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DODGING ECONOMIC ISOLATION: THE ASYMMETRIC IMPACT OF WESTERN SANCTIONS ON BELARUS

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Dodging Economic Isolation: The Asymmetric Impact of Western Sanctions on Belarus

David Zehner*

Abstract

This paper assesses the economic consequences of targeted Western sanctions on Belarus following the 2020 post-election crackdown. This study analyses aggregate exports alongside a specific focus on potash, a vital state revenue engine where Belarus commands 20% of global production, making it a sensitive global commodity. Utilising a Difference-in-Differences (DiD) framework and complemented by Synthetic Control Methods (SCM), the study evaluates bilateral trade flows from 2015 to 2021. The results reveal a structural asymmetry, where the initial economic shock caused a 48.5% contraction in Belarus's aggregate exports relative to a post-Soviet control group, and potash exports remained insulated, yielding an insignificant coefficient of 0.000 relative to global peers. This divergence suggests that while comprehensive measures disrupted aggregate trade, targeted sectoral sanctions faced enforcement limits. This study contributes to literature on sanction circumvention in integrated regional markets.

JEL Classification: F14, F51, P33, C21

Keywords: sanction effectiveness, trade circumvention, Belarus, potash sector, Difference-in-Differences

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1. INTRODUCTION

Policymakers have long favoured economic coercion as a non-military tool to influence foreign state behaviour, sparking robust literature on the intersection of geopolitical conflict and international trade (Hufbauer et al., 2007; Haidar, 2017; Neuenkirch & Neumeier, 2015). The policy tools implemented were designed to pressure regimes while theoretically minimising civilian harm. Tools, such as sanctions, range from targeted financial bans to comprehensive trade embargoes (Crozet & Hinz, 2020). Their rising frequency is of profound global relevance in that by 2023 roughly 12% of country pairs and 27% of global trade were constrained by economic sanctions (Felbermayr et al., 2025). This proliferation highlights a central divide between disciplines. While economists focus on the inevitable economic costs, political scientists observe that substantial economic pain rarely guarantees policy concessions (Felbermayr et al., 2025; Eggers et al., 2024). This divergence raises a compelling question: if sanctions are costly and frequently fail to deliver their objectives, why do they remain so prevalent?

Part of the answer lies in the shift from comprehensive *blanket* embargoes toward *smart* or *targeted* sanctions designed to isolate vital economic sectors and regime-aligned elites. Following the disputed 2020 presidential election and subsequent political crackdown in Belarus, Western allies (including the EU, US, and UK) deployed a mix of these measures to restrict the Lukashenka regime's access to global markets. Commanding roughly 20% of global production, potash serves as both a primary foreign revenue engine for the state and a systematically sensitive global commodity. Examining potash alongside aggregate trade is critical for structural logic. Its high global demand and market centralisation create strong incentives for enforcement friction and strategic resilience that the general export sector lacks.

Despite extensive research on economic coercion, empirical evidence on Belarus remains scarce. Existing studies predominantly focus on large, long-sanctioned states like Iran and Russia (Crozet & Hinz, 2020; Scheckenhofer et al., 2023; Haidar, 2017). The post-2020 Belarusian case offers a distinct natural experiment, where a small, landlocked economy leverages a monopolistic resource under high-intensity pressure. Current literature lacks insights into how regional integration shields such economies from isolation. As a core member of the Eurasian Economic Union (EAEU) and its shared Customs Union, Belarus possesses a unique institutional buffer to rapidly alter its trade routes for both aggregate goods and specialised bulk commodities.

This study addresses these gaps by evaluating Belarus' trade performance from 2015 to 2021. Employing a Poisson Pseudo-Maximum Likelihood (PPML) framework with high-dimensional fixed effects alongside a Difference-in-Differences (DiD) approach, this study isolates a stark empirical asymmetry in how these sanctions impacted different sectors and partners. While total Belarusian exports fell by 48.5% relative to the control group, the coefficient for the indispensable potash sector remained a statistical zero (*0.000*), demonstrating that targeted sectoral sanctions face enforcement limits compared to broader trade bans. This friction is also evident across trading partners. Belarusian exports to sanctioning states collapsed by 63.5% overall, yet potash-specific exports to those exact same countries experienced an insignificant 7% increase. Exports to non-sanctioning states trended downward, suggesting a compliance chilling effect among non-aligned nations. Leveraging EAEU ties, the findings reveal that while Belarus struggled with direct total exports, neighbouring Kazakhstan experienced a 99.4% export surge during the same period, signalling extensive regional trade rerouting.

This paper quantifies the short-term macro-consequences of targeted coercion. The findings provide empirical support for the hypothesis that regional-integrated partners helped facilitate trade rerouting to evade Western sanctions without a quantification bias. This study adds new evidence on how economic isolation reshapes Eastern European trade networks.

2. BACKGROUND AND WESTERN SANCTIONS

2.1. Election Sanction Timeline

The EU, the United States, Canada, and the United Kingdom adopted multiple sanction packages following the disputed presidential election on 9 August 2020. According to the Belarusian Central Election Commission, the incumbent Alexander Lukashenko secured 80.1% of the vote with an 84.3% turnout. However, these official results were widely contested by Western governments and international observers, sparking widespread civil unrest amid documented allegations of electoral fraud and human rights abuses (Coleman, 2021). Subsequent formal assessment of the election’s legitimacy by these sanctioning partners led to extensive, coordinated sanction packages intended to pressure the Belarusian leadership and deter future democratic transgressions.

In total, there were 5 separate packages of sanctions delivered over 16 months. Figure 1 lays out the timeline from when the election was held to when the last package was announced. The figure depicts the announcement and execution date for each package. For sanction packages 1, 2, 3, and 5, their execution was effective immediately (EC, 2025). Package 4 was extended to include vital industries, such as potash and petroleum. The sanctions’ objectives included the release of political prisoners and unjustly detained individuals, as well as the initiation of a genuine and inclusive national dialogue (EC, 2024).

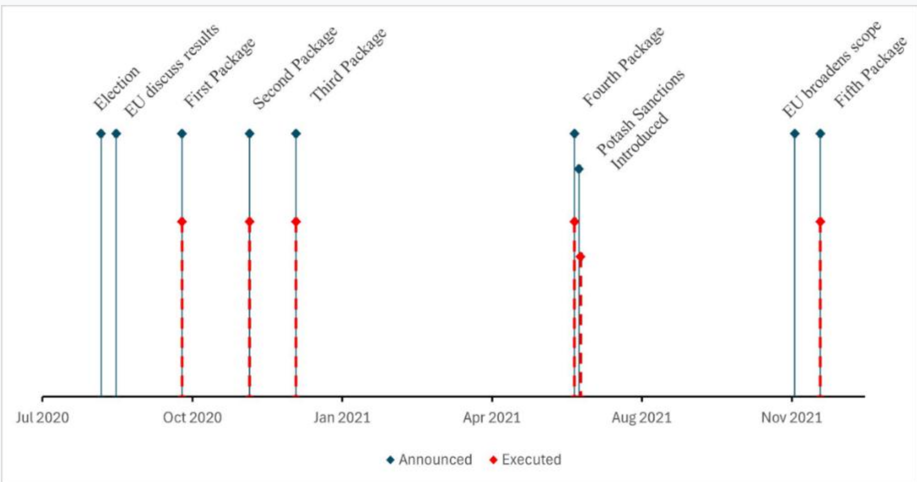

Figure 1. Belarus Sanction Timeline

In the first package of sanctions, announced on 2 October 2020, the EU-27, United Kingdom, and Canada imposed travel bans and asset freezes on individuals and entities responsible for the repression and intimidation of peaceful protestors (EC, 2024). The second and third packages were announced and executed on 16 November 2020 and 17 December 2020, respectively. Absent from the first two packages, the United States joined the other sanctioning bloc in the third package to continue the effort to invoke political change. In these initial *blanket* packages, 310 individuals and 46 entities were sanctioned, including Lukashenko, propagandists, the prosecutor general, propaganda outlets and the Supreme Court.

The fourth package was announced on 21 June 2021 as the initial reaction to the forced landing of a Ryanair flight and continuing repressions. This package was extended a couple of days later, on 24 June 2021, to include additional responsible individuals, the potash and petroleum industries, and EU financial service restrictions. The EU broadened its listing criteria on 15 November 2021, and the fifth and final package of sanctions was announced and executed on 2 December 2021. The final package was in response to continued human rights abuses and the instrumentalisation of migrants by their European neighbours to the West. The analysis period used in this study ends in 2021 due to the isolation of these sanction packages with the additional measures placed on Belarus' for its involvement in Russia's invasion of Ukraine in 2022. The sanctions stemming from the 2020 election will remain in effect until February 2027.

2.2. Potash Sector

Potash is a vital product in the agriculture and food supply chain. Feeding an ever-growing global population requires a constant supply of potash and other essential nutrients. The main ingredients of agricultural fertilisers consist of nitrogen (N), phosphorus (P), and potassium (K). High crop yields and plant health are highly dependent on sufficient potash in many growth processes (Wakeel & Ishfaq, 2022). There are no known substitutes for potassium as a key nutrient for plants. Alternatives, such as organic materials like manure or compost, may contain some potassium, but they cannot be true substitutes. Soils enriched with potassium improve plant quality and reduce crop diseases to increase shelf-life and yields (Yager, 2016). Adequate potash supply help crops withstand environmental stresses and protects local populations from crop failures and the resulting economic shocks. The indispensability of potash has transformed it into a major product in Belarus' export portfolio on which the overall health of the economy depends.

The state-controlled potash industry is one of the most important revenue sources for the Belarusian state. Belaruskali built a monopoly in the industry and is one of the world's largest potash producers. Figure 2 shows the percentage of total Belarusian exports accounted for by potash-related products (HS Code 3104). Over this period, an average of 8% of Belarusian exports were related to the potash sector. Prior to 2019, Belarus exported more than 10.5 million tonnes of potash fertiliser to more than 100 countries worldwide (German Economic Team [GET], 2021). The largest importers were Brazil, China, Indonesia and India, which accounted for over half of potash exports. Another 15% would go to the EU and the US, indicating an integrated market for this small trade-dependent country. These logistical relationships would make Belarus the third-largest potash exporter in the world, allowing them to control roughly 20% of the global potash market (GET, 2023). Canada, Russia and Belarus control the majority of global potash reserves resulting in the potash market being highly concentrated within these countries. Belarus' stake in this critical industry makes global agricultural stability vulnerable to internal political disruptions but also makes it a tough trade relationship to completely abandon.

