%95-march-13-2025/.

52 Tom Balmforth and Mariano Zafra, "Thousands of Troops, Millions of Shells," *Reuters*, 15 April 2025, https://www.reuters.com/graphics/UKRAINE-CRISIS/NORTHKOREA-RUSSIA/lgvdxqjwbvo/.

53 James Byrne et al., "Blood and Oil: Russian Oil Deliveries Follow North Korean Weapons Transfers," *Royal United Services Institute*, 2024, https://www.rusi.org/explore-our-research/publications/commentary/report-blood-and-oil-russian-oil-deliveries-follow-north-korean-weapons-transfers.

54 James Byrne et al., "Refined Tastes Russian Oil Deliveries to Pyongyang Breach the Million Barrel Mark," *Open Source Centre*, November 2024, https://stories.opensourcecentre.org/refined-tastes/.

55 "Vladimir Putin 'Gifts Kim Jong-un 24 Purebred Horses in Exchange for Artillery Shells Used in Ukraine War," *The Independent*, August 2024, https://www.independent.co.uk/asia/east-asia/putin-kim-jong-un-russia-north-korea-ukraine-war-b2604899.html.

time, the use of DPRK weapons and joint Russian-North Korean military exercises in the Sea of Japan signal a further deepening of ties, possibly at China's expense. But what does this mean in the short, medium and long term?

Over the next three to five years, according to our OSINT-validated calculations, total Russian-DPRK transshipment and weapons-related exchanges could reach a cumulative range of roughly USD 9–15 billion if the current tempo of deliveries is maintained. Deviations, of course, are possible depending on conflict duration and the persistence of sanctions-evasion mechanisms. In any case, any figures should be interpreted as order-of-magnitude projections grounded in observed transfer dynamics rather than deterministic forecasts of total bilateral trade.

Trade goods

North Korea and Russia will continue to engage in exchanges of raw materials, workforce contributions, division of labour, and technological know-how. North Korea has provided Russia with military supplies, such as small arms, artillery shells and older or upgraded missile systems.[56] Russia may reciprocate by providing crude and refined petroleum,[57] minerals, and fertilizers. Minerals and fertilizers essential for North Korea's agricultural sector are also significant components of this trade, with estimated annual values reaching up to USD 150 million and USD 140 million, respectively.

Total trade volume as well as the rise in demand for particular goods largely depend on Russia's battlefield strategies. For a more detailed analysis of different categories, please see the appendix.

Labour agreements are already in place, as North Korean workers have – in breach of sanctions – been present in Russia for years.[58] North Korea's labour force contributions, comprising 20,000 to 50,000 workers essential for the construction and manufacturing industries, could generate significant yearly revenue. In addition, as many as 12,000 North Korean soldiers have already been deployed to the war in Ukraine.[59] In Pyongyang, Kim Jong Un publicly praised the sacrifice of North Korean soldiers killed in action in Russia's war against Ukraine.[60]

Technology transfers form another vital component of these exchanges. Russia may send specialists to the DPRK to offer advanced military training and knowledge of critical technologies. Russia could also share older missile guidance systems, industrial equipment and other technical resources, reinforcing its long-term strategic collaboration with North Korea.

Transport logistics

As trade between Russia and North Korea is likely to continue at the current level, at the very least, we can draw some conclusions about plausible transport logistics. Railways, such as the Tumangang-Khasan connection, will remain central for bulk exchanges while maritime routes connecting the port of Rajin to Vladivostok and Nakhodka will continue to be essential for covert operations. Air logistics, though limited, are likely to be reserved for transports of high-value items under scenarios of heightened secrecy or scaled-up cooperation.

Recommendations

By shipping oil, luxury goods and military technologies to North Korea, Russia has effectively violated the UN's sanctions regime. However, after the dismantlement of the UN Panel of Experts on North Korea, it is unclear how to unify monitoring efforts. Some countries like Canada, France, South Korea, Japan and Australia have sent vessels to East Asia to monitor the DPRK's activities. The United Kingdom and Italy also have dispatched ships to the region.

Given the enormous risks associated with North Korea's nuclear programme, NATO, its member states as well as its regional partners South Korea, Japan, New Zealand and Australia (the Indo-Pacific Four – IP4) have an urgent interest in weakening the ties between Russia and North Korea and in strengthening the sanctions regime against North Korea.

