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Sectoral Adaptation and Strategic Resilience: The Impact of Sanctions on Russian Corporate Performance (2014–2021)

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ABSTRACT

We examine the sectoral impact of Western sanctions on Russian corporate performance from 2014 to 2021 using a panel of listed nonfinancial firms. Applying continuous-time heterogeneous treatment models and difference-in-differences estimators, we document persistent divergence across sectors: The energy sector exhibits sustained underperformance, whereas materials and utilities display relative resilience. Notably, state or strategic designation does not consistently shield firms from adverse outcomes. Our findings conceptualise sanctions as structural stress tests that expose institutional asymmetries and adaptive capacities, offering new empirical insights into the long-term economic consequences of geopolitical constraints.

JEL Classification: F51, F52, G32, L16, P31, P52

1 | Introduction

> Some Russians **still** drive Moskvich. Some **already** drive Moskvich.

This paradoxical aphorism in the epigraph captures both inertia and reinvention—nostalgia reassembled under duress. The revival of a Soviet-era car brand in 2022 (Interfax 2022), long obsolete yet newly rebranded, arguably mirrors the broader industrial choreography of post-sanctions Russia: adaptation not by leaping forward, but by cycling back with new paint and borrowed parts.

Sanctions are a common foreign policy tool, but their long-term economic impact remains contested—particularly at the sectoral level. Much of the literature continues to rely on macroeconomic aggregates such as GDP or trade volumes, potentially overlooking the differentiated responses observable at the firm and sector levels (Drezner 1999, 2000, 2011; Hufbauer and Jung 2021).

We study the case of Russia after 2014, where externally imposed sanctions after the annexation of Crimea interacted with internal institutional and financial structures to shape divergent paths across key sectors of the economy. This paper contributes to a growing body of work that examines how firms and industries adapt strategically to sustained external pressure (Meyer et al. 2023; Stępień et al. 2024). The post-Crimea sanctions provide a quasi-natural experiment with externally imposed shocks affecting sectors with varying degrees of exposure. This allows us to distinguish structural sectoral adaptation from idiosyncratic firm-level responses.

Our analysis relies on a unique panel of firm-level data for Russian nonfinancial listed companies over the period 2006–2021 collected from the S&P Compustat Global database (WRDS 2025). The long horizon allows us to identify both short-run dislocations and persistent structural adjustments. Unlike most existing research, which focuses on short-term firm-level causal effects or macroeconomic aggregates, we adopt a meso-

level perspective, tracking sectoral return on equity (ROE) and return on assets (ROA) to assess structural divergence and adaptation capacity.

The sample comprises systemically important firms listed on the Moscow Exchange (MOEX), making it particularly suited for assessing strategic sectoral performance. We focus on 8 key GICS industries with sufficient data (MSCI 2024)—energy, materials, industrials, utilities, communication services, consumer discretionary and consumer staples.

Our study also controls for the role of systemically important firms by employing a state and strategic firms (SSF) indicator, defined based on firms' inclusion in the MOEX state-owned and regulated companies equity indices. Inclusion in these indices signals substantial government involvement or strategic significance. This classification enables us to isolate the specific impacts of state ownership and strategic firm status on corporate performance in the context of sanctions.

Although macroeconomic shocks—including crude oil price fluctuations and currency devaluation—were common to all sectors, sanctions directly targeted only some industries. This variation in exposure, combined with a multiyear treatment window and firm-level data, allows us to move beyond binary before/after comparisons. In doing so, we trace not just whether firms were affected, but how they structurally adjusted along different dimensions of financial and operating performance.

Our empirical strategy exploits sector-level variation in exposure and response to sanctions using a continuous-time heterogeneous treatment model (CT-HTM). The CT-HTM estimates sector-specific trends and interactions with macroeconomic variables (e.g., change in oil price and GDP growth), while controlling for firm-level characteristics, as well as firm fixed effects and clustered standard errors at the firm level. We supplement this analysis with a heterogeneous difference-in-differences (H-DiD) framework, including average treatment effects on the treated (ATET) estimated using both two-way fixed effects (TWFE) and augmented inverse probability weighting (AIPW). Together, these models provide a cross-validation of key inferences.

We do not claim to isolate the causal effect of sanctions in a narrow sense. Rather, we interpret sanctions as an exogenous policy shock that interacted with existing sectoral conditions, regulatory regimes and state-firm linkages. The resulting divergence in firm performance across sectors—after controlling for extensive fixed effects and time-varying macro conditions—constitutes an important empirical regularity. In particular, the similarity of post-2014 sectoral performance gaps across CT-HTM and H-DiD models suggests that neither macro controls nor common time trends are solely responsible for the observed patterns.

A distinctive feature of our approach is the operationalisation of state and strategic firm (SSF) status. Rather than relying on formal ownership thresholds or ad hoc classifications, we construct an SSF indicator based on firm inclusion in the MOEX state-owned and regulated companies indices. This method captures market-relevant designations of strategic importance and regulatory visibility, offering a replicable and policy-aligned measure of state affiliation. This classification allows us to explore whether strategic designation confers performance insulation under sanctions and to examine sectoral asymmetries in SSF dynamics. This approach also departs from conventional reliance on ownership thresholds or subjective classifications and instead aligns with market-recognised institutional categorisations used by investors and regulators.

A key finding of this study is the persistent underperformance of the Russian energy sector after the 2014 sanctions, in sharp contrast to the relative resilience observed in the materials and utilities sectors. We further identify a comparable degree of underperformance among SSF firms, a treatment group heavily concentrated in the energy sector, underscoring the structural limits of state-driven buffering mechanisms. Notably, the materials sector, with only one SSF firm among its constituencies, stands out for its exceptional financial and operational performance, whereas other nonenergy sectors—despite some improvements in financial metrics—faced noticeable declines in operational efficiency. These patterns suggest that sanctions, beyond their immediate punitive function, serve as exogenous stress tests that expose institutional asymmetries, sector-specific vulnerabilities and the uneven strategic capacities of state-affiliated firms.

These findings resonate with a growing body of literature that emphasises the asymmetric effects of sanctions and the heterogeneous responses across firms and sectors (Ahn and Ludema 2020; Golikova 2023; Nigmatulina 2023). Recent research has underscored the roles of trade dependencies, technological vulnerabilities and institutional rigidity in shaping resilience under sanctions (Gaur et al. 2023). Although firm-level studies have highlighted that targeted companies often benefit from state shielding mechanisms—albeit with unintended consequences such as productivity misallocation (Nigmatulina 2023)—our analysis shifts focus to sector-level performance trajectories to capture the broader, long-term structural effects across the Russian corporate landscape.

In doing so, we complement and extend recent firm-level evidence. Ahn and Ludema (2020) and Gaur et al. (2023) underscore the significance of trade linkages and supply chain adaptations in shaping firm outcomes. Similarly, Nigmatulina (2023) and Huynh et al. (2023) demonstrate that although state support can buffer immediate shocks, it often distorts market signals and impedes allocative efficiency. Our sectoral approach interprets sanctions not solely as restrictive policy instruments but as strategic stress tests that expose underlying differences in sectoral embeddedness, organisational capacity and the credibility of institutional responses under conditions of external constraint.

Although sanctions formally targeted a limited set of sectors and entities, our analysis reveals substantial indirect exposure and likely collateral effects among nondesignated firms. For instance, although the materials sector exhibited post-2014 resilience on average, its sole SSF constituent—Alrosa, the state-affiliated diamond monopoly not formally sanctioned until 2022—experienced marked post-sanction performance deterioration. This divergence underscores the limitations of sectoral averages and highlights the importance of firm-level heterogeneity. It also

illustrates how sanctions transmit beyond their legal scope through financial constraints, reputational de-risking by international intermediaries and elevated compliance burdens. In this context, sanctions act as system-wide stress tests, revealing institutional asymmetries and showing that strategic designation alone offers limited insulation. These dynamics support the need for firm-level disaggregation when evaluating the broader economic and structural consequences of sanctions.

This paper contributes to the literature on firm and sectoral responses to sanctions in four key ways. First, it provides novel evidence on long-run structural divergence in corporate performance across Russian sectors, showing persistent underperformance in energy and resilience in materials and utilities. Second, it employs a continuous-time heterogeneous treatment model (CT-HTM) that flexibly captures sector-specific adaptation dynamics, macroeconomic interactions and firm fundamentals—improving upon standard binary DiD frameworks. Third, it introduces an innovative operationalisation of state and strategic firm (SSF) status based on MOEX index inclusion, offering a replicable, market-aligned proxy for strategic affiliation in opaque institutional environments. Fourth, it uncovers significant indirect effects of sanctions on nondesignated firms, demonstrating how broader macro-financial spillovers and institutional transmission mechanisms reshape sectoral outcomes beyond the directly targeted entities.

The findings have broader relevance for scholars and policymakers seeking to understand the political economy of sanctions and firm adaptation under external pressure. Sectoral trajectories are shaped not only by exposure to sanctions but also by the strategic behaviour of firms, the degree of state involvement and the capacity to reorient towards alternative markets or funding sources. Russia's experience prior to 2022 thus offers a window into how targeted economies respond over time—not through collapse, but through differentiated adaptation.