The importance of potash to Belarus' trade portfolio made it a justified target for restrictive measures following the 2020 election. With the announcement of the fourth sanction package on 24 June 2021, EU partners were prohibited from importing, purchasing, or transferring potassium chloride ("potash") products from Belarus (EC, 2024). Some larger importers terminated relations immediately, forcing Belarus to change its export strategy quickly. The sanctions allowed for existing contracts signed before 25 June 2021 to continue to be fulfilled. As global potash prices have stabilised over the last couple of years, sanction measures on the potash industry will continue to remain one of the most valuable pressure instruments in the international community's toolkit.

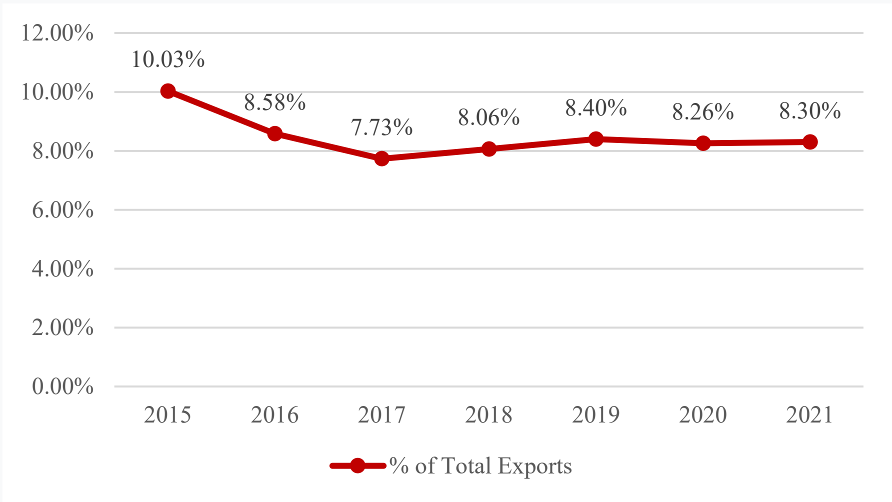

Figure 2. HS4 3104 as % of Total Belarusian Exports

Logistically, landlocked Belarus relied heavily on the transport infrastructure of other countries for shipping to overseas partners. Lithuania plays the biggest role, as 90% of Belarusian potash was estimated to be exported through Klaipeda (GET, 2023). This makes Lithuania one of Belarus' most important partners. Lithuania gradually banned transit through its country, which allowed Belarus to expedite exports according to the EU 25 June contract deadline before having to look elsewhere for transportation (Černiauskas et al., 2022). Russia, as a major competitor in potash, was reluctant to provide access to its infrastructure but inevitably opened St Petersburg as an alternative route for Belarus.

3. LITERATURE REVIEW

3.1. Sanction Effectiveness

Economic sanctions have evolved from the late 19th century blockades designed to interrupt the flow of goods and information to adversaries into the primary mechanism of modern foreign policy (Mulder, 2022). Deployed as alternatives to military conflict to shield the public from extreme hardship, these tools increasingly to seek alter political regimes, institutional structures, and international standards (Mulder, 2022). Following the creation of the UN Charter in 1945, the practice of inflicting economic damage transitioned from an exclusive UN instrument to a frequent unilateral tool for individual nations. This transformation was shaped by 20th-century geopolitical benchmarks, such as the Arab States' boycott of Israeli products, the USSR blockade of Yugoslavia, and the British recourse to Iranian oil (Thouvenin, 2020). The expansion of these *blanket* measures is highly visible where the total number of sanction regimes implemented following the Cold War nearly equalled those recorded during the first ninety years of the twentieth century (Hufbauer et al., 2007). The United States and the

European Union have been particularly active since World War II, utilising sanctions against the communist bloc, China, Argentina, Cuba, and most recently, launching multiple enforcement packages against Russia (Thouvenin, 2020). Strategic design has similarly evolved, shifting toward smart, targeted measures to raise a regime's cost of non-compliance without the devastating impact of total economic isolation (Drezner, 2011). For global powers, this rationale is frequently driven by the cost of inaction. The loss of domestic and international confidence in a state's willingness to act is perceived as more damaging than the immediate costs of the sanctions themselves (Hufbauer et al., 2007).

Despite their popularity, the political and economic success of these mechanisms remains a subject of academic debate. Empirical results suggest that sanctions achieve their intended political objectives in only about one-third of cases, while simultaneously imposing substantial economic costs on the target nation (Drezner, 2011; Hufbauer et al., 2007). The opposing view is that sanctions have often failed to exert significant, sustainable stress on trade. Pape (1997) challenged these assessments, arguing that sanctions rarely alter the structural incentives of ruling elites, and demonstrating a historical success rate of less than 5 per cent. This core scepticism has redirected contemporary research from diplomatic rhetoric toward evaluating objective, measurable economic consequences (Pape, 1997). When human rights serve as the core rationale for intervention, economic coercion can prove counterproductive, frequently leading to heightened domestic abuses as the punished regime tightens internal control (Peksen, 2009). The resulting disruptions trigger long-term developmental scars. Elevated casualty rates, refugee outflows, and diminished human capital are prevalent as unpopular elites mitigate personal risks by shifting economic burdens onto political opponents or disenfranchised groups (Justino, 2011).

To model these outcomes theoretically, literature frequently relies on utility analysis and game-theoretic approaches (Eaton & Engers, 1992). Foundational strategic frameworks reveal that successful coercion is most likely to conclude at the threat stage. However, while initial models imply high equilibria of success, real-world complexity and selection effects often understate these success rates in empirical data (Drezner, 2003). As a strategic interaction between sender and target countries, a sanction's ultimate success depends heavily on the credibility of the threat. The balance between enforcement costs and informational symmetry can inadvertently increase negotiation delays (Eaton & Engers, 1992). Modern theoretical advances have integrated these dynamics into sophisticated general-equilibrium trade models. Sanctions are formalised as significant increases in trade costs that propagate through complex global production networks via direct trade restrictions, financial frictions and reputational spillovers (Fajgelbaum & Khandelwal, 2022). The policy instruments result in lower aggregate real income, but the recorded macroeconomic effects are often smaller in magnitude relative to major national statistics, such as total GDP.

These global networks introduce measurement challenges, particularly when attempting to isolate causal effects without ethical or practical opportunities for randomised treatment assignment across sovereign states (Rubin, 1978). To overcome these limitations, modern empirical designs leverage structural foundations like Difference-in-Differences (DiD) analysis. Researchers additionally rely on the Synthetic Control Method (SCM) to overcome unstable pre-trend assumptions and properly analyse long-run counterfactual effects across broader country samples (Chupilkin et al., 2022). Comprehensive panel analyses covering 160 countries demonstrate that UN and US sanctions reduce target-country GDP growth by two to four percentage points annually, inflicting measurable damage on core indicators even when utilizing directed smart measures (Neuenkirch & Neumeier, 2015; Drezner, 2011). These sustained economic losses are particularly acute for smaller, trade-dependent economies.

Limited economies must generate rapid internal flexibility and reallocate resources across and within borders to prevent specific sectors from being decimated by precise policy tools.

3.2. Trade Circumvention

Larger economies can maintain their strategic advantage through the reallocation of resources across vital industries to navigate trade shocks. This results in market fragmentations that alter firm heterogeneity, weaken international co-movement, and lower the domestic environment's attractiveness for firm entry (Ghironi et al., 2024). Welfare analyses indicate that sanctions targeting consumer-good trade yield the largest economic losses (Dang et al., 2024; Ghironi et al., 2024). This creates a compelling shift toward less efficient domestic production sectors where the target country lacks a comparative advantage. Beyond aggregate output, these restrictions reshape internal economic structures and exacerbate inequality by disproportionately harming lower-income groups while leaving political elites relatively insulated (Afesorgbor & Mahadevan, 2016). For example, targeted sanctions against specific state programmes can lead to a severely diminished middle class, stripping the population of a traditional economic driver of reform and altering the balance of power (Farzanegan & Habibi, 2025; Acemoglu & Robinson, 2005). When the middle class contracts, lower-income demographics represent a larger share of the population, which frequently induces the ruling elite to favour political repression over democratisation to prevent revolution.

These severe macroeconomic realities motivate firms and states to seek alternative trade pathways. Recent empirical literature tracking specific trade outcomes demonstrates that bilateral sanctions disrupt export and import flows, causing *friendly fire* costs for the sanctioning countries due to direct retaliation, counter-sanctions, and an inability to successfully redirect disrupted trade to alternative markets (Crozet & Hinz, 2020; Lektzian & Souva, 2003). For trade-dependent nations, these initial disruptions eventually spill over into products that were not directly targeted by the original sanctions, distorting established export patterns and inducing long-term trade inefficiencies (Crozet & Hinz, 2020). Targeted states actively attempt to mitigate these losses through partial trade diversion, rerouting necessary export volumes through third countries. Deep bilateral and regional interdependencies complicate a firm's ability to comply with conflicting international demands. Meaning that if a third-party country withdraws its direct relations, the target nation will deepen ties with alternative regional partners through systematic circumvention (Dang et al., 2024).

This phenomenon of "roundabout trade" is highly prevalent across interconnected geopolitical networks. Following the imposition of strict EU sanctions on Russian exports, direct exports of disaggregated products to Russia declined by approximately 60% more for sanctioned goods than for non-sanctioned products (Chupilkin et al., 2026). At the same time, EU exports of those restricted items to regional intermediaries in the Caucasus and Central Asia rose by an additional 30%, providing clear evidence of trade diversion to evade enforcement and stabilise the target economy. For restricted regimes, these rerouting strategies allow exporters to successfully alter trade trajectories and maintain the status quo. Firm-level data indicates that exporters actively adjust micro product classifications, particularly regarding restricted dual-use or military goods, to continue trading prohibited items. While detecting this evasive activity remains operationally difficult, empirical evidence shows that friendly intermediary countries are 20% more likely to bypass sanctions to export military goods to restricted states compared to neutral nations (Scheckenhofer et al., 2023).

These adaptive re-exports play a vital role in helping a target country avoid economic collapse. This avoidance is driven largely by weak institutional enforcement and the widespread availability of substitute markets (Early & Spice, 2015). International organisations unintentionally facilitate these logistical realignments where member states are statistically far more likely to engage in sanction-busting if the overarching international institution does not officially participate in the sanctioning effort (Early & Spice, 2015). This allows target countries to seamlessly coordinate with non-sanctioning partners. Extensive upstream relabelling and downstream reclassification conceal a substantial portion of continued trade, leading to a drastic underestimation of global evasion in aggregate trade statistics (Iyoha et al., 2025). Micro transaction-level data demonstrates that rerouting can account for significant percentages of export growth within intermediary trade hubs, highlighting the structural limits of aggregate data for uncovering circumvention networks. While these complex concealment and rerouting strategies rarely fully compensate for the losses of direct trade, they demonstrate the profound adaptability of sanctioned economies and their capacity to undermine the policy goals of sanctioning bodies.

4. DATA

The analysis here is based on bilateral trade data obtained from the UN Comtrade Database for 2015 to 2021. This period includes five pre-treatment years, a one-year transition period in 2020 when the sanctions began, and a one-year post-sanction period to analyse the initial performance shock. The years following 2021 were excluded due to no verifiable annualised UN Comtrade data for Belarus. To ensure there was no dramatic or radical shift in the reporting of 2021 exports, the total statistics were confirmed against the available data from the National Statistical Committee of the Republic of Belarus (*BelStat*).

The datasets include annual export values (in current USD) for Belarus and a set of comparable control countries. The first control group (*Total Exports*) is used when analysing total export performance. These non-sanctioned countries were selected because they are small- to mid-sized transition economies in the post-Soviet region with similar trade structures, geographic characteristics, and historical linkages. The group consists of: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan and Uzbekistan.

The second control group (*Potash Exports*) is used when analysing potash export performance. These countries were selected because they are the remaining top 10 global potash exporters (U.S. Geological Survey, 2024). This group consists of: Canada, Chile, China, Germany, Israel, Jordan, Laos, Russia and the United States. With Belarus being the third-largest global potash supplier, these peers can illustrate global trends, price shocks, and other geopolitical challenges.

The dependent variable in the main specification is export value in USD and represents the export value from the reporter country i to partner j in year t. The dataset excludes import values, as exports serve as the primary outcome variable, given that sanctions directly constrained Belarus' ability to sell goods abroad. The data was merged with auxiliary country-level and geographic information from the CEPII GeoDist database (Mayer & Zignago, 2011), which provides bilateral distance and border indicators. The CEPII controls capture differences in economic size and proximity that influence trade flows, according to the gravity model framework. Also included are GDP and GDP per capita for each partner country provided by the World Bank's World Development Indicators (WDI). These macroeconomic controls ensure that bilateral trade variations are properly isolated from country-specific income levels and market sizes across product aggregations, sanctioning partners, and the treatment country variable (*belarus*).

To analyse the impact of direct sanctions imposed on specific products, the study will break down the exports by product aggregation codes. The HS code system 2012 version is utilised to maintain a consistent product code throughout the duration of the study. For the analysis of potash exports, the HS product aggregation codes are *31* (HS2), *3104* (HS4), and *310420* (HS6). Potash-related exports are identified using HS Chapter 31 and its relevant subheadings for potassium compounds. The baseline will be extended to analyse each level of product aggregation and determine whether the direct sanctions imposed on key industries had a significant impact.

Three separate datasets were created to run the analysis. The first dataset for total exports, the second for potash exports, and the third for synthetic control estimation. The total exports dataset includes Belarus and the *Total Export* control group as reporter countries. The initial dataset results in 1.24 million observations, broken down by each reporter country and each product aggregation. After cleaning the data to guarantee matching country codes (*iso3*) to distinct partners and avoiding double-counting exports in the aggregate, there are roughly 879k observations. The potash exports dataset includes Belarus with the *Potash Export* control group. This dataset initially contains 13,679 observations, and after cleaning the data, is reduced to 11,456 observations. In the datasets, Belarus is the *treated* country. Kazakhstan will also have its own dummy as a *treated* country to isolate their export performance.

The synthetic control dataset was created for both total and potash exports. The time duration for the SCM dataset is from 2012 to 2021. The timeline is extended to include greater pre-treatment to better estimate the weights for the SCM. In the synthetic total export analysis, there are 15 variables and 90 country-year observations. For the synthetic potash export analysis, there are 16 variables and 100 country-year observations.

5. EMPIRICAL STRATEGY

5.1. Difference-in-Differences

To estimate the impact of post-2020 sanctions on Belarus' trade, a Difference-in-Differences (DiD) framework is employed for both the total and potash exports. This approach is similar to Crozet and Hinz (2020) but will extend the theoretical foundations of the model. This methodology compares changes in Belarus exports before and after the treatment (introduction of sanctions) with those in the corresponding non-sanctioned control countries. This method matches and isolates the within-group variation for both the treated country and the untreated group. The approach controls for group differences and time differences, although the untreated group is not affected by the treatment, it is affected by time.

The baseline model will include the pre-sanction period of 2015-2019, the one-year period during which the sanction period begins, and the one-year post-sanction period in 2021. The model will demonstrate the immediate short-run impact of sanctions without diving into the long-run effects. The estimation will also use the Poisson Pseudo-Maximum Likelihood (PPML) method. PPML will be used to handle zeros in the independent variables and to avoid the heteroskedasticity bias common in log-linear OLS and other estimation models (Silva & Tenreyro, 2006). The baseline specification is given by:

$$Exports_{ijt} = \alpha + \beta\left(treat_i \times Post2020_t \times sanction_j\right) + Controls_{ijt} + \gamma_i + \theta_j + \delta_t + \varepsilon_{ijt}$$

where:

- $Exports_{it}$ - face value of total exports (USD) of reporter i to partner j in year t
- $treat_i$ - binary indicator for the *treated* country (Belarus)
- $Post2020_t$ - binary indicator for the post-treatment period
- $sanction_j$ - binary indicator for the sanctioning partner
- $Controls_{ijt}$ - include partner GDP and other gravity-standard covariates
- γ_i - reporter fixed effects
- θ_j - partner fixed effects
- δ_t - year fixed effects
- ε_{ijt} - error term

The coefficient of interest, β, measures the average treatment effect of the sanctions on Belarus' exports relative to the control group, after accounting for the fixed effects. To calculate the percentage change from the coefficient (β), the formula $(e^{\beta} - 1) \times 100$ is applied. For example, a coefficient of *-0.665* results in a change of $(e^{-0.665} - 1) \times 100$ = *-48.5%.* This transformation is necessary because the PPML model utilises an exponential link function, meaning that the coefficients are interpreted as semi-elasticities similar to a log-linear specification. A negative and statistically significant β would indicate that Belarus experienced a disproportionate decline in exports post-treatment. The specification includes a triple interaction involving Belarus, the post-2020 period, and the sanctioning partner indicator. The binary indicators will determine whether the reporter country is the *treated* country (Belarus or Kazakhstan in the alternative), if the period is pre-, post-, or transition, and whether the partner is the one imposing the sanctions. The $Controls_{ijt}$ includes partner GDP and other gravity-standard covariates, such as distance between capitals (km) or shared border.

High-dimensional fixed effects PPML estimation is used because the trade data can contain numerous zero flows and exhibit heteroskedasticity, which would introduce a severe bias in a standard log-linearised OLS framework. First, reporter fixed effects are included to control for time-invariant exporter characteristics, such as the overall size of the economy, institutional quality, geography, and a nation's long-run comparative advantage. Second, partner fixed effects are used to control for time-invariant importer characteristics, such as market size, demand structure, geographic position and trade openness. These fixed effects control for permanent differences across market destinations. Third, year fixed effects are included to control for standard shocks such as Covid-19, along with global commodity price cycles and trade disruptions. With year fixed effects, these will net out global shocks affecting all trade flows. Including these fixed effects helps isolate the direct impact of the sanctions on Belarusian exports from contemporaneous shocks. All regressions are estimated using robust standard errors to address heteroskedasticity. Because the data are structured at the bilateral level, all trade partners (i.e., other import destinations) are included in the estimation. There are no complementary regressions using import data as the dependent variable, as the sanctions were primarily targeted toward Belarusian exports. Further studies could implement import data to assess whether sanctions also constrained Belarus' import capacity.

To validate the DiD identification strategy, a parallel trends analysis is conducted to examine whether the treated and control units followed comparable trajectories prior to the sanction period. Figure 3 plots the average log-exports for Belarus against the *Total Exports* control group (left). Visual inspection of the pre-treatment period (2015--2019) reveals that while both groups exhibit broadly similar upward trajectories, the trends are not perfectly parallel. For total exports, the control group's growth proceeded at a slightly different rate than that of Belarus. This could be a result of the market liberalisation experienced in Uzbekistan in 2017, and sustained export expansion in Azerbaijan and Kazakhstan. These trends suggest shared underlying trade dynamics, but with the lack of perfect alignment, it underscores a common limitation of DiD studies using macro-level data. To complement the DiD analysis, the Synthetic Control Method (SCM) is employed. By contrasting a counterfactual that re-weights control countries to match Belarus' pre-treatment path, the SCM addresses the potential selection bias and trend divergence that a simple unweighted control group might introduce.

The right side of Figure 3, focusing on potash exporters, shows loosely coupled trends in the pre-treatment period, likely dictated by global potash price fluctuations. However, the volatility inherent in commodity markets makes a perfect parallel assumption difficult to satisfy via DiD alone. Post-2020, Belarus' potash exports show a pronounced decline relative to the control group of global producers. While the potash sector contraction was severe, total exports exhibit a persistent downward shift. This suggests that the sanctions effectively constrained the sector's previous growth momentum, forcing a transition from growth to stagnation.

5.2. SUTVA Extension

To empirically justify the selection of the secondary *treated* unit for the circumvention analysis, a preliminary screening was conducted of all post-Soviet partners, including Russia. Using a modified PPML-DiD framework to isolate post-treatment trade shocks, the objective was to identify a specific partner acting as a conduit for roundabout trade. While most regional partners followed a downward trajectory due to the compliance chilling effect, Kazakhstan emerged as a significant statistical outlier (Table 9, Appendix), exhibiting an export surge that coincided precisely with the imposition of Western sanctions.

Figure 3 (bottom) depicts the parallel trends analysis for Kazakhstan's export volumes, which moved broadly in tandem with the control group prior to 2020 due to shared regional macroeconomic shocks. While Kazakhstan displays some individual baseline volatility between 2015 and 2019, the post-2019 divergence is statistically overwhelming. The near-vertical increase in log-exports represents a structural break that cannot be explained by standard regional economic recovery, validating its selection.

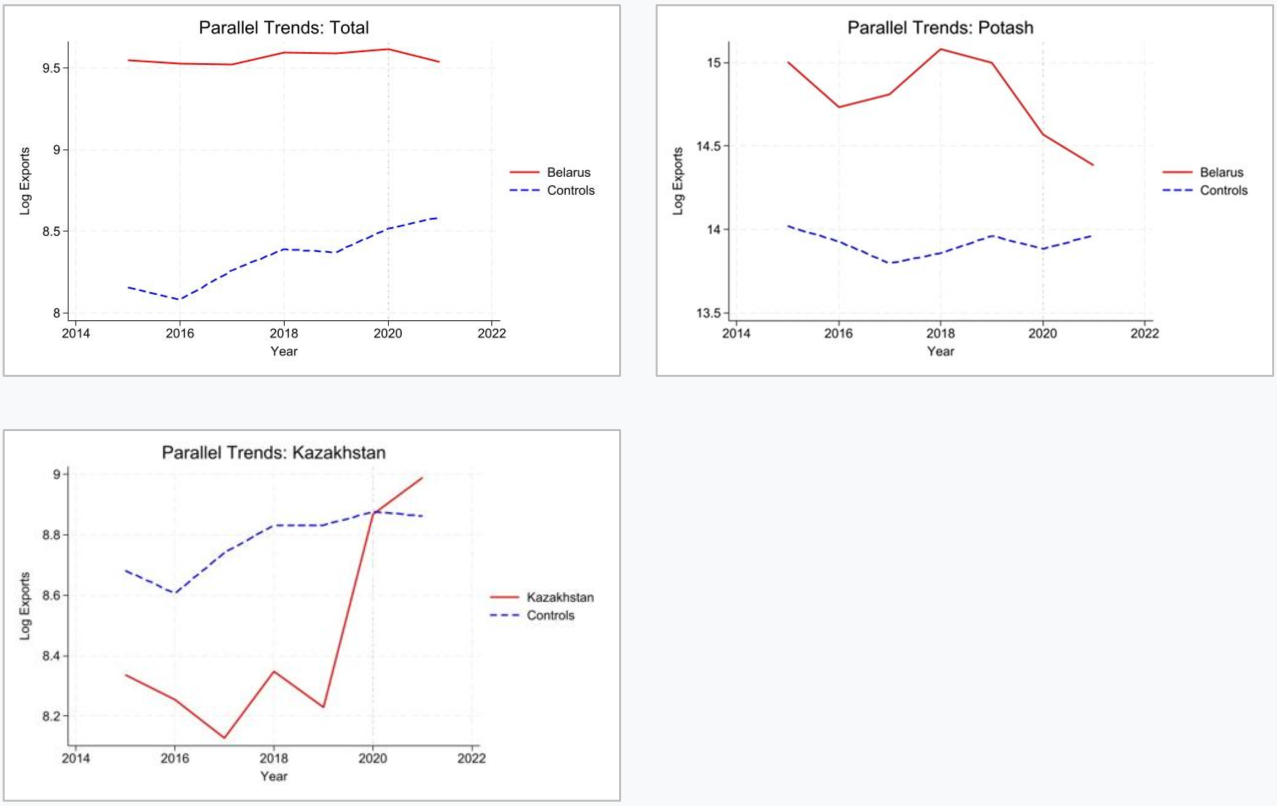

Figure 3. Parallel Trend average for log total and potash exports by year

Following this verification, the main model was extended by shifting Kazakhstan from the control group to a secondary *treated* unit. This simulation follows the framework established by Chupilkin et al. (2023) to capture a Stable Unit Treatment Value Assumption (SUTVA) violation. In highly integrated environments like the EAEU Customs Union, a SUTVA violation, where the treatment of one unit (Belarus) spills over to alter the trade flows of another (Kazakhstan), provides direct empirical evidence of trade circumvention. In this setup, Kazakhstan effectively serves as a proxy for the diverted Belarusian trade, mapping the roundabout pathways used to evade economic coercion.

5.3. Robustness Checks

To ensure that the main findings are not driven by modelling choices or data structure, several robustness checks are performed. These checks are performed for both export groups. First, the model is re-estimated excluding the transition year of 2020. The sanctions and trade disruptions were introduced and intensified during that year, suggesting they may represent a partial treatment period and a drop-off period in 2020, depending on how the treatment timing is defined. Second, the analysis is repeated over different product aggregation levels (HS2, HS4, HS6). Consistency of results across aggregation levels indicates that the findings are not an artefact of product classification granularity and also shows whether specific direct sanctions had the intended results.

Third, the partner groups are split into sanctioning and non-sanctioning countries, and estimates are provided separately for each. This extension of the baseline verifies that the estimated treatment effect is concentrated among sanctioning partners, as predicted by the identification strategy. The sanctioning countries include the EU-27 (excluding the UK, although the pre-treatment period stretches over their transition out of the European Union), the US, the UK, Canada and Switzerland.

Fourth, a log-linear model is estimated using OLS with fixed effects. In this specification, the dependent variable is the natural logarithm of exports, and the estimation is conducted using high-dimensional fixed effects as in the DiD baseline. This approach is common in gravity-type trade models but excludes zero trade flows by construction. Comparing these results with the PPML estimates allows the assessment of whether the main effects are sensitive to functional form and estimator choice. Fifth, a PPML model is included excluding zero trade flows. While PPML is specifically designed to handle zero trade values consistently, removing zero flows provides a proper diagnostic check. If coefficients remain similar after excluding zero observations, this suggests that the estimated treatment effects are not driven primarily by changes at the extensive margin of trade.

The last robustness check is a placebo test which follows the model performed by Abadie and Gardeazabal (2003). This analysis will compute the gap between Belarus and non-sanctioned countries. The idea is to compare the economic evolution of a region similar to Belarus, but without the policy tools implemented. The purpose is to analyse whether the gap observed is created by factors other than sanctions. This will be implemented with both export groups and assessed against the control countries.

5.4. Synthetic Control

To complement the DiD framework, the synthetic control method (SCM), introduced by Abadie and Gardeazabal (2003) and further developed by Abadie et al. (2010), provides a data-driven approach for estimating the effects of aggregate interventions affecting a small number of treated units. Compared to traditional comparative case studies or regression approaches, SCM is disciplined in settings where a single country is exposed to a policy shock and an appropriate counterfactual must be constructed from a pool of untreated units. It does not need to rely on parallel trends or a regression like DiD.

In this study, the SCM is used to estimate the counterfactual trajectory of Belarusian exports in the absence of post-2020 economic sanctions. To continue with the works of Abadie et al. (2010), a "Synthetic Belarus" is constructed as a weighted combination of non-sanctioned control countries that best approximate Belarus' pre-treatment characteristics. The donor pool consists of the *Total Exports* control group countries. These countries were chosen as a combination of non-sanctioned countries to resemble the relevant economic characteristics of the treated country before the start of the sanctioning period, including trade structures, geographic characteristics and historical linkages.

The effect of the sanctions is examined using a model of estimated outcomes (Rubin, 1978). Let units be indexed by $j = 1, \dots, J + 1$ and time by $t = 1, \dots, T$. Unit $j = 1$ is Belarus, the treated country, and treatment begins at time $T_0 + 1$. The remaining units, $j = 2, \dots, J + 1$, are untreated control countries. The objective is to estimate the treatment effect of sanctions on Belarusian exports for periods $t = T_0 + 1, \dots T$. Y_{jt}^N denotes the potential outcome observed for unit j at time t in the absence of the sanctions, and Y_{jt}^S denotes the potential outcome under sanctions. For Belarus ($j = 1$), the observed outcome equals Y_{1t}^N for $t = 1, \dots, T_0$ and Y_{1t}^S for $t = T_0 + 1, \dots, T$. The treatment effect at time $t \geq T_0 + 1$ is:

$$\tau_t = Y_{jt}^N - Y_{jt}^S$$

Because Y_{jt}^N is unobserved after the treatment, it is estimated using a weighted average of control countries:

$$\widehat{Y_{jt}^N} = \sum_{j=2}^{J+1} W_j Y_{jt}$$

where $W_j \geq 0\ and\ \sum W_j = 1$. The SCM thus selects a set of weights such that the resulting synthetic control resembles the affected unit before the intervention (Abadie, 2010). These weights are chosen to minimise the distance between Belarus and the weighted combination of control countries during the pre-treatment period (2012-2019).

The predictor variables for the total exports analysis include: *Total exports (lags for 2012, 2015, 2018), average GDP per capita, average GDP growth, average trade openness, average industry % of GDP, average share of CIS total trade, average rule of law (WGI indicator), landlocked dummy, and trade openness (% of exports in GDP)* over the pre-treatment period. These predictors were chosen to show the growth of the economies over this period while also showing how open the 'Synthetic Belarus' economy compares to the *treated* unit. This model will use lags instead of the average over the pre-treatment period because of the volatile nature of individual trade years or each country, and having the average include an outlier year would throw off the weights. The selection of these predictor variables is to ensure that the synthetic control closely matches Belarus in terms of trade history, macro and economic structure, geography, trade dynamics, and institutional strength prior to sanctions. The estimated treatment effect is therefore:

$\widehat{\tau_t} = Y_{1t}^S - \sum_{j=2}^{J+1} W_j Y_{jt}$.

This difference represents the deviation between actual Belarusian exports and the counterfactual path implied by the synthetic control. A sustained divergence after 2020 is interpreted as evidence of a sanction-induced effect. The same procedure is applied separately to total exports and potash exports to assess whether sector-specific dynamics differ from aggregate export performance. While a permutation-based inference test (Abadie et al., 2010) was attempted, the limited size of the donor pool (*N=9*) and high collinearity among post-Soviet economic indicators prevented the convergence of the SCM algorithm in Stata for a sufficient number of placebo units. The analysis relies on the visual fit of the synthetic control and magnitude of the post-treatment divergence as the primary evidence of the effect.

An alternative version of the SCM will use the *Potash Export* control group instead to include the other 9 leading global potash producers besides Belarus to handle fertiliser price swings and demand. The predictor variables include: *Potash exports (lags for 2012, 2015, 2018), potash reserves, landlocked dummy, distance between Brazil/China/India, average potash share of total exports, average share of country in global fertiliser market, average rule of law (WGI indicator), average GDP and average GDP per capita*. These predictors were chosen to handle trade histories, resource wealth, geography, market access, and size, as well as intra-country specialisation in the agriculture sector. The variables are controlled to show that each of these economies relies on potash to a different extent in their overall trade portfolio. For countries such as Belarus, Jordan, or Laos, potash is an important part of overall export performance.

These variables will ensure that the synthetic control closely matches Belarus in terms of economic size and export dynamics prior to sanctions.

6. RESULTS

6.1. Baseline DiD Results

This study identifies the effect of export sanctions in terms of loss of exports for Belarus at exporter-partner level. Table 1 presents the total export baseline results of the DiD estimation. The focus is on how much the treated group changed from the untreated group for exports before and after the treatment period. Column (1) includes all seven years in the study (2015-2021). The coefficient of *-0.621*(**) suggests that total exports were 46.3% lower relative to total exports from the *Total Export* control group. This drastic decrease represents a sharp and immediate loss of exports in the treated country. Comparable to the results of Haidar (2017), the negative coefficient makes it possible to observe immediate import deflection from partnering countries as the sanctions legitimately halted outward trade flows for Belarus.

Table 1. Impact on Belarus Exports by Product Aggregation

	(1) Full Sample	(2) Excl. 2020	(3) HS2	(4) HS4	(5) HS6
treatment	-0.621**	-0.665**	-0.504**	-0.645**	-0.707**
	(0.294)	(0.316)	(0.238)	(0.305)	(0.334)
Observations	859072	736590	78962	236598	421012
Reporter FE	Yes	Yes	Yes	Yes	Yes
Partner FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Column (2) presents the results excluding 2020 due to the global trade disruptions of the Covid pandemic. The treatment period is kept as 2020, but all bilateral trade data is removed for the remainder of the robustness checks. The results state that there was 48.5% lower exports compared to the control group. This suggests that the decrease in export performance was not due to global trade disruptions and that by removing 2020, it is consistent with results from the baseline model. The year 2020 was disruptive for all international trade, yet the results from removing it were not that different from when it was included. This could mean that Belarus was already dealing with severe changes from the sanctions before and after Covid-19, with the sanctions playing a role in the contraction of trade.

Similar patterns are observed at product aggregation levels. These results did not include 2020 to keep the estimations consistent. Column (3) results in a 39.6% decrease in exports at the HS2 aggregation. The broadly aggregated sectors experienced a contraction, although not as drastic as the baseline. HS2 products were split up at the HS chapter level and broken down into the aggregation levels of all HS4 and HS6 to view product-level effects in greater depth. Column (4) states a 47.5% decrease at HS4 aggregation level. The coefficient of *-0.645*(**)* is more aligned with the baseline estimation and matches well with the headline result. Column (5) demonstrates a 50.9% decrease at the least disaggregated level. The consistent results of the three aggregation levels indicate that the findings are not an artefact of product classification granularity. The more disaggregated the products were, the larger the negative effect, which demonstrates that specific direct sanctions had an impact on the more specific product sectors.

Policymakers can see that the *blanket* sanctions did have a comprehensive impact on the entire market and not just in a single industry.

6.2. Sanction versus Non-Sanctioning Partners' Results

The coefficients of sanctioning and non-sanctioning partners can determine if the countries involved in the sanction packages ensured that sanctions were honoured and key imports were banned. Table 2 shows the results between sanctioning and non-sanctioning partners. In Column (1), the model limits the partner countries to the 30 sanctioning partners. The large negative coefficient of *-1.009(**)* suggests that total exports decreased by 63.5% to those partners responsible. This result provides evidence that sanctioning countries followed through on their policies. With the improving pre-treatment relationship Belarus had with its EU partners, there is no surprise that when the relationship was disbanded, trade rapidly declined. These results are comparable to Crozet and Hinz (2020), where sanctions on Russia from EU partners resulted in the largest effect. These negative effects highlight that integrated, trade-dependent countries like these are most likely to suffer from losing their closest trade allies.

Table 2. Sanctioning vs. Non-Sanctioning Partners

	(1) Sanctioning	(2) Non-Sanctioning
treatment	-1.009^{**}	-0.515
	(0.394)	(0.329)
Observations	277940	458650
Reporter FE	Yes	Yes
Partner FE	Yes	Yes
Year FE	Yes	Yes

Note: Robust standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Column (2) continues the trend and shows a 40.3% decrease among non-sanctioning countries. Although the coefficient was not statistically significant, it can provide evidence of non-sanctioning countries avoiding trade from sanctioned countries through the "chilling compliance effect". This exemplifies that even though these partners were not directly involved in the imposition of sanctions, Belarus experienced a decrease in demand for its exports. These findings could be a result of other countries that were not involved wanting political change as well. With the lack of statistical significance, this could suggest that the decline was not equal across all non-sanctioning partners. This could be due to the strengthened trade relationship with Russia, China, or other Central Asian countries, although overall, trade was still not maintained in the short run.

6.3. Robustness Results

Robustness tests were performed to assess whether the results were sensitive to a functional form or estimator choice. Column (1) in Table 3 shows the results of the log-linearised OLS estimation. The results state that there was 16.7% lower exports compared to the control group. The estimated coefficient is statistically significant at the 1 per cent level. These results correspond with the PPML estimates to demonstrate the loss of export performance for the treated unit. The effect of having an OLS model is not as strong as the effect from the PPML, but the results are still consistent with Belarus having experienced a sharp decline.

Table 3. Robustness Checks

	(1) Log-OLS	(2) No Zeros
treatment	-0.183***	-0.621**
	(0.059)	(0.294)
Observations	736588	859070
Reporter FE	Yes	Yes
Partner FE	Yes	Yes
Year FE	Yes	Yes

Note: Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Column (2) goes back to a PPML model, but instead of handling zero trade flows consistently, the estimation strictly removes zero trade to provide a diagnostic check. This version of the PPML model also shows a 46.3% decrease related to the control group. The results correspond exactly with what the PPML estimates in the baseline model, suggesting that the estimated treatment effects are not driven primarily by the intensive margin of trade.

The post-Soviet partners did not experience the sanctions, so a placebo test is established as another way to visualise Belarus' trade disruptions and to determine if there were regional trends. A direct loss of export performance for Belarus could result in other economies gaining in terms of partners and trade intensities. As shown through the placebo test in Figure 4, the impact of sanctions on Belarusian total exports leaves it near the bottom in trade performance compared with its peers. This aligns with the results from the DiD model, as although Belarus appears to have improved trade in absolute terms, they still fall way short compared to others in its control group. The placebo test suggests that while log-exports for the treated country can be reproduced using these techniques, the catch-up in the control countries after the 2020 period was more pronounced.

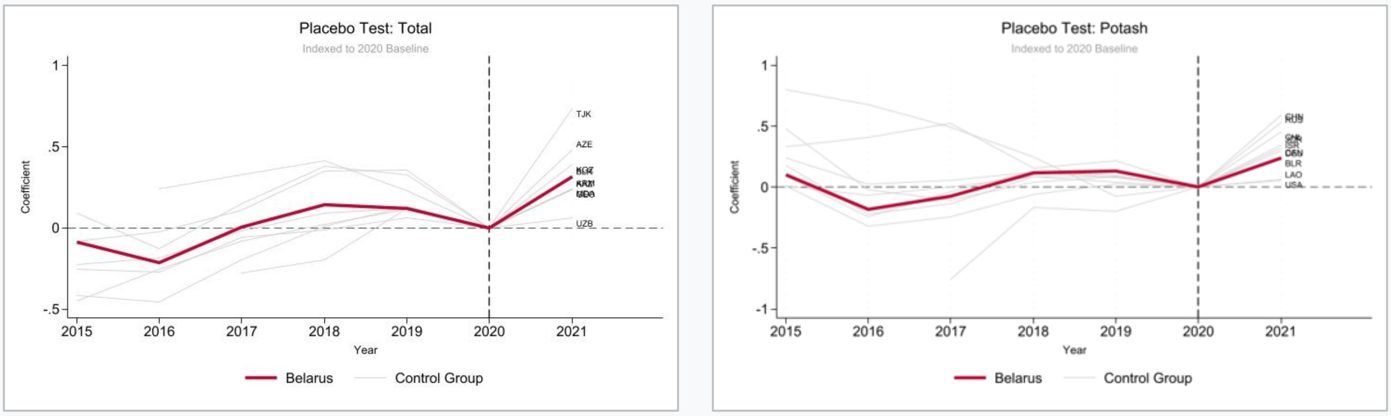

Figure 4. Total and Potash Placebo Tests

6.4. Kazakhstan Counterfactual

The preliminary screening (Table 9, Appendix) examines Belarus' export performance to each specific regional partner to identify potential conduits for trade diversion. While nearly all coefficients were negative, indicating broad regional disruption in Belarusian export logistics post-2020, the magnitude of these coefficients varies significantly. Exports to partners like

Tajikistan *(-0.674***)* and Kyrgyzstan *(-0.641***)* saw severe contractions, likely due to indirect logistical friction and the "chilling compliance effect". Uzbekistan was omitted from the diagnostic due to severe heteroskedasticity, as the extreme variance in bilateral trade data and the lack of 2015 and 2016 data prevented PPML convergence.

The diagnostic identified Kazakhstan (*-0.121***)* and Russia *(-0.123***)* as primary harbours for Belarusian exports. These two nations exhibited the smallest contractions in the entire region signalling their roles as the dominant absorbers of Belarusian goods during the Western trade collapse. Even with a slight negative coefficient, Kazakhstan is a noteworthy outlier as its relative stability compared to the broader control group identifies it as the most statistically resilient backdoor for redirecting trade. This stability, combined with the trade explosion later observed by Kazakhstan's own export market, confirms Kazakhstan as the optimal *treated* unit for the subsequent circumvention simulation.

With the new *treated* unit, the study investigated whether Kazakhstan experienced a drastic change in export performance relative to the control group. Table 4 shows the estimates for Kazakhstan. Column (1) shows the complete opposite of what was shown in Table 1. In the full sample, Kazakhstan demonstrated an 84.2% increase in total exports over the period of the study. This shows that even at a time when a close, post-Soviet peer is sanctioned, Kazakhstan withstood regional trade effects and experienced strong export growth in its own market. The results suggests that, along with their own export growth, there is evidence that is compatible with Belarus rerouting exports to Kazakhstan to circumvent sanctions.

Table 4. Kazakhstan Exports (Rerouting Analysis)

	(1) Full Sample	(2) Excl. 2020	(3) HS2	(4) HS4	(5) HS6
kaz treatment	0.611^{***}	0.690^{***}	0.368^{***}	0.684^{***}	0.759^{***}
	(0.199)	(0.228)	(0.139)	(0.218)	(0.255)
Observations	859072	736590	78962	236598	421012
Reporter FE	Yes	Yes	Yes	Yes	Yes
Partner FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Column (2) states a 99.4% increase in total exports for the treated unit. This suggests that even with the removal of the disruptive Covid-19 year, Kazakhstan was still able to experience rapid export growth compared to the control group. Columns (3-5) break down the product aggregation levels to see if specific product classifications performed better or worse than the total market. The HS2 product aggregation classification had a 44.5% increase. This suggests that there could be sections of the export portfolio that did not experience the growth, and that a reason for their growth could be from re-exports from Belarus. The HS4 aggregation level experienced a 98.2% increase. This result is more aligned with the rest of the exports, suggesting that export growth occurred across markets. The HS6 aggregation level experienced the most rapid explosive growth compared to the control group, with a 113.6% increase. The phenomenon of the "roundabout trade" from Chupilkin et al. (2026) is prevalent here to show another example of evidence that sanctioned countries are able to manoeuvre through regional partners to stabilise trade. This result is compatible with the rerouting of trade without having a quantification bias. Disaggregation at product-level shows that even when *smart* sanctions are imposed, there is a distinct difference between Belarus and Kazakhstan.

6.5. Potash Sector

Smart sanctions on Belarus' potash sector tell a contrary story to that of the rest of the total exports. The "strict prohibition of importing, purchasing, or transferring potash products" (EC, 2024) that was implemented to cripple infrastructure, concluded with surprising results. The coefficients in Table 5 show how Belarus' potash export performance compares to the rest of the *Potash Exports* control group. Column (1) shows that there was an insignificant 1.8% decrease in potash products based on the performance of the rest of the control group. The result, although statistically insignificant, paints a more asymmetric picture than the total results. It is determined that there is very little change for other large potash exporters, suggesting evidence that the sanctions did not have nearly as significant an impact on the industry.

By removing 2020, the coefficient of *0.000* shows no change in the post-treatment period. These empirics could be evidence that *smart* sanctions were ineffective. Potash is a vital commodity in Belarus's trade arsenal and this product is irreplaceable for global food demands. As a key global player in the fertiliser industry, Belarus has to quickly manoeuvre around sanctions in order to keep up with global supply. This could provide evidence that countries are noncompliant with their own policies to meet their own fertiliser demands. Columns (3-5) break the potash industry into more disaggregated product levels, all of which show very little change. The HS2 classification resulted in a 4.8% decrease, the HS4 classification resulted in a 10.1% increase, and the HS6 classification resulted in a 6.6% increase, all of which were not statistically significant.

Table 5. Impact on Belarus Potash Exports

	(1)	(2)	(3)	(4)	(5)
	Full	Drop2020	HS2	HS4	HS6
treatment	-0.018	0.000	-0.049	0.096	0.064
	(0.130)	(0.131)	(0.159)	(0.120)	(0.121)
Observations	11456	9756	4648	2762	2311
Reporter FE	Yes	Yes	Yes	Yes	Yes
Partner FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 shows the results of the estimations on sanctioning partners versus non-sanctioning partners. These results differ from the total exports, as Column (1) shows that Belarus experienced a 7% increase in potash performance to sanctioning partners. This could be due to the staggered implementation by Lithuania, which hesitantly shut down trade routes and allowed the extension of existing contracts (Černiauskas et al., 2022). These results could also be a result of countries continuing to import the critical product due to a lack of alternatives. Column (2) shows that there was a 5.7% decrease in non-sanctioning partners. This is more closely aligned with the total exports, as Belarus experienced a slight decrease in export performance in both non-sanctioning partner categories.

Table 6. Sanctioning vs. Non-Sanctioning Partners in the Potash Sector

	(1) Sanctioning	(2) Non-Sanctioning
treatment	0.068	-0.059
	(0.267)	(0.197)
Observations	1090	3557
Reporter FE	Yes	Yes
Partner FE	Yes	Yes
Year FE	Yes	Yes

Note: Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The robustness checks that were also applied to make sure there was consistency in the tests and that they were not determined by the model specification are shown in Table 7. Column (1) shows the results of the log-OLS estimate, which resulted in a 45.1% decrease in potash performance. The coefficient of *-0.598(***)* differs from the PPML model (*0.000*) in the baseline model. This stark difference between the results can lead to questions about the model. The study stands by the results of the PPML, as it is viewed as the gold standard model for analysing trade and handling heteroskedasticity-driven bias. This will be argued more in the Discussion section.

Column (2) has the results for the PPML no-zero trades estimation. This altered version of the PPML model shows a 1.8% decrease related to the control group. The results, although statistically insignificant, correspond exactly with what the PPML estimates in the baseline potash model, suggesting that the estimated treatment effects are not driven primarily by the intensive margin of trade.

Table 7. Potash Robustness Checks

	(1) Log-OLS	(2) No Zeros
treatment	-0.598^{***}	-0.018
	(0.208)	(0.130)
Observations	9756	11456
Reporter FE / Partner FE / Year FE	Yes	Yes

Note: Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As examined with total exports, the placebo test was replicated to run with the potash group. Figure 4 indicates that the log potash exports gap remains at the lower end of its global producing peers. Some of the potash export peers, such as Laos, have extreme coefficients for the gap compared to the 2020 baseline case, as is shown in the bottom line. The 2015 and 2016 observations for Laos are withheld as they were below the negative 1 coefficient. These potash export control group members all experienced a positive coefficient in regard to the 2020 baseline, albeit at different magnitudes, which complements the PPML coefficient where Belarus fits in the middle of the group. In the post-treatment period, Belarus is near the bottom of the group, which complements the log-OLS model, suggesting that there is an increase in absolute terms for potash exports, but to a lesser degree than its peers.

6.6. Synthetic Control Results

A synthetic control unit was constructed to represent Belarus in the absence of the treatment. The weights for the "Synthetic Belarus" were determined by balancing key predictor variables, including economic structure, trade history and institutional dynamics. The individual effects of each variable are listed in Figure 8 (Appendix). The resulting optimal weights were assigned to Azerbaijan: 0.612 and Kazakhstan: 0.388. These countries serve as logical synthetic controls for Belarus, as all three share similar trade patterns, economic growth trajectories, and geopolitical risk profiles during the pre-treatment period.

Figure 6 illustrates the log of total exports for both "Actual-" and "Synthetic Belarus" from 2012 to 2021. The two units demonstrate a high degree of fit during the pre-treatment phase, particularly between 2014 and 2019, suggesting that the synthetic unit is a valid counterfactual for the real country's export dynamics. Both "Actual-" and "Synthetic Belarus" experienced an uptick in exports following the treatment period, but the growth of the "Actual Belarus" appears to be decelerating slightly compared to its synthetic counterpart. The initial investigation to figure out the weight had fewer predictor variables, which only included average GDP per capita, average GDP, average trade openness, and average total exports (USD). The result of the initial review was roughly the same (60% Azerbaijan and 40% Kazakhstan) as the more extensive version with 9 predictor variables. This suggests that Azerbaijan and Kazakhstan are consistently fit to build out a "Synthetic Belarus" when controlling for different economic and trade dynamics.

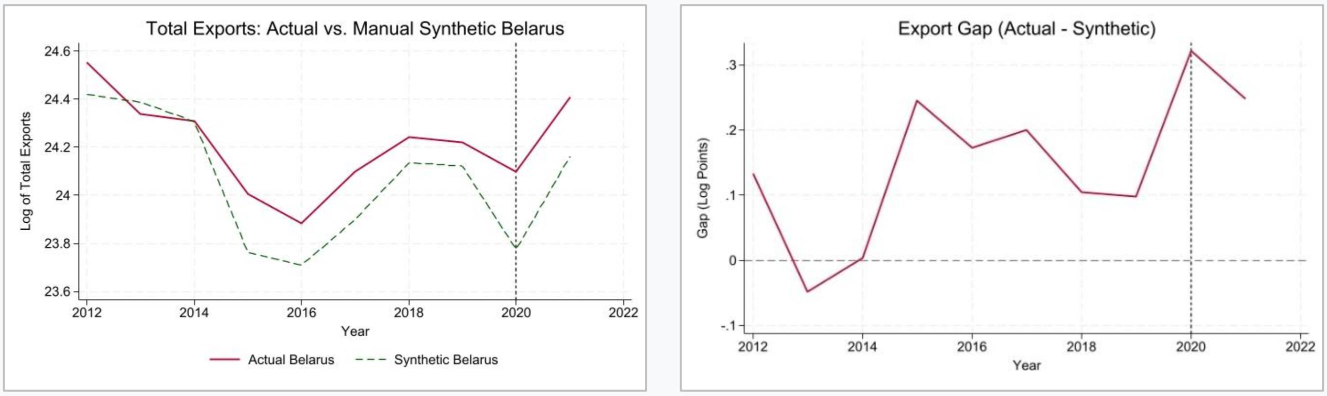

Figure 6. SCM of log-linear Total Exports of Belarus vs Synthetic Belarus

To validate the technical reliability of the Synthetic Control for total exports, the pre-treatment Mean Squared Error (MSE) was calculated. As shown in Table 9 (Appendix), the MSE of 0.030 indicates an exceptionally high degree of fit. This suggests that the synthetic counterfactual, constructed primarily from the trade trajectories of Azerbaijan and Kazakhstan, mimics the actual Belarusian export trend with minimal error prior to 2021. The observed divergence in the right panel of Figure 6 can be attributed to the impact of the 2020/2021 sanction waves with a high degree of confidence. While the gap remains positive, likely due to Belarus's larger economic scale relative to the weighted average of the control group, there is a downward trend in 2020. The gap peaked in 2020 at over 0.3 log points but fell to 0.25 log points by 2021. This contraction of the gap suggests that while total exports are rising in absolute terms, Belarus is underperforming relative to its predicted trajectory. This indicates that the integration of sanctions may have begun to weigh on total trade volumes.

The same analysis is replicated regarding the potash exports. The weights for the "Synthetic Belarus" were determined by balancing key variables, including resource wealth, economy size, and specialisation. The individual effects of each of the variables are listed in Figure 9 (Appendix). The resulting optimal weights were assigned to Canada: 0.043, Jordan: 0.395, and Russia: 0.562. These countries represent a logical counterfactual as they are the primary global competitors in the potash market and share similar export-driven economic sensitivities. Figure 7 illustrates the log of potash exports for both "Actual-" and "Synthetic Belarus" from 2012 to 2021. The two units demonstrate a strong fit during the pre-treatment phase, particularly between 2017 and 2019.

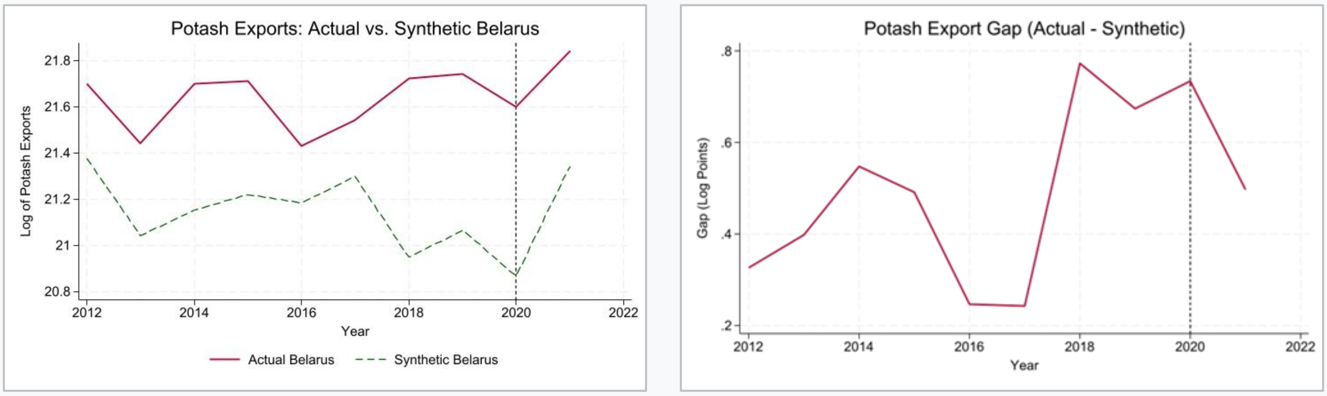

Figure 7. SCM of log-linear Potash Exports of Belarus vs Synthetic Belarus

This trend confirms that the synthetic weighted average of Russia, Jordan and Canada effectively mirrors Belarus' potash trade dynamics in the pre-treatment period. Following the treatment period, both units experienced a recovery in export values. However, the growth trajectory of "Actual Belarus" is notably shallower than that of the Synthetic unit, which experienced a sharper rebound in 2021. The model fit for the potash sector, detailed in Table 9 (Appendix), yielded a pre-treatment MSE of 0.280. While this error is higher than that of the total export model, it remains an acceptable threshold for commodity-specific analysis. The increased variance is likely due to the inherent volatility of global fertiliser prices and the use of a geographically diverse donor pool (Russia, Jordan and Canada), which was necessary to capture specific potash market dynamics. Despite this higher margin of error, the model establishes a baseline that confirms the negligible impact of targeted sanctions on potash volumes in 2021 compared to total trade.

The divergence between them is quantified on the right side of Figure 7. While the pre-treatment period saw the gap fluctuate at a relatively high level, the post-treatment period is characterised by a steep and immediate decline. Potash exports plummeted from the 2018 peak of approximately 0.8 log points to nearly 0.5 log points by 2021. While the gap remains positive, which is consistent with the PPML finding that aggregate potash export volumes did not collapse, the sharp negative slope indicates a substantial loss in market share and export potential relative to global peers. This suggests that while Belarus may have been able to reroute trade to stabilise total volumes, it failed to capture the broader market recovery and price surges enjoyed by its global peers, such as Canada and Jordan.

7. DISCUSSION

7.1. Initial Shock and Export Contraction

The empirical findings for total exports demonstrate that the imposition of economic sanctions caused an immediate trade shock on Belarus. The baseline DiD coefficient of *-0.665* indicates that Belarus experienced a 48.5% contraction in total exports relative to the control group. This negative outcome is consistent across alternative product aggregation levels, validating the conclusion that the institutional measures successfully penalised the regime down to specific commodity lines. Crucially, the deepening trade interdependence between Minsk and Moscow was insufficient to offset this immediate export collapse. Although total exports from Belarus to Russia expanded by 35.6% between 2015 and 2021 (UN Comtrade), this rapid growth between the two former Soviet allies failed to insulate the broader Belarusian export portfolio from Western disruptions. Isolating through partner exclusions reveals that the primary driver of this trade collapse was the direct withdrawal of the sanctioning states. A significant coefficient of *-1.009* indicates a 63.5% drop in trade with sanctioning partners compared to the control group. These findings confirm that the coalition effectively executed its threat to halt the transit and purchase of Belarusian goods to apply intense political pressure.

Beyond direct trade prohibitions, the empirical evidence reveals a substantial "compliance chilling effect" among non-sanctioning states. The corresponding DiD coefficient of *-0.515* for non-sanctioning partners translates to a 40.3% decline in exports. While this specific estimate is statistically insignificant, its economic magnitude strongly implies that international firms engaged in widespread over-compliance to avoid reputational risks, legal exposure or asset contagion. Third-party firms were forced to alter their purchasing strategies due to disrupted indirect trade routes, supply chain frictions and parallel financial restrictions. In particular, the deployment of targeted asset freezes and the disconnection of Belarusian financial institutions from the SWIFT network injected severe operational friction across all trade channels.

Robustness checks strongly corroborate these baseline estimations. The SCM complements the DiD analysis by illustrating a persistent, widening divergence between the observed trajectory of Belarus and its counterfactual synthetic counterpart. Regardless of the specific predictor variables utilised, the synthetic control framework, constructed predominantly from the weighted trade profiles of Azerbaijan and Kazakhstan, remains stable. The clear underperformance of real Belarus relative to its predicted counterfactual trajectory provides evidence for policymakers that comprehensive economic sanctions can engineer a direct, quantifiable macroeconomic shock.

7.2. Potash Asymmetry

The potash sector did not experience the same drastic negative impact as remaining exports. The DiD coefficient (*0.000*) suggests that Belarus maintained stable potash exports through alternative means. All of the product aggregation and partner exclusions were consistent with little change in export performance compared to the other major potash producers. These results provide evidence that potash is a strategic, future-looking commodity, and partner countries cannot find alternative ways to import in the event of sanctions. Belarus is a major player in global fertiliser prices and potash supply for the agriculture sector (GET, 2023). As demand for this vital commodity increases, countries such as Belarus will need to remain players to keep the global fertiliser market stable.

The contrast between the log-OLS estimate *(-0.598***)* and the PPML result (*0.000*) provides a methodological insight into sectoral resilience. As established by Silva and Tenreyro (2006), log-linearised models suffer from a fundamental bias due to Jensen's inequality. Because the expected value of a log-transformed random variable does not equal the log of its expected value, log-OLS yields inconsistent parameters by mismodeling non-linear variances. This divergence is driven by the mathematical handling of the extensive margin of trade. Because the logarithm of zero is mathematically undefined, the log-OLS model automatically drops all country-pairs reporting zero trade within a given year, introducing severe selection bias (Head & Mayer, 2014). If Belarus ceased direct potash shipments to traditional hubs like Lithuania but successfully initiated roundabout trade through emerging partners, log-OLS systematically omits these vital commercial reorientations. On the other hand, the PPML framework retains zero-trade observations, and models absolute trade levels directly, capturing the comprehensive global portfolio (Head & Mayer, 2014). The near-zero PPML coefficient (*0.000*) confirms that total Belarusian potash volumes remained entirely stable via geographical rerouting, corroborating the "roundabout trade" mechanisms identified by Chupilkin et al. (2026). While sanctions disrupted traditional bilateral routes, they failed to induce a structural contraction in the potash sector which is a reality only captured by the PPML framework.

This insularity is further illustrated when separating trading partners. Sanctioning nations yielded a positive, statistically insignificant coefficient of *0.068* (a 7.0% increase in potash trade), while non-sanctioning states returned a minor negative coefficient of *-0.059* (a 5.7% decrease). This difference between aggregate export vulnerability and potash resilience exposes strategic selectivity by sanctioning states. This selectivity often staggers restrictions to shield domestic supply chains. The immediate closure of existing logistics did not coincide with the legal imposition of sanctions due to wind-down allowances for pre-existing contracts, allowing Minsk to maximise its export window during the initial treatment phases (Černiauskas et al., 2022). This structural lag in terminating primary transit routes effectively mitigated the initial shock observed in other industrial sectors.

This commodity resilience has directly shaped subsequent diplomatic manoeuvres and enforcement architectures. Recognising the limits of long-term enforcement amidst global economic pressures, the United States executed two rounds of strategic sanction relief. In December 2025, Washington granted limited sanction waivers to three primary Belarusian potash entities, Belaruskali, the Belarusian Potash Company (BPC), and Agrorozkvit, following the release of political prisoners and publicised commitments from Minsk to halt politically motivated arrests (Sytas, 2025). Subsequently, on 19 March 2026, an additional 250 political prisoners were released in direct exchange for expanded US sanction relief for the fertiliser industry (Sapuppo, 2026). This strategic relaxation coincided with intense geopolitical pressures from the Iran War, which drove global fertiliser prices to historic highs and disrupted Western agricultural supply chains. While these reciprocal adjustments point to shifting diplomatic engagements, comprehensive sanctions enforced by the EU, Canada and the United Kingdom remain active. As transit remains legally barred through Lithuania under EU mandates, Belarus must rely heavily on Russian transport infrastructure to service its newly unsanctioned American buyers, despite intensifying domestic debates surrounding the potential reopening of the Klaipeda port terminal.

7.3. Sanction Circumvention

The survival of the Belarusian export economy highlights the protective utility of regional integration agreements. Existing institutional treaties, notably the Eurasian Economic Union (EAEU) and the Customs Union encompassing Russia and Kazakhstan, provided the regulatory and logistical architecture necessary to absorb the economic shock. While Belarus faced severe direct contractions, Kazakhstan exhibited an entirely opposite trade trajectory, recording an extraordinary 99.4% expansion in global trade over the treatment period. Because no other nation within the total export control group has experienced a parallel macroeconomic surge, this spike cannot be attributed to broader regional or secular trends. By utilising a DiD specification that holds all unobserved regional shocks constant, this stark divergence strongly indicates that Belarus utilised Kazakhstan as a hub for systematic trade circumvention.

A persistent challenge in evaluating trade flows during sanction regimes is the operational unreliability of target-country customs data, such as under-invoicing, transfer pricing, and roundabout routing, frequently obscuring the true value of diverted trade. This study methodologically protects its findings against contractual reporting biases by utilising mirror statistics to track the global export performance of Kazakhstan. Rather than relying on potentially manipulated or missing bilateral declarations, observing Kazakhstan's outward shipments to the rest of the world captures the market-clearing trade volumes and values verified by independent third-party customs authorities. This empirical approach ensures that the identified 99.4% expansion in Kazakh trade reflects objective, real-world flows independent of state reporting.

These findings expand upon the foundational circumvention literature, validating the "roundabout trade" mechanics documented by Chupilkin et al. (2026) and the firm-level adaptation models formalised by Scheckenhofer et al. (2023). The empirical evidence confirms that targeted autocracies possess internal flexibility to blunt the impact of international policy regimes through strategic rerouting, re-exporting and product relabelling. By utilising regional intermediaries, target states create complex supply chains that complicate the tracking efforts of sanctioning bodies. The availability of these regional integration pathways allows targeted regimes to circumvent economic isolation, introducing enforcement challenges that systematically degrade the coercive leverage of Western sanctions.

7.4. Theoretical Implications

The empirical conclusions of this study contribute to the long-standing theoretical debate regarding the ultimate efficacy of economic coercion, yielding highly mixed evidence for both sides. At the aggregate level, the statistically significant contraction in total exports directly aligns with traditional paradigms asserting that sanctions can successfully inflict severe macroeconomic damage on a target state (Hufbauer et al., 2007; Drezner, 2011). From a purely economic standpoint, Western coalition members executed their coercive threats as the Belarusian export economy progressed into an immediate 48.5% contraction that regional integration with Russia could not fully alleviate. While this severe disruption failed to trigger the primary political objective of regime change or institutional democratisation, sending states can still point to the immediate collapse of aggregate trade as proof of operational success.

The complete resilience of the potash sector validates critical theoretical frameworks that highlight the structural limits and frequent failures of international economic coercion (Pape, 1997; Peksen, 2011). These findings confirm that narrowly tailored *smart* sanctions, while theoretically designed to penalise elite resources while protecting broader populations, routinely fail to induce the sweeping economic pain achieved by comprehensive, total trade embargoes (Neuenkirch & Neumeier, 2015). By exploiting non-sanctioning partners and alternative geographic channels, the regime insulated its most vital industry, avoiding a catastrophic collapse of its sovereign export portfolio and maintaining the status quo.

The Belarusian case reinforces the theoretical arguments of Peksen (2011), demonstrating that international economic pressure frequently fails to kerb severe human rights violations or aggressive foreign policy alignments. Despite sustained Western enforcement, the regime actively sustained its external provocations, including facilitating Russia's 2022 invasion of Ukraine and executing weaponised migration strategies through the forced, strategic deportation of undocumented migrants across its shared borders with Eastern European neighbours.

These dynamics reveal that the structural impact of modern foreign policy tools must be analysed through an asymmetric lens. It remains theoretically difficult to classify sanctions as an inherently effective or ineffective policy instrument for inducing political reorientation. Senders can engineer sharp, instantaneous contractions in aggregate commerce when coalition members demonstrate high compliance. However, the operational success of these measures will remain structurally compromised as long as targeted nations can exploit strategic commodities, flexible firm-level reclassifications, and integrated regional neighbours to insulate vital revenue streams.

8. CONCLUSION

This study investigated the trade-related consequences of the sanctions imposed on Belarus following the 2020 presidential election. A dual empirical approach was used with the Difference-in-Differences framework extension of Crozet and Hinz (2020) and Synthetic Control Methods used by Abadie et al. (2010) on bilateral trade data from 2015 to 2021. The research provides a granular view of how a modern sanction regime impacts a small, landlocked, and trade-dependent economy. The results underscore a fundamental asymmetry in the effectiveness of economic sanctions.

The empirical evidence indicates that Belarus' total exports fell approximately 48.5% below the counterfactual baseline in the wake of 2021 sanctions. This collapse was most visible in trade with Western sanctioning partners, where volumes plummeted by 63.5%. These findings remain robust across various model specifications, suggesting that *blanket* elements of the sanction packages disrupted Belarus' macro-level trade performance. However, the potash sector presents a different narrative. Despite being a primary target of *smart* sectoral sanctions, potash exports experienced an insignificant coefficient of *0.000*. The divergence between total trade and sectoral performance suggests that Belarus managed to insulate its most critical export commodity from the intended economic shock.

A central contribution of this research is the identification of the mechanisms that blunted these sanctions. The analysis reveals that regional integration served as vital support for Belarusian trade. Specifically, the explosive 99.4% growth in Kazakhstan's exports during the treatment period is consistent with the patterns of trade circumvention. By leveraging membership in the Eurasian Economic Union, Belarus appears to have engaged in circumvention, shifting trade flows through regional intermediaries to bypass Western barriers. This finding lends weight to the argument that regional trade blocs can diminish the impact of international sanctions.

Despite these insights, the study faces certain limitations. Due to a lack of transparent reporting from BelStat and UN Comtrade following the crisis, this analysis is limited to the immediate short-term impact in 2021. Additionally, separating the effects of sanctions from broader domestic instability, including the Covid-19 pandemic and the Lukashenko regime's crackdowns, remains a challenge. Events such as the 2021 Ryanair flight diversion and the subsequent migration crisis at the EU border likely influenced trade relations in ways that overlap with formal sanction packages.

Future research can expand on these findings by incorporating recent mirror statistics as they become available to trace the long-term persistence of these trade shocks. Utilising firm-level data could shed light on whether specific industries successfully substituted into non-aligned markets or if compliance chilling effects eventually discouraged even non-sanctioning partners from maintaining ties with Belarus. Newer estimation models, such as the Staggered Difference-in-Differences presented by Nagengast and Yotov (2025), could yield better estimates for analysing causal effects for multiple sanction packages at different times.

While the 2020 sanctions eroded Belarus' aggregate trade position, there is a disconnect between the *smart* sanction intent and empirical outcome during the period under study. This study highlights the inherent limitations of economic coercion in a deeply integrated global economy, where political allies and regional connections provide a necessary shield against isolation. The Belarusian case serves as a reminder that as long as alternative logistical and political routes remain open, the effectiveness of *smart* sanctions will remain compromised.

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APPENDIX A

Table 8. Descriptive Statistics of Key Variables

	count	mean	sd	min	max
Exports (USD)	1244490	3926550.87	1.57e+08	0.00	4.28e+10
Log of Exports	1244488	8.99	3.57	-4.61	24.48
Partner GDP (USD)	1164335	1.51e+13	3.12e+13	48015259.88	9.81e+13
Distance (km)	574566	2760.05	2786.33	169.53	17451.06
Observations	1244490				

Note: This was conducted in Stata

Data source: UN Comtrade and World Bank. Sample includes years 2015-2021.

Table 9. Belarus Export to Partner Control Countries

	(1) Drop2020
ARM	-0.068***
	(0.001)
AZE	-0.266***
	(0.002)
GEO	-0.404***
	(0.002)
KAZ	-0.121***
	(0.002)
KGZ	-0.641***
	(0.002)
MDA	-0.533***
	(0.002)
RUS	-0.123***
	(0.002)
TJK	-0.674***
	(0.000)
UZB	0.000
	(.)
Observations	84174

Standard errors in parentheses

Note: Coefficients represent the interaction of partner country and post-2020 period.

* p < 0.10, ** p < 0.05, *** p < 0.01

Table 10. Pre-treatment Mean Squared Error (MSE) and Predictor Weights

Feature	Model (1) Total Exports	Model (2) Potash Sector
Pre-treatment MSE	0.030	0.280
Optimization Period	2012-2020	2012-2020
Treatment Year	2021	2021
Donor Weights (*W*)	AZR (0.612) KAZ (0.388)	RUS (0.562) JOR (0.395) CAN (0.043)
Predictors Matched	Log-Exports (2012, 2015, 2018), GDP per capita, Trade Openness	Log-Exports (2012, 2015, 2018), GDP per capita

Note: Weights (*W*) indicate the relative contribution of each donor country to the construction of "Synthetic Belarus." MSE was calculated manually using the squared vertical distance between observed and synthetic values for the pre-treatment period (2012–2020).

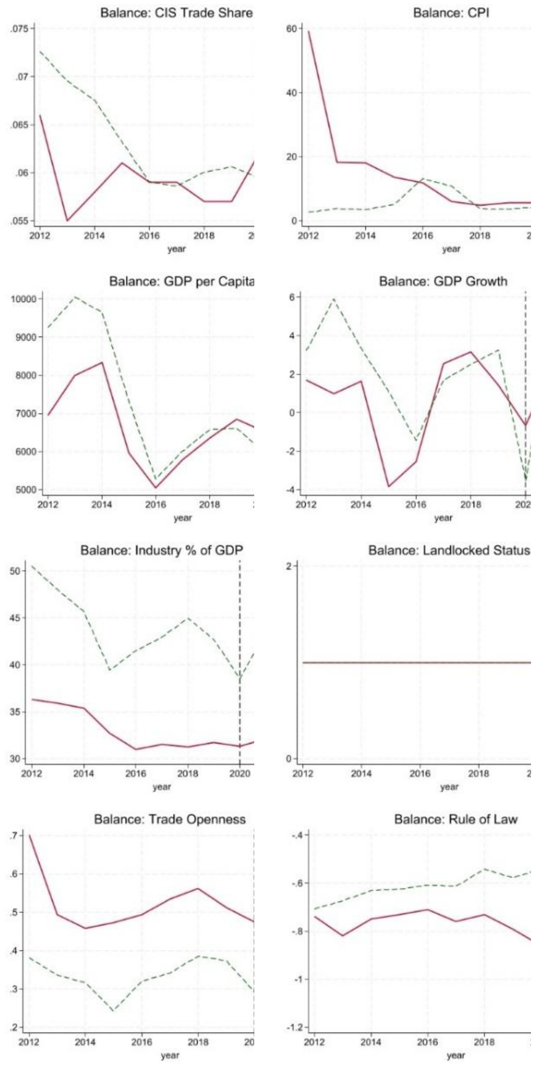

Figure 8. Individual Predictor Variable Charts (Total Exports)

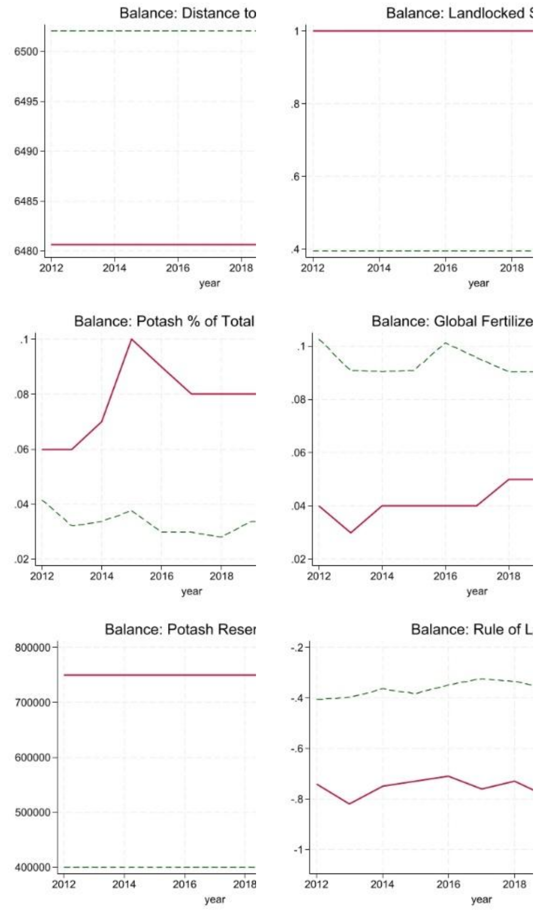

Figure 9. Individual Predictor Variable Charts (Potash Exports)