Action at the level of the United Nations is probably pointless as Russia can be expected to block more effective inspection and compliance mechanisms. However, the following recommendations can be implemented without a UN mandate:

- NATO institutions would be well advised to continue monitoring North Korea and its trade with Russia even though the Indo-Pacific does not lie within NATO's area of operations.
- NATO and its member states could cooperate more closely with regional enforcement efforts via the Indo-Pacific Four (IP4), consisting of NATO's regional partners. This could include supporting operations such as Australia's Argos as well as exchanging intelligence and satellite data.
- NATO's member states and the IP4 could join efforts to identify individuals and companies involved in the illicit arms trade and to impose and tighten sanctions. To this end, closer cooperation would also be necessary amoung the U.S. Treasury Department, the European Union and the regional partners.
- NATO member states could reach out to East Asian countries to explore ways of creating a more

56 Guseinova, "Putin's Partner – North Korea's Cooperation with Russia Amid the War against Ukraine."
57 Byrne et al, "Refined Tastes – Russian Oil Deliveries to Pyongyang Breach the Million Barrel Mark."
58 Anastasia Napalkova, "The Secret World of Russia's North Korean Workers," BBC, April 2019, https://www.bbc.com/news/world-europe-43802085 and Greg Scarlatoiu, "North Korean Workers Officially Dispatched to China & Russia", Human Rights Denial, Chain of Command & Control, 2022, page 16, https://www.hrnk.org/wp-content/uploads/2024/07/Overseas_Workers_0926.pdf
59 Justin McCurry, "More Than 1,000 North Korean Military Casualties in Ukraine War, says South Korea," *The Guardian*, 23 December 2024, https://www.theguardian.com/world/2024/dec/23/north-korean-soldiers-killed-wounded-ukraine-war-south-korea.
60 NBC, "Kim Jong-un Praises North Korean Soldiers Who Died for Russia as 'Heroes' in Emotional Ceremony," *NBC*, August 2025, https://www.nbcnews.com/world/asia/kim-jong-un-praises-north-korean-soldiers-died-russia-heroes-rcna226486.

constructive regional ecosystem for peace and security. Any development that would lead Russia to transfer nuclear and missile know-how to North Korea is dangerous not just for NATO and its partners in the region, but also for every other major or minor power in East Asia.

- NATO countries could consider opening up channels to the North Korean regime to discuss under which circumstances North Korea could be allowed to resume legal imports of oil and food.

Appendix: Future trade flows between North Korea and Russia

Not only the total trade figures but also the demand for specific goods will depend on Russia's future battlefield needs, on transport capacities, and on the political environment. The graph below illustrates the range (Min-Max) of values for different categories of products over the next three to five years.

The asymmetric expansion observed across different categories of exchanged goods is not arbitrary but reflects structurally distinct causal mechanisms shaping Russian–DPRK wartime economic interaction.

First, attrition-driven consumables—such as artillery shells and RPG ammunition—display the widest divergence between minimum and maximum projected values. Their demand scales quasi-linearly with battlefield intensity, making them highly sensitive to conflict duration and operational tempo. Consequently, even moderate escalation scenarios generate disproportionately large increases in their annual monetary value.

Second, capacity-constrained industrial and logistical goods—including rail cars, machine tools, and construction inputs—exhibit comparatively limited variation. These items depend on production lead times, infrastructure availability and transportation bottlenecks, which impose structural ceilings on short-term expansion regardless of battlefield dynamics.

Third, politically sensitive strategic technologies—notably missile guidance systems, advanced military expertise and dual-use technical transfers—follow a discontinuous growth logic. Their exchange is governed less by operational demand than by high-level political decisions and risk tolerance regarding sanctions escalation. As a result, their projected values may appear disproportionately large relative to baseline levels, reflecting threshold-based rather than incremental escalation.

Taken together, these three mechanisms—operational elasticity, industrial capacity constraints and