The rest of the paper proceeds as follows: Section 2 reviews the relevant theoretical and empirical literature; Section 3 describes the data and outlines descriptive sectoral patterns; Section 4 presents the empirical model and main results; Section 5 reports robustness checks; Section 6 offers a case study of Gazprom PJSC; Section 7 discusses broader implications; and Section 8 concludes.

2 | Literature Review and Contextual Framework

In this section, we review key theoretical and empirical literature on firm and sectoral responses to sanctions, with a focus on post-2014 Russia. Organising the discussion thematically, we situate our contribution within debates on strategic adaptation, state buffering and sectoral performance divergence under geopolitical pressure.

2.1 | Theoretical Perspectives on Sanctions and Firm Behaviour

Economic sanctions represent institutional shocks that reshape firms' constraints and strategic incentives. Several theoretical frameworks have been used to conceptualise firm responses. The institution-based view (IBV) highlights how sanctions alter both formal rules (e.g., financing restrictions) and informal expectations (e.g., reputational risk), requiring firms to realign with the evolving institutional environment (Meyer et al. 2023). The resource-based view (RBV) suggests that firms with internal capabilities—such as export flexibility, financial reserves or innovation capacity—are better positioned to adapt to sanctions-induced shocks (Lockett and Thompson 2001). Finally, resource dependence theory (RDT) emphasises the vulnerability of firms that rely on international capital or imported technology, necessitating supply chain reconfiguration, domestic financing strategies or strategic market pivoting (Hillman et al. 2009).

These frameworks converge on the idea that sanctions generate heterogeneous impacts, depending on firms' external dependencies and internal resource configurations. In the Russian case, they underscore the strategic importance of sectors such as energy and materials, which differ markedly in their exposure and capacity to adapt, as we illustrate in our study.

Our identification of SSF firms based on equity index inclusion rather than formal ownership directly operationalises the institutional salience highlighted in IBV, while also allowing us to explore how resource endowments (RBV) and external dependencies (RDT) influence firm trajectories under sanctions.

2.2 | Historical Role of the State in Russian Industrial Policy

Understanding firm- and sector-level performance in post-2014 Russia requires situating the corporate landscape within the country's long-standing traditions of state-led industrial development. The legacy of Soviet economic planning—prioritising heavy industry, energy and defence sectors—continues to shape institutional and structural dynamics in contemporary Russia. The collapse of the USSR in the early 1990s initiated a transition towards market mechanisms, but this shift was partial and uneven. By the mid-2000s, the Russian state had reasserted a central role in industrial coordination, particularly through targeted financial interventions, strategic asset consolidation and institutional vehicles such as Vnesheconombank and state corporations such as Rostec (Abramov et al. 2017; Libman et al. 2022; Matveev and Zhuravlev 2023; Nusratullin et al. 2020; Vernikov 2012).

Simachev and Kuzyk (2018) identify five distinct phases of Russia's industrial policy since 2005, each marked by evolving strategies of state engagement:

1. 2005–mid-2008 ('Fat Years'): A period of rapid growth underpinned by high commodity prices, during which state-backed institutions were mobilised to expand strategic sectors.
2. 2008–2009 (global financial crisis): Emergency support measures were deployed to stabilise key industries, particularly metals and automotive manufacturing.
3. 2010–early 2014: A post-crisis recovery strategy emphasised domestic production and selective technological upgrading.

4. 2014–2015 (geopolitical and economic crisis): The imposition of sanctions triggered import substitution programmes and renewed industrial protectionism.
5. 2016–present: Industrial policy evolved into a hybrid model combining horizontal innovation incentives with vertical support for sectoral 'champions' under persistent geopolitical uncertainty.

This institutional trajectory offers a structural lens through which to interpret both the observed performance divergence across sectors and the limitations of state buffering mechanisms. For instance, the relative resilience of the materials sector post-2014 can be partly attributed to its strategic positioning in earlier industrial policy cycles (Vidal 2023), whereas the persistent underperformance of the energy sector reveals the fragility of politically favoured sectors when exposed to exogenous shocks. Moreover, our operationalisation of the 'state and strategic firms' (SSF) indicator—based on MOEX index inclusion—resonates with this policy lineage, capturing not only ownership but also regulatory visibility and strategic designation as recognised in state-led developmental frameworks.

2.3 | Empirical Studies of Sanctions and Firm Performance

Early macro-level studies document the adverse effects of sanctions on economic growth, investment and trade (Hufbauer and Jung 2021; Neuenkirch and Neumeier 2015).[1] For Russia, Connolly (2018) shows that post-2014 sanctions disrupted access to Western capital and technology, particularly in finance and energy.

Firm-level evidence, however, reveals considerable variation in outcomes. Ahn and Ludema (2020) find that sanctioned Russian firms suffered sharp declines in revenue and employment but that state-designated strategic firms were partially shielded through fiscal transfers and preferential policies. Their shielding model provides a theoretical rationale for why politically connected firms may maintain operations despite external shocks, though at fiscal cost.

Nigmatulina (2023) extends this analysis, showing that sanctioned firms received disproportionate capital inflows, leading to significant misallocation and a 1% decline in national TFP. Her findings highlight the long-term costs of shielding policies and suggest that formal sanctions may unintentionally favour less productive firms.

Gaur et al. (2023) approach the issue from an institutionalist angle, documenting how sanctioned firms navigated conflicting pressures from hostile international and supportive domestic institutions. They find that many such firms, particularly in strategic and export-oriented sectors, outperformed their non-sanctioned peers over time, aided by supply chain adjustments, political connections and lobbying. Their study highlights firm agency in adapting to sanctions.

Keerati (2022) offers further details, finding that sanctioned firms shrank significantly less than comparable peers due to reallocation of domestic credit in their favour. Sanctions constrained access to foreign capital but pushed domestic lenders to prioritise politically significant borrowers, crowding out others and tightening financial conditions economy-wide.

Huynh et al. (2023) provide a longer-run panel analysis of Russian firms and show that nonenergy firms experienced significant declines in investment and financial health after 2014, whereas energy firms appeared relatively unaffected. Their outcome focus (investment ratios, WACC, R&D) differs from our performance-based measures (ROE and ROA), potentially explaining the discrepancy with our finding that the energy sector underperformed other strategic sectors post-2014.

Golikova (2023) uses survey data to capture perceptual and behavioural responses among Russian SMEs. Her results underscore that although adaptation occurred, access to state support was uneven. State-affiliated and export-oriented firms reported more resilience, whereas nonstrategic SMEs struggled with persistent financing and input constraints. This complements our findings by showing that resilience is contingent not just on sector but also on institutional embeddedness.

Collectively, these studies emphasise that sanctions' effects are uneven, shaped by firm-level characteristics, political status and broader institutional responses. They also reveal important trade-offs between short-term stability and long-run efficiency.

Although these studies provide essential insights into firm-level responses and misallocation effects, they leave open questions about long-term sectoral reconfiguration, the role of indirect exposure among nontargeted firms and the institutional consequences of strategic designation—questions we address by aggregating firm-level ROE/ROA data into sectoral trajectories and leveraging CT-HTM and H-DiD frameworks.

In contrast to the literature's emphasis on formal sanction designation, our findings on Alrosa—a strategically important firm not sanctioned until 2022—suggest that reputational de-risking, compliance burdens and capital access constraints affect performance well before official listing. This supports calls for broader conceptualisations of sanction exposure that include institutional signalling and market perception.

2.4 | Sectoral Divergence and Institutional Context in Russia

Several studies and institutional reports underscore the strategic role of sectoral dynamics in the Russian sanctions context. The materials sector (especially metals and mining) demonstrated resilience by reorienting exports to Asia and leveraging strong global demand (Nivorozhkin and Castagneto-Gissey 2016; Oxford Analytica 2018). Fitch Ratings (2021) confirms that firms such as Norilsk Nickel and Rusal remained profitable despite the sanctions environment, due to high commodity prices and limited dependence on Western capital.

By contrast, the energy sector, though formally shielded from some sanctions, suffered from reduced access to Western extraction technology and capital markets (Oxford Analytica 2017). Case-level analysis of Gazprom and Tatneft shows how

even large, state-linked firms faced declining ROE and capital efficiency in the sanctions era (Fitch Ratings 2021a, 2021e).

Utilities, often state regulated and tariff insulated, maintained operational stability. Firms such as RusHydro and the Federal Grid Company continued to invest and deliver steady returns, aided by state support and predictable revenue streams (Fitch Ratings 2021f, 2022). In contrast, communication services saw stagnant returns due to limited pricing power and constrained consumer demand, despite some state backing (Fitch Ratings 2020a, 2020b, 2020c).

Despite positive industrial output growth between 2015 and 2018, fixed asset depreciation remained alarmingly high, with over 50% depreciation rates in key sectors such as oil, metallurgy and manufacturing (Nusratullin et al. 2020). These infrastructural challenges illustrate the limitations within which sectoral resilience was forged.

The role of secondary sanctions, such as those under CAATSA (Leddy 2018), and financial spillovers (Russell 2016) further broadened the reach of sanctions. These affected firms not formally targeted but connected through ownership or financial networks.[2]

Recent research has begun to recognise the indirect consequences of sanctions on firms not formally targeted. These effects manifest through increased financing costs, due diligence delays, de-risking by foreign partners and disrupted input procurement (e.g., Connolly 2018; Keerati 2022; Russell 2016). Such spillovers exacerbate uncertainty and can degrade performance even in sectors with no formal restrictions. Our analysis contributes to this emerging strand by empirically documenting performance deterioration among firms indirectly exposed to the evolving sanctions architecture, reinforcing the view of sanctions as systemic shocks rather than isolated interventions.

The case of Oleg Deripaska and United Company Rusal offers a salient example of the complexities surrounding ownership, control and indirect sanction exposure (Moehr 2018). Although Rusal was formally designated in April 2018 by the U.S. Treasury, the ensuing market turmoil—including aluminium price spikes, shipping disruptions and supply chain breakdowns—illustrated the systemic sensitivity to sanctions targeting globally integrated firms. The London Metal Exchange blocked Rusal deliveries, whereas international partners such as Rio Tinto invoked force majeure, disrupting upstream and downstream operations. Notably, the eventual lifting of sanctions in 2019—conditional on Deripaska's divestment—underscored how ownership structures, reputational concerns and geopolitical lobbying can mediate sanction effects. Even after delisting, Deripaska himself remained sanctioned, limiting access to international finance and tainting associated ventures. This case thus exemplifies how individual designations can propagate indirect constraints across affiliated firms, sectors and international markets, reinforcing our broader finding that strategic designation offers limited insulation from systemic and reputational risk channels (Stępień et al. 2024).

The literature reviewed above underscores the heterogeneity of firm responses to sanctions, the role of state affiliation and the importance of sector-specific structural factors in shaping resilience. However, existing studies tend to focus on either micro-level causal estimates or broad macroeconomic trends, leaving a gap in understanding the medium- to long-run structural dynamics that play out at the sector level. Our analysis fills this gap by extending the temporal window to 2021 and focusing on financial and operational indicators that reflect deeper strategic shifts rather than immediate firm survival.

Taken together, the literature highlights the value of a meso-level analysis that integrates firm-level heterogeneity and sectoral structure, particularly in economies where strategic designation and state affiliation intersect with sanctions in complex, often opaque ways.

3 | Data and Descriptive Insights Into Sector Heterogeneity

This study draws on firm-level panel data from S&P Compustat Global (WRDS 2025), covering up to 285 publicly listed Russian nonfinancial companies over the period 2006–2021. This yields 3295 firm-year observations. To our knowledge, this represents the longest and most comprehensive post-2014 panel used in sanctions-related and general corporate performance research on the Russian corporate sector. Unlike prior studies that focus on narrower time windows or specific post-crisis years, our extended horizon enables us to track both immediate disruptions and longer-term sectoral adjustments. The sample is obtained following standard panel data quality filters consistent with Wooldridge (2010). Because of an insufficient number of observations, firms in the health care, real estate and information technology sectors were excluded from the analysis. This exclusion had minimal impact on the overall sample composition, as confirmed through descriptive statistics and nonparametric tests.

Our data include all firms listed during the sample period, capturing those directly or indirectly affected by sanctions, thereby avoiding survivorship bias. Rather than excluding firms that were later delisted or restructured, we retain them for all available periods. Because our sample focuses on listed entities with consolidated financial disclosures, it over-represents large, systemically important firms—including many multinational enterprises and state-linked corporations. Findings should thus be interpreted in the context of Russia's strategic industrial core, not the SME sector, which faces distinct constraints and adaptation paths.

We construct financial and operating performance indicators from the consolidated financial statements of companies in our sample. Return on assets (ROA) is calculated as EBITDA over total assets. This metric assesses how efficiently a company utilises its asset base to generate earnings before interest, taxes, depreciation and amortisation and serves as a proxy for operational efficiency (Penman 2010). Notably, our EBITDA ROA indicator is distinct from more traditional ROA measures that typically rely on net income. Our return on equity (ROE) indicator is calculated as net income over shareholders' equity. ROE measures a firm's profitability relative to its net assets and reflects the company's ability to generate returns from equity

financing—a key indicator of managerial effectiveness in maximising shareholder value (Penman 2010).

Firm-level controls include size (log of total assets), leverage (total debt over assets), liquidity (cash and marketable securities over assets), investment (CAPEX over assets) and asset turnover (revenues over assets). We do not include firm age as a control variable. In the Russian context, age is an ambiguous indicator: Many large firms—especially former state enterprises—have technically long institutional histories but were legally reconstituted or transformed during the post-Soviet period. Legal age may therefore not reflect organisational maturity or continuity. Furthermore, firm age is often highly collinear with size, particularly in our sample of large, internationally active firms. Although age may be relevant in broader SME-oriented studies (e.g., Savin and Novitskaya 2023), our size-based controls already capture much of the associated variation. All financial variables are winsorised at the 1st and 99th percentiles. Relevant figures are converted into USD to neutralise inflationary and exchange rate effects.

Firms are grouped by GICS sector classifications (MSCI 2024). We also identify "state and strategic firms" (SSF) based on their historical inclusion in the MOEX state-owned and regulated companies indices, discussed in more detail in Box A1. This allows us to test whether strategic affiliation or political embeddedness shaped firms' responses to sanctions. It is important to note early in our analysis that within the materials sector, the SSF category includes only one state-owned firm—Alrosa, a Russian diamond mining company, the world's largest by volume. Alrosa's unique market position and operational profile may significantly influence the observed outcomes for the SSF firms.

Although ROA and ROE are commonly used to assess firm performance, interpreting them in turbulent environments demands caution. Prior work by Henderson et al. (2012) and Savin and Novitskaya (2023) highlights the risk of misattributing performance to structural resilience when it may result from random fluctuations. To mitigate these risks, we incorporate firm fixed effects, cluster standard errors at the firm level and apply robustness checks.

3.1 | Descriptive Trends

Figure 1 and Table A1 depict the average evolution of key firm-level financial indicators from 2006 to 2021. Several patterns emerge. ROA and ROE declined sharply during the 2008–2009 global financial crisis, then partially recovered. ROA stabilised around 10%, whereas ROE showed more volatility, dropping sharply in 2014—the first sanctions year—before recovering and peaking in 2021.

Leverage increased steadily between 2006 and 2014, then plateaued at around 26%–28%, suggesting that firms maintained their debt positions despite external financial constraints. Liquidity improved slightly after 2014 but declined afterwards. CAPEX as a share of assets declined from roughly 10% in 2008 to 6% post-2014, reflecting persistent retrenchment in investment. Firm size and sales dropped in 2014–2015 but rebounded post-2016. Asset turnover declined after the global financial crisis and remained subdued until a modest recovery in 2021.

Table 1 summarises the mean differences in financial indicators pre- and post-2014. ROE increased slightly (by 0.9 percentage points), whereas ROA remained broadly unchanged; both changes lack statistical significance. However, structural shifts are visible: Firm size and sales volume declined significantly and notably,[3] CAPEX fell by 2 percentage points, leverage rose and liquidity weakened slightly. These shifts indicate a more cautious, defensive corporate stance in the post-2014 period, marked by lower investment, greater indebtedness and smaller operational scale.

Regarding firm-level covariates, our descriptive statistics indicate a significant decline in sales and total assets across firms, aligning with findings from related studies. Specifically, Ahn and Ludema (2020) observe similar financial deterioration in

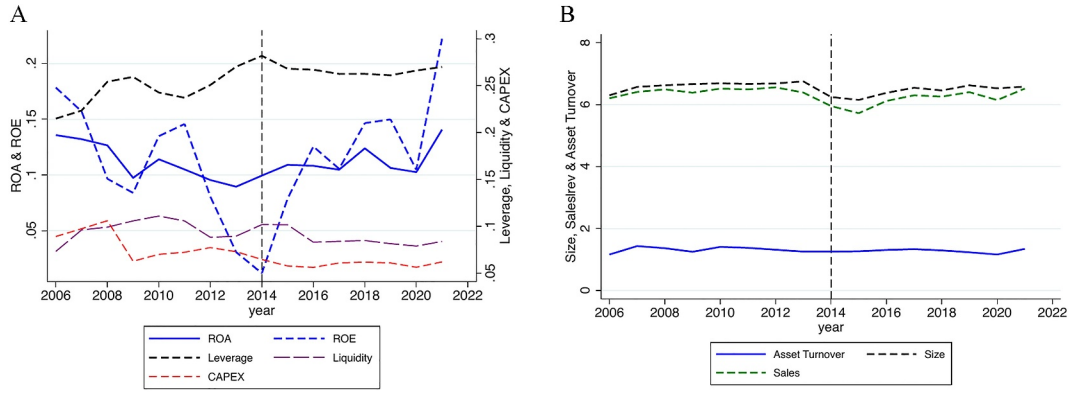

FIGURE 1 | Temporal trends in firm-level indicators, 2006–2021. (A) The financial ratios presented are Return on Equity (ROE), Return on Assets (ROA), Leverage ratio, Liquidity ratio, Capital Expenditure ratio. (B) The financial ratios/indicators presented are Asset Turnover ratio, Size as measured by the logarithm of total assets (in $US), and Sales as measured by the logarithm of total revenues (in $US). The figure presents annual averages of selected firm-level indicators for Russian listed nonfinancial companies, based on data from the S&P Compustat Global. Variable definitions and construction methods are provided in Table A4. ROA the trends highlight shifts in profitability, operational efficiency, and capital structure across the pre-sanctions (2006–2013) and post-sanctions (2014–2021) periods. *Source:* Authors' calculations based on Compustat Global data.

their analysis, documenting substantial reductions in revenues and assets among firms targeted by sanctions. They report a roughly 25% decline in operating revenue and approximately 50% reduction in total assets for sanctioned firms relative to nonsanctioned peers. Although their focus is explicitly on targeted firms, our broader analysis reveals analogous effects within a general sample, suggesting a wider systemic impact of sanctions beyond explicitly sanctioned entities. These parallels reinforce the robustness of our findings, highlighting consistent economic repercussions under sanction conditions across different empirical contexts.

3.2 | Sectoral Insights

Appendix Table A2 and Figure 2 illustrate sectoral heterogeneity in firm responses to the post-2014 sanctions environment.

TABLE 1 | Temporal differences in firm-level indicators: pre-2014 versus post-2014 periods (2006–2021).

Variable	Difference (post-pre)	Std. err.
Return on assets (ROA)	−0.00034	0.004
Return on equity (ROE)	0.00896	0.011
Size	−0.163**	0.071
Sales	−0.297***	0.079
Asset turnover	−0.0953*	0.057
Leverage	0.0231***	0.007
Liquidity	−0.00848**	0.004
CAPEX	−0.0197***	0.002
Observations	3295	

Note: This table presents results from Welch's *t*-tests assuming unequal variances, comparing the means of selected firm-level indicators for Russian listed nonfinancial companies between the pre-sanctions period (2006–2013) and the post-sanctions period (2014–2021).
***$p < 0.1$.
**$p < 0.05$.
*$p < 0.01$.
Source: Authors' calculations based on S&P Compustat Global data.

The energy sector experienced a statistically significant decline in ROE by 6.4 percentage points ($p = 0.008$), accompanied by marked reductions in CAPEX ($p < 0.001$) and asset turnover ($p = 0.001$), consistent with constraints from financial and technological sanctions. The materials sector, by contrast, saw a modest but statistically marginal increase in ROE (+4.5 percentage points, $p = 0.085$), coupled with a significant rise in leverage ($p = 0.043$) and reduction in CAPEX ($p < 0.001$), suggesting strategic adaptation under pressure.

Utilities showed a weakly significant improvement in ROA ($p = 0.099$) and a significant increase in leverage ($p < 0.001$), but also a sharp decline in liquidity ($p < 0.001$) and CAPEX ($p < 0.001$), reflecting cost containment under regulatory insulation. The communication services sector experienced significant declines in ROA ($p = 0.011$) and CAPEX ($p < 0.001$), alongside reductions in sales and liquidity, indicating pressure from stagnant demand and limited pricing flexibility.

Industrial and consumer-facing sectors saw significant contractions across multiple dimensions: Industrials recorded declines in firm size ($p = 0.008$) and CAPEX ($p = 0.069$), whereas consumer discretionary and consumer staples exhibited statistically significant declines in CAPEX ($p = 0.001$ and 0.000, respectively), asset turnover ($p = 0.000$ and 0.057) and sales ($p = 0.019$ and 0.051), indicating sustained pressure from demand-side and financing constraints.

Figure 2 further illustrates that although sectoral performance trajectories were broadly aligned before 2014, divergence intensified thereafter. Panel A reveals pronounced divergence of ROE across sectors after 2014. The materials sector exhibits a strong post-sanction rebound, becoming the top performer by 2021. In contrast, energy, which had the highest ROE pre-2009, experiences persistent underperformance thereafter. Utilities maintain relatively stable returns, whereas consumer discretionary, industrials and communication services show more volatile and subdued trends.

Panel B (ROA) confirms this pattern. Although materials and utilities stabilise or improve post-2014, communication services

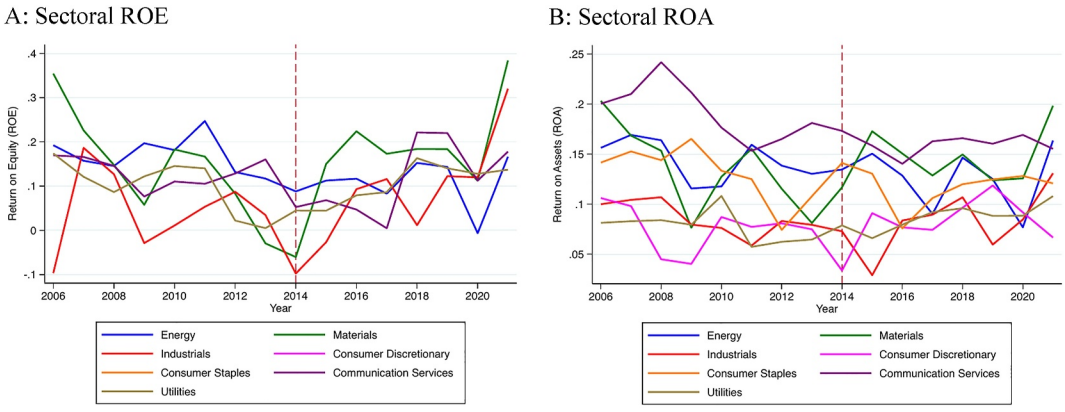

FIGURE 2 | Sectoral trends in return on equity (ROE) and return on assets (ROA), 2006–2021. This figure presents annual averages of return on equity (Panel A) and return on assets (Panel B) for Russian listed nonfinancial companies over the period 2006–2021. Firms are classified by sector according to the Global Industry Classification Standard (GICS). The vertical dashed line indicates the onset of Western sanctions in 2014. *Source:* Authors' calculations based on S&P Compustat Global data.

and consumer sectors decline markedly, suggesting deteriorating asset efficiency. Energy, although volatile, appears to converge gradually towards the sectoral mean after 2014.

Overall, these dynamics visually reinforce the paper's core argument: Sanctions acted as a structural stress test, amplifying sectoral asymmetries in performance and revealing differing capacities for adaptation or state-supported stabilisation.

4 | Continuous-Time Heterogeneous Treatment Model Specification and Estimation

Building directly on the descriptive insights from Section 3, this section formalises our empirical strategy using a continuous-time heterogeneous treatment model (CT-HTM). The model is designed to evaluate sector-specific adaptation to the sanctions regime imposed from 2014 onwards, leveraging firm-level financial data over a long horizon. Although all firms in our sample are nominally 'treated' by the geopolitical and macroeconomic shifts of the post-2014 period, their exposure and adjustment capacity vary systematically by sector and strategic status. The CT-HTM generalises the difference-in-differences (DiD) framework to a setting without an untreated control group, allowing us to estimate trend breaks and interaction effects flexibly and transparently. Unlike standard DiD designs, this approach accounts for continuous treatment effects and varying exposure over time, crucial given the prolonged and evolving sanctions environment post-2014.

The empirical challenge lies in identifying structural divergence under a universal but heterogeneously experienced treatment. To this end, our model incorporates sectoral fixed effects, firm-level controls and interactions with macroeconomic variables such as oil prices, commodity index returns, exchange rate dynamics and GDP growth. Strategic firm status—proxied by historical inclusion in the MOEX state-owned and regulated companies indices—is included to test for performance differentials linked to state affiliation.

Formally, the baseline model specification is as follows:

$$\begin{aligned} y_{it} = {} & \alpha_i + \gamma_r^{\text{pre}}\left(t \cdot \left(1 - D_t^{\text{post}}\right)\right) + \gamma_{\text{r}}^{\text{post}}\left(t \cdot D_t^{\text{post}}\right) \\ & + \sum_{k \neq r}\left[\gamma_k^{\text{pre}}\left(S_{ik} \cdot t \cdot \left(1 - D_t^{\text{post}}\right)\right) + \gamma_k^{\text{post}}\left(S_{ik} \cdot t \cdot D_t^{\text{post}}\right)\right] \\ & + \sum_k\left[\sum_j \delta_{jk}\left(S_{ik} \times Z_{jt}\right) + \theta_k^{\text{pre}}\left(SSF_i \cdot t \cdot \left(1 - D_t^{\text{post}}\right)\right)\right. \\ & \left. + \theta_k^{\text{post}}\left(SSF_i \cdot t \cdot D_t^{\text{post}}\right)\right] + X_{it}'\delta + \varepsilon_{it} \end{aligned} \tag{1}$$

where:

- y_{it}: outcome (ROE or ROA) for firm i in year t
- α_i: firm fixed effects
- S_{ik}: sector dummy for sector k, omitting reference sector r
- D_t^{post}: post-2014 indicator
- t: continuous-time trend, centred at 2014
- Z_{jt}: vector of macroeconomic controls (% change in Bloomberg Commodity Index, % change in Urals crude oil price, % change in the nominal effective exchange rate of rouble, lagged Russian GDP growth)
- X_{it}: vector of firm-level controls (size, leverage, liquidity, CAPEX and asset turnover)
- SSF_i: state and strategic firm dummy (defined via MOEX index presence, discussed in Box A1)
- ε_{it}: error term

The coefficients γ_k^{pre} and γ_k^{post} capture how sectoral financial and operating performance trajectories diverged relative to the materials sector baseline trend captured by the coefficients γ_r^{pre} and γ_r^{post}. Interactions with SSF_i and Z_{jt} capture heterogeneous slopes by sector and firm's strategic status.

Unlike standard DiD models, the absence of an untreated group requires identification via parallel slope assumptions and relative divergence. This generalisation permits continuous treatment effects and interaction with structural economic variables, enhancing our capacity to detect sustained trends.

4.1 | Model Fit and Baseline Diagnostics

The baseline model is estimated via high-dimensional fixed effects (HDFE) regression (Correia 2023), which accommodates firm-level heterogeneity and interaction complexity. The selected period (2009–2021) deliberately excludes earlier economic shocks, notably the global financial crisis (GFC), because the parallel slopes assumption fundamental to our identification strategy does not hold in periods characterised by exceptional global disruptions.

Model selection is guided by AIC/BIC and log-likelihood comparisons. Variance inflation factors (VIFs) confirm no serious multicollinearity. Wooldridge tests validate the adequacy of clustered standard errors. Robustness checks using first-difference and alternative model specifications yield consistent results.

To further validate the robustness of our identification strategy, we implemented an alternative specification of our continuous-time heterogeneous treatment model (CT-HTM). Specifically, we substituted macroeconomic control variables with additional sector-level fixed effects, thereby capturing unobserved sector-specific shocks or trends that might confound our main results. The outcomes of this multilevel model, reported alongside our primary specification in Table A3, corroborate the robustness of our main model findings.

Appendix Table A4 describes data sources and variable construction. Table A3 reports CT-HTM full regression results. Figures 3–6 display predicted sectoral ROE and ROA trends, derived from model margins. These visualisations provide an intuitive depiction of the performance trajectories modelled.

Figures 3 and 4, showing marginal predicted values, illustrate the absolute trends in sectoral performance and highlight the divergence across sectors in levels and trajectories. Panel A

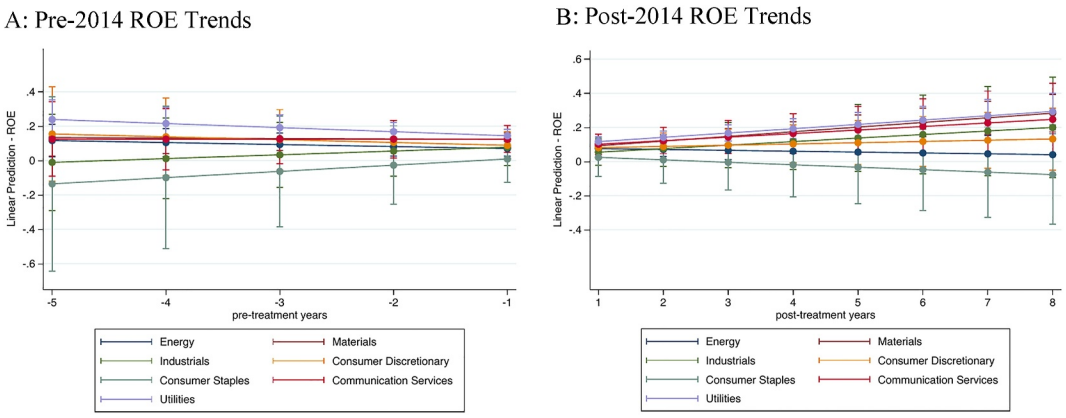

FIGURE 3 | Sectoral counterfactual predictions of ROE from the CT-HTM model before and after 2014, 2009–2021. The figure presents predicted values and temporal trends of return on equity (ROE) from the CT-HTM model (Equation (1)), estimated using data from Russian listed nonfinancial companies sampled from S&P Compustat Global. The estimation covers the full 2009–2021 period, whereas the graphical presentation separates pre-2014 (Panel A) and post-2014 (Panel B) predictions. The treatment breakpoint is centred at 2014 to highlight divergence in sectoral trends after the onset of sanctions. Vertical lines represent 95% confidence intervals based on robust standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global and Refinitiv Eikon (LSEG) data.

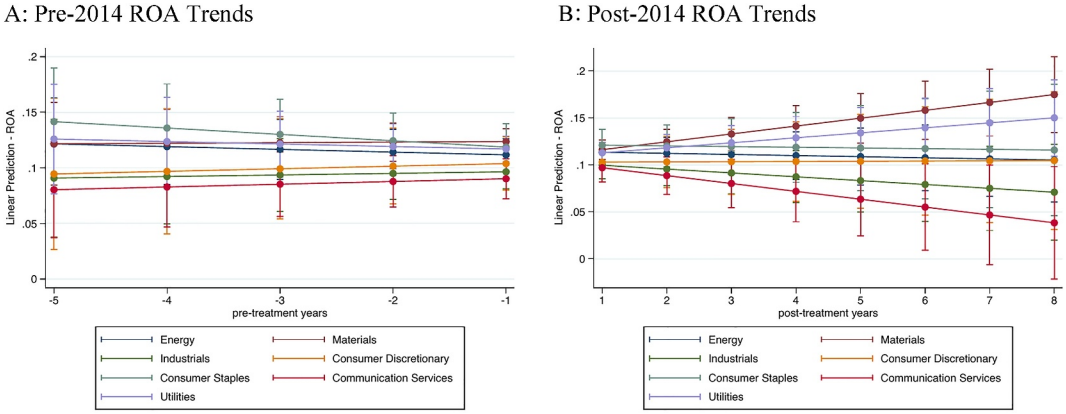

FIGURE 4 | Sectoral counterfactual predictions of ROA from the CT-HTM model before and after 2014, 2009–2021. The figure presents predicted values and temporal trends of return on assets (ROA) from the CT-HTM model (Equation (1)), estimated using data from Russian listed nonfinancial companies sampled from S&P Compustat Global. The estimation covers the full 2009–2021 period, whereas the graphical presentation separates pre-2014 (Panel A) and post-2014 (Panel B) predictions. The treatment breakpoint is centred at 2014 to highlight divergence in sectoral trends after the onset of sanctions. Vertical lines represent 95% confidence intervals based on robust standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global and Refinitiv Eikon (LSEG) data.

shows predicted sectoral trends in ROE and ROA for the pre-2014 period. The postestimation test statistics indicate that, jointly, the sectors exhibit statistically indistinguishable slopes, supporting the parallel trends assumption (ROE: $p = 0.164$; ROA: $p = 0.877$). Post-2014 trends, displayed in Panel B, demonstrate visible divergence, with a postestimation test rejecting the null hypothesis of equal sectoral trends post-2014 (ROE: $p < 0.001$; ROA: $p = 0.021$).

The regression estimates indicate that after 2014, the materials sector, which by construction defines the baseline trend, experienced a predicted annualised ROE gain of 3.1 percentage points and an ROA gain of 0.9 points. The energy sector's ROE and ROA trends are 3.6 and 1.1 percentage points below this, suggesting downward performance trajectories for the energy sector. Utilities showed performance trends comparable to materials. Consumer sectors maintained relatively stable operating performance, with consumer discretionary also showing some upward trend in ROE. The industrials and communication services relative trends coefficients suggest a potentially weaker but upward trend for ROE, whereas the magnitude of significant ROA deviations of the point estimates from the baseline trend of materials suggests a declining ROA trend in industrials and communication services, as shown in Figures 3 and 4.

4.2 | Macroeconomic Drivers and Firm-Level Fundamentals

Regression estimates in Table A3 show that the crude oil price increases benefited ROE and ROA for energy and materials, while mostly negatively affecting other sectors. The Bloomberg Commodity Index (BCOM) has a counterintuitive negative effect on energy and materials, possibly reflecting commodity-

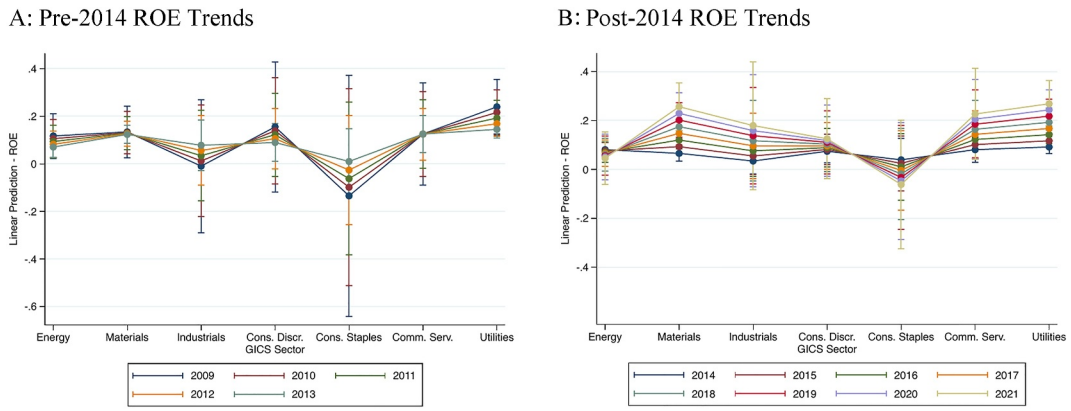

FIGURE 5 | Sectoral predictions and trend divergence in ROE from the CT-HTM model, 2009–2021. The figure presents predicted values and temporal trends of return on equity (ROE) based on the CT-HTM model from Equation (1), estimated using data for Russian listed nonfinancial companies from the S&P Compustat Global database. The sample covers the period 2009–2021. Pre-2014 and post-2014 predictions are produced within a unified estimation framework but are shown separately in Panel A (2009–2013) and Panel B (2014–2021) to illustrate divergence in sectoral performance. Vertical lines represent 95% confidence intervals based on robust standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global and Refinitiv Eikon (LSEG) data.

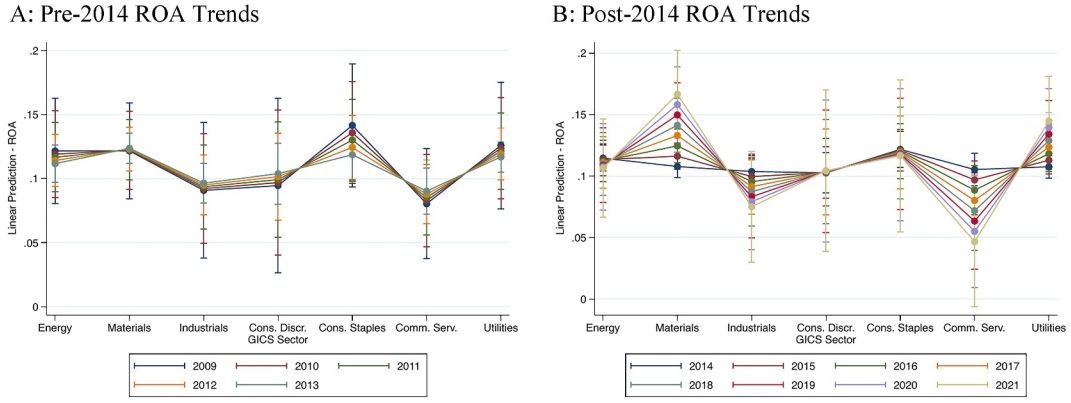

FIGURE 6 | Sectoral predictions and trend divergence in ROA from the CT-HTM model, 2009–2021. The figure displays predicted values and temporal trends of return on assets (ROA) based on the CT-HTM model from Equation (1), estimated using data for Russian listed nonfinancial companies from the S&P Compustat Global database. The sample covers the period 2009–2021. Pre-2014 and post-2014 predictions are generated within a single estimation but are presented separately in Panel A (2009–2013) and Panel B (2014–2021) to highlight divergence in sectoral trends. Vertical lines represent 95% confidence intervals based on robust standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global and Refinitiv Eikon (LSEG) data.

specific divergence, supported by a marginally positive coefficient for the industrials sector's ROA. Rouble appreciation, as captured by the annual percentage change in the nominal effective exchange rate of the rouble (NEER), is associated with weaker firm performance, particularly in export-oriented sectors, but the results tend to lack statistical significance. Lagged GDP growth has a negative effect on ROE and ROA in energy and materials, indicating procyclical sensitivity. Postestimation Wald tests reject the null hypothesis that sectoral trends for macro indicators are jointly insignificant.

Firm-level fundamentals behave as expected. Higher leverage is associated with lower ROE, whereas capital expenditures, liquidity and asset turnover tend to be positively linked to firms' operating performance and, to a lesser extent, to their financial performance. Firm size shows a positive but statistically insignificant effect on firms' performance indicators.

4.3 | State and Strategic Firm Dynamics

The interaction between sector affiliation and the SSF (state and strategic firms) indicator reveals pronounced heterogeneity in performance dynamics. Prior to 2014, SSF firms in the energy sector exhibit a significant upward trend in return on equity (ROE), whereas those in the materials and communication services sectors show rising trends in return on assets (ROA). Post-2014, however, this pattern reverses for several sectors. The ROE of SSF firms in the materials sector declines significantly, whereas ROA also deteriorates for SSF firms in both the materials and utilities sectors. In contrast, communication services and industrials show statistically significant improvements in ROA after 2014.

Notably, the materials sector's SSF classification is driven exclusively by a single firm—Alrosa, Russia's state-affiliated

diamond monopoly and the world's largest producer by volume. This firm-specific classification highlights the nonrepresentative nature of the sectoral trend and cautions against overgeneralised inference. Although Alrosa was not under direct international sanctions prior to February 2022, it likely encountered indirect exposure to the evolving sanctions architecture. As a state-owned enterprise, Alrosa operated within a constrained institutional environment shaped by restrictions on Russian financial institutions, reduced access to international capital markets and heightened compliance risk. For example, Directive 1 under Executive Order 14024 (April 2021) barred U.S. financial institutions from participating in the primary market for Russian sovereign debt, indirectly tightening financing conditions for firms such as Alrosa. Even without formal designation, counterparties abroad may have subjected Alrosa to enhanced due diligence or disengaged altogether, thereby raising transaction costs and limiting operational flexibility.

In addition, the broader sanctions climate likely produced spillover effects, diminishing Alrosa's market opportunities through weakened customer demand and negative investor sentiment. Despite these constraints, Alrosa maintained a strong commercial footprint, generating over $4.2 billion in revenues in 2021. As a vertically integrated entity spanning exploration, extraction and jewellery production, and with diamond exports exceeding $4.5 billion that year, Alrosa's strategic relevance to the Russian economy remains significant. However, the observed decline in its post-2014 ROA suggests limited operational resilience and reinforces the importance of firm-level characteristics over formal strategic designation in mediating performance outcomes.

Taken together, these findings indicate that the SSF label alone does not insulate firms from the adverse effects of sanctions. Instead, sectoral context and firm-specific factors—such as global supply chain integration, export market composition and financial flexibility—play a decisive role in shaping adaptive capacity.

Postestimation Wald tests confirm statistically significant breaks in sectoral performance trends associated with SSF firms. Specifically, we reject the null hypothesis that pre- and post-2014 trends are jointly insignificant. Structural shifts are evident in ROE for the energy and materials sectors and in ROA for communication services and materials, further substantiating the presence of systemic divergence in the trajectories of strategically affiliated firms.

4.4 | Sectoral Performance Visualisations

Figures 5 and 6, like Figures 3 and 4, plot model-predicted sectoral ROE and ROA for the pre- and post-sanctions periods (2009–2013 and 2014–2021, respectively). The divergence across sectors is pronounced: Materials emerge as consistent post-2014 outperformers, whereas energy displays a persistent decline. Utilities maintain relative stability, whereas communication services and industrials exhibit mixed trajectories. Consumer sectors, by contrast, show greater volatility and wider confidence intervals, suggesting less reliable trend predictions and greater heterogeneity within these groups.

The model estimates imply that sample-wide ROE increased from approximately 9% in 2014 to 21% by 2021, with gains distributed across most sectors except energy and consumer staples. Predicted ROA rose more modestly, from around 11% to 13%, with improvements largely concentrated in materials and utilities. These trends reinforce the asymmetric character of sectoral resilience. Although some sectors managed to maintain or improve profitability—often through financial restructuring or increased leverage—there were fewer sustained improvements in core operational efficiency, as reflected in ROA.

The predictions also highlight growing performance gaps across sectors. By 2021, the ROE gap between energy and the rest of the sample reached up to 12 percentage points, indicating substantial sectoral underperformance. The ROA gap for energy shifted from +0.5 percentage points in 2014 to −0.4 in 2021, suggesting a reversal in relative asset efficiency. Meanwhile, the gap between materials and other nonenergy sectors also widened, particularly in terms of ROE, underscoring their strategic and financial adaptability.

Although some divergence may reflect model-imposed linearity, the predicted trajectories corroborate evidence of structural differentiation in firm performance. Sectoral responses appear shaped by both external shocks and internal adaptive capacity.

These patterns provide further motivation for the alternative identification strategy introduced in Section 5, which seeks to validate and benchmark estimated treatment effects through a complementary lens.

Importantly, our robustness checks emphasise caution in attributing sectoral performance shifts solely to the post-2014 sanctions environment. Although sanctions likely contributed to observed divergence, their effects were intertwined with broader structural dynamics—particularly in the materials and energy sectors. Placebo tests using alternative treatment years (2012 and 2013) tend to be consistent with some of the observed sectoral trends pre-dating the formal post-2014 sanctions period. These patterns suggest that global commodity cycles, regulatory reforms and post-GFC recovery trajectories may also shape sectoral outcomes independently of sanctions. As such, our estimated treatment effects should be interpreted as reflecting the combined influence of sanctions and evolving structural forces, rather than isolated sanction-induced shifts. This view is essential for evaluating policy responses and understanding sectoral adaptation.

5 | Robustness: Sector-Level Difference-In-Differences and Strategic Firm Effects

To validate the findings from our continuous-time heterogeneous treatment model (CT-HTM), we implement an auxiliary robustness strategy using simplified sector-level heterogeneous difference-in-differences (H-DiD) estimators. This complementary analysis allows us to benchmark average treatment effects for the energy sector and for the state and strategic firms (SSF) using more traditional frameworks.

5.1 | ATET Estimation: TWFE and AIPW Models

In contrast to the CT-HTM, which captures sectoral divergence via trend slope differences, the average treatment effects on the treated (ATET) in H-DiD models estimate average post-treatment deviations relative to a defined control group. For the energy sector, we estimate treatment effects using both two-way fixed effects (TWFE) and augmented inverse probability weighting (AIPW) models. The TWFE estimator includes firm and year fixed effects and measures average differences pre-treatment and post-treatment, conditional on controls (Wooldridge 2021). The AIPW estimator further corrects for selection bias and offers double robustness, yielding consistent estimates even if only one of the treatment or outcome models is correctly specified (Callaway and Sant'Anna 2021).

Although these estimators do not account for continuous treatment timing or macro-sector interactions as in the CT-HTM, they serve as valuable robustness checks, helping confirm whether the energy sector's post-2014 underperformance persists across alternative estimation strategies.

5.2 | Energy Sector ATETs: TWFE and AIPW Results

We estimate average treatment effects on the treated (ATETs) for energy firms, using materials, industrials, communication services and utilities as a control group. Our sample spans 2010–2021 and excludes consumer sectors. We employ different analytical timeframes and sample restrictions across models to ensure the reliability of our estimations. Specifically, the TWFE and AIPW robustness checks are restricted to the 2010–2021 period, as the necessary parallel trends assumption for these estimators is less likely to hold in the volatile immediate aftermath of the global financial crisis (2008–2009). By contrast, the CT-HTM model utilises the extended sample from 2009 to 2021 to leverage continuous treatment timing and assess long-term structural effects comprehensively.

Table 2 reports annual and overall ATETs for the energy sector's ROE and ROA. The parallel trends assumption holds for both ROE and ROA models. Both TWFE and AIPW estimates indicate persistent post-treatment underperformance, with overall ATETs of approximately −10 percentage points for ROE and −4 percentage points for ROA. Year-specific effects are most pronounced in 2016–17 and 2019–20 (see also Panel A, Figures 7 and 8), with the latter period coinciding with pandemic-related shocks. As a robustness check, we restrict the post-2014 sample to the prepandemic years (2010–2019). As expected, the magnitude of the overall ATETs decreases to around −7 percentage points for ROE and −3 for ROA, while remaining both economically and statistically significant.

To examine temporal dynamics within the TWFE framework, we estimate duration-of-exposure ATETs, using the number of years since 2014 as the exposure variable. The results in Panel B of Figures 7 and 8 confirm a pattern of cumulative performance

TABLE 2 | Estimated average treatment effects on the treated (ATET) for energy sector firms' ROE and ROA based on TWFE and AIPW models, 2010–2021.

Year	ROE (TWFE)	ROE (AIPW)	ROA (TWFE)	ROA (AIPW)
2011	—	0.034 (0.026)	—	0.002 (0.014)
2012	—	0.003 (0.031)	—	0.011 (0.012)
2013	—	0.017 (0.043)	—	0.003 (0.013)
2014	−0.031 (0.061)	0.030 (0.053)	−0.028* (0.017)	−0.018 (0.018)
2015	−0.123** (0.062)	−0.052 (0.070)	−0.029 (0.022)	−0.012 (0.020)
2016	−0.164*** (0.049)	−0.124** (0.049)	−0.038** (0.018)	−0.029 (0.019)
2017	−0.120*** (0.043)	−0.114* (0.059)	−0.060*** (0.017)	−0.063*** (0.022)
2018	−0.096 (0.061)	−0.082 (0.069)	−0.034* (0.020)	−0.033 (0.022)
2019	−0.176** (0.078)	−0.121* (0.066)	−0.032* (0.019)	−0.039** (0.020)
2020	−0.282*** (0.081)	−0.201*** (0.073)	−0.081*** (0.031)	−0.076*** (0.027)
2021	−0.182** (0.092)	−0.150 (0.124)	−0.059* (0.030)	−0.044 (0.051)
Model diagnostics				
Parallel trends test (*p*-value)	0.108	0.609	0.957	0.799
Overall ATET estimate	−0.099*** (0.028)	−0.097* (0.053)	−0.033*** (0.016)	−0.038** (0.019)
No. of observations	1501	1501	1824	1824
Treated observations	221	221	263	263

Note: Robust standard errors clustered at the firm level. Significance levels: *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. The table reports year-specific and overall ATET estimates for the energy sector's return on equity (ROE) and return on assets (ROA), based on two-way fixed effects (TWFE) and augmented inverse probability weighting (AIPW) models. The analysis uses data for Russian listed nonfinancial companies from the S&P Compustat Global database. The sample period is restricted to 2010–2021, with 2010–2013 designated as the pretreatment period and 2014–2021 as the treatment period. The AIPW model reports treatment effects relative to the immediately preceding year. The estimates reflect performance differentials between energy sector firms and a control group comprising the materials, industrials, communication services and utilities sectors. Negative ATET values indicate years of relative underperformance for energy. Robust standard errors are clustered at the firm level.
Source: Authors' calculations based on Compustat Global data.

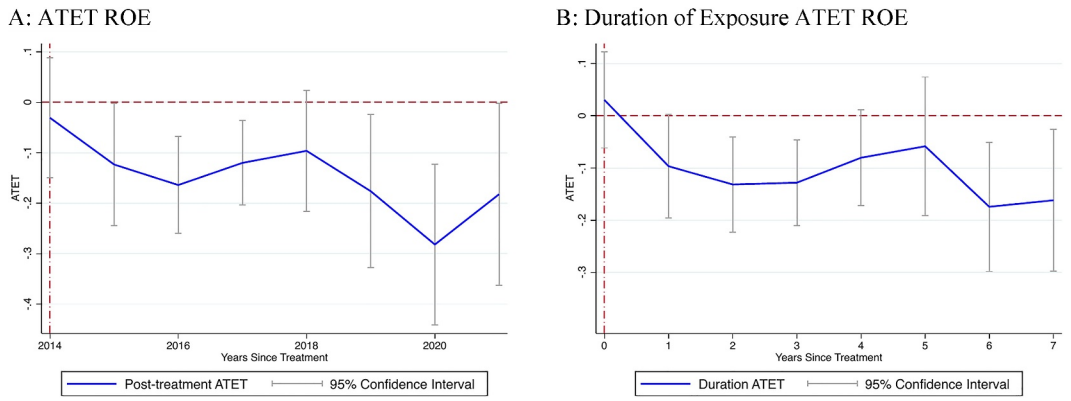

FIGURE 7 | Estimated year-specific and duration of exposure ATET for the energy sector's ROE, TWFE model, 2010–2021. This figure presents estimates of year-specific and duration-based average treatment effects on the treated (ATET) for return on equity (ROE) in the energy sector, based on a two-way fixed effects (TWFE) model. The analysis uses data for Russian listed nonfinancial companies from the S&P Compustat Global database, covering the period 2010–2021, with 2010–2013 as the pretreatment years. The ATET estimates capture deviations in ROE for energy sector firms relative to a control group comprising companies from the materials, industrials, communication services and utilities sectors. The duration of exposure effects is conditional on the number of years since the onset of the post-2014 treatment period. The model includes firm-level covariates. Shaded areas represent 95% confidence intervals based on robust standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global data.

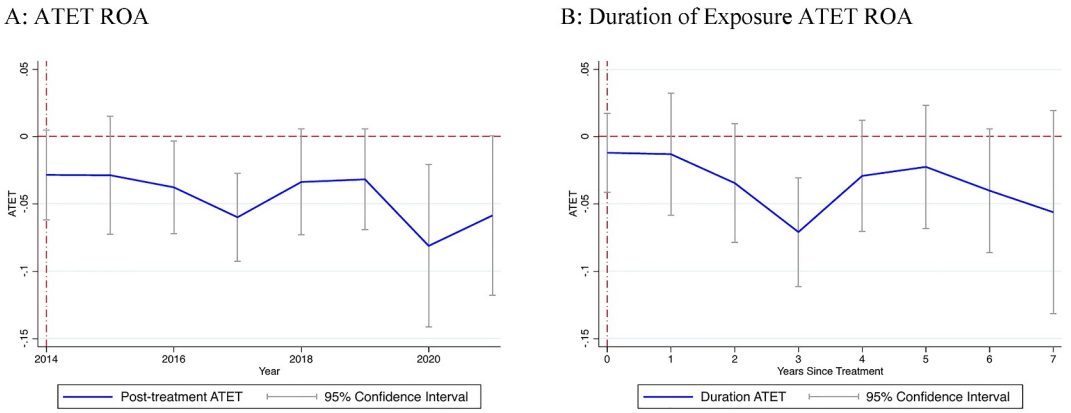

FIGURE 8 | Estimated year-specific and duration of exposure ATET for the energy sector's ROA, TWFE model, 2010–2021. This figure presents estimates of year-specific and duration-based average treatment effects on the treated (ATET) for return on assets (ROA) in the energy sector, based on a two-way fixed effects (TWFE) model. The analysis uses data for Russian listed nonfinancial companies from the S&P Compustat Global database, covering the period 2010–2021, with 2010–2013 as the pretreatment years. The ATET estimates capture deviations in ROA for energy sector firms relative to a control group consisting of companies from the materials, industrials, communication services and utilities sectors. The duration of exposure effects is conditional on the number of years since the onset of the post-2014 treatment period. The model includes firm-level covariates. Shaded areas represent 95% confidence intervals based on robust standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global data.

deterioration in the energy sector, with ATETs remaining significantly negative across most treatment years. In the AIPW framework, duration of exposure is embedded within the treatment estimation (see Figure 9) and directly corresponds to the ATETs reported in Table 2. Overall, the duration analysis reinforces the conclusion that the energy sector's underperformance reflects not merely a short-run adjustment but a sustained structural divergence.

5.3 | State and Strategic Firms (SSF): AIPW Estimation

To examine whether the state and strategic firms (SSF) fared differently, we estimate ATETs for SSF firms using the AIPW framework. SSF firms are defined by company inclusion in the MOEX state-owned or regulated companies indices. The control group consists of non-SSF firms from the same set of strategic sectors.

Figure 10 presents the estimated ATETs for ROE and ROA over the 2010–2021 period. The models control for firm-level covariates and apply robust standard errors clustered at the firm level. The statistical tests for both models cannot reject the hypothesis of parallel trends in the pretreatment years, as visually supported by Figure 10. The duration of exposure ROE ATETs for the SSF firms are negative and statistically significant in several post-2014 years, particularly in 2018, 2019 and 2021. ROA ATETs are only statistically significant in 2015, but the overall ROA ATET is significant at −0.029 (p = 0.066). The overall ROE ATET is −11.2 percentage points (p = 0.063).[4]

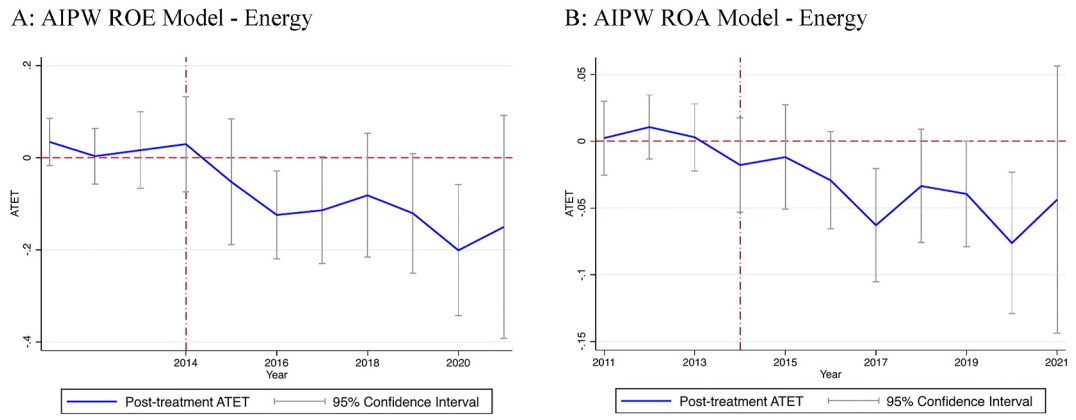

FIGURE 9 | Estimated duration of exposure ATET for the energy sector's ROE and ROA, AIPW model, 2010–2021. This figure displays estimates of the average treatment effects on the treated (ATET) by duration of exposure for return on equity (ROE, Panel A) and return on assets (ROA, Panel B) in the energy sector during the post-2014 treatment period. The sample includes Russian listed nonfinancial firms from S&P Compustat Global for the years 2010–2021, with 2010–2013 serving as the pretreatment baseline. The ATET estimates are obtained using an augmented inverse probability weighting (AIPW) model. The estimates reflect performance differentials between energy sector firms and a control group composed of firms in the materials, industrials, communication services and utilities sectors, conditional on years of exposure to the post-2014 environment. The model includes firm-level covariates. Error bars represent 95% confidence intervals based on standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global data.

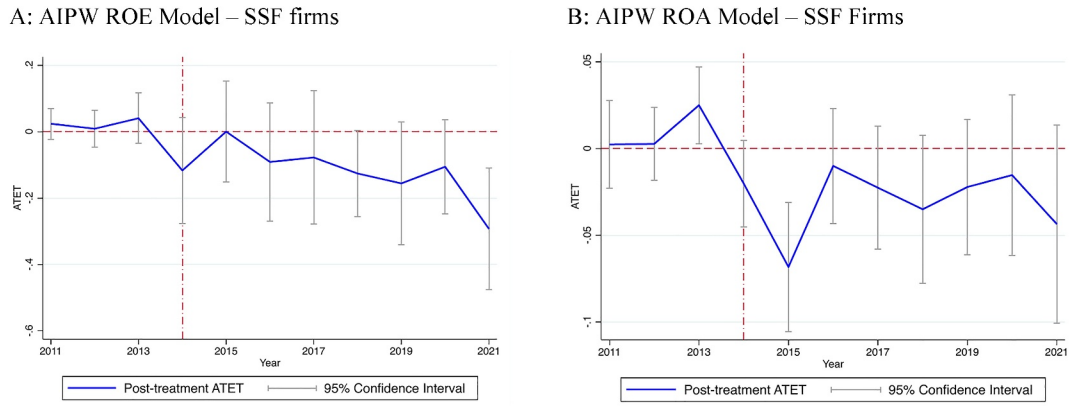

FIGURE 10 | Estimated duration of exposure ATET for state and strategic firms' ROE and ROA, AIPW model, 2010–2021. This figure presents estimates of the average treatment effects on the treated (ATET) by duration of exposure for return on equity (ROE, Panel A) and return on assets (ROA, Panel B) of state and strategic firms (SSF) during the post-2014 treatment period. The sample comprises Russian listed nonfinancial companies drawn from S&P Compustat Global, covering 2010–2021, with 2010–2013 serving as the pretreatment years. The ATET estimates are obtained using an augmented inverse probability weighting (AIPW) model, with 313 treated observations for ROE and 321 for ROA. Treatment is defined by SSF classification based on MOEX indices. The ATET captures performance differentials relative to a control group comprising firms from the materials, industrials, communication services and utilities sectors, conditional on years of exposure since 2014. The model controls for firm-level covariates. Error bars represent 95% confidence intervals with standard errors clustered at the firm level. *Source:* Authors' calculations based on Compustat Global data.

As a robustness check, we restricted our sample to prepandemic years (2010–2019) to isolate sanction-induced effects from potential confounding impacts related to the COVID-19 pandemic. The unreported results confirm our main findings for SSF firms. Specifically, the overall ATET magnitude decreases slightly to approximately −8 percentage points for ROE, whereas the ROA estimate remains essentially unchanged at −3 points. Both metrics continue to be economically meaningful and statistically significant.

Notably, the magnitudes of overall ATETs computed for the SSF firms are very similar to those estimated for the energy sector, suggesting that energy firms—many of which are SSF-designated—contributed significantly to the observed underperformance of SSF firms. These findings reinforce the interpretation that state affiliation alone did not shield firms from post-sanctions pressures and that performance gaps are largely sector-structural.

5.4 | Summary and Implications

Our robustness checks confirm that energy sector underperformance persists across multiple identification strategies. The consistent and statistically significant ATETs from both TWFE and AIPW models support the main CT-HTM findings.

The additional evidence from SSF firms further suggests that state designation does not ensure superior outcomes, especially when structural exposure to sanctions is high.

Together, these findings underscore the asymmetric adjustment capacity across sectors and challenge the assumption that strategic status offers uniform protection. The H-DiD results offer a conservative, interpretable benchmark that strengthens the paper's broader argument about sectoral adaptation under sustained geopolitical pressure.

6 | Case Study: Gazprom PJSC

Gazprom PJSC serves as a paradigmatic example of the intersection between geopolitical stress, sectoral adaptation and financial resilience under sanction-induced constraints. As Russia's flagship energy giant and a key supplier of natural gas to Europe, Gazprom's experience reveals the complex interplay between macro shocks, state support and strategic reconfiguration. Despite not being directly sanctioned by the US or EU prior to 2022, Gazprom experienced substantial indirect effects stemming from the broader sanctions environment and increasing reputational and financial scrutiny (Chen et al. 2023; Jayanti 2022; Shagina 2023; Tuzova and Qayum 2016).

Fitch Ratings (2021) rated Gazprom BBB with a stable outlook, constrained by Russia's sovereign ceiling. The agency assessed the company's standalone credit profile as 'a-', based on low-cost production, substantial reserves and strong market positioning. However, this profile was mitigated by governance concerns and external constraints on international funding. Between 2014 and 2021, Gazprom faced a significant deterioration in external financing conditions. Restrictions on Russian financial institutions, coupled with the threat of secondary sanctions, limited Gazprom's access to Western capital markets. Additionally, projects such as Nord Stream 2 became focal points of geopolitical contestation, with sanctions on construction partners delaying project completion and affecting strategic planning.

Increased compliance burdens, de-risking by Western financial institutions and the volatility of the rouble all contributed to elevated transaction costs and financing difficulties. Although Gazprom was not formally sanctioned, the tightening of the macro-financial environment had significant second-order effects on the company. These effects were compounded by technological barriers in accessing advanced Western equipment for Arctic and deep-sea exploration, further kerbing expansionary ambitions.

Table 3 presents a DuPont decomposition of Gazprom's ROE over the sample period, disentangling the underlying drivers of financial performance: profit margin, asset turnover and the equity multiplier. ROE dynamics reflect the combined influence of profitability, efficiency and financial leverage.

Formally, the DuPont framework (e.g., Soliman 2008) decomposes return on equity (ROE) into the following:

1. Net profit margin: net income/sales
2. Asset turnover: sales/total assets
3. Equity multiplier: total assets/shareholders' equity

To gain further granularity, net profit margin is decomposed into the following:

- Tax burden: net income/pre-tax income
- Interest burden: pre-tax income