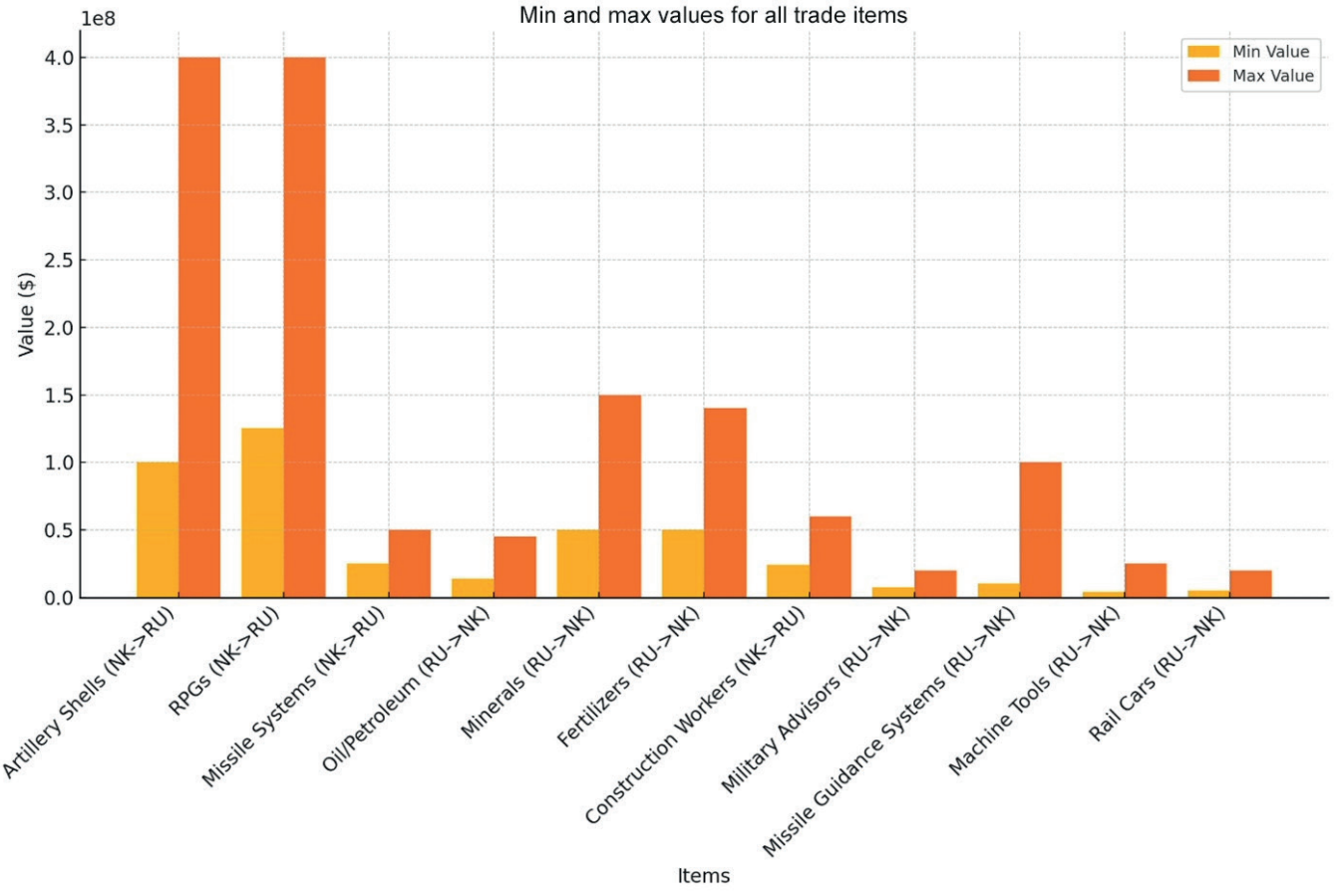

Figure 7. Min and max values for all trade items.
Source: Authors.

political-strategic threshold effects—explain the uneven scaling patterns visible in the min–max projections. The resulting asymmetry therefore constitutes an expected structural feature of wartime clandestine trade systems rather than a modelling inconsistency.

Category	Battlefield elasticity	Capacity constraint	Political threshold	Resulting elasticity regime	Expected min–max spread
Artillery shells	High	Low	Low	**High-elasticity consumable**	Very wide
RPG ammunition	High	Low	Low	**High-elasticity consumable**	Very wide
Missile systems	Medium	Medium	High	**Threshold-dependent strategic**	Wide but discontinuous
Missile guidance tech	Low	High	Very high	**Threshold-dependent strategic**	Step-change expansion
Petroleum products	Medium	Medium	Medium	**Hybrid constrained**	Moderate
Minerals & fertilizers	Low	Medium	Low	**Capacity-linked**	Moderate-low
Construction workers	Medium	Low	Medium	**Labour-elastic hybrid**	Moderate
Military advisers	Low	Low	Very high	**Political-threshold**	Discontinuous
Machine tools	Low	High	Medium	**Capacity-constrained**	Narrow
Rail cars	Low	Very high	Low	**Strongly constrained**	Very narrow

Figure 8. MCDA matrix of trade elasticity[61]
Source: Authors.

61 At the present stage of the analysis, the relative weight assigned to the variables included in the MCDA-elasticity framework is determined through qualitative expert judgment rather than formal mathematical calibration. This choice reflects both the structural opacity of clandestine sanction-evasion systems and the limited reliability of open-source quantitative baselines for several exchange categories, particularly those governed by political authorization or covert logistical constraints.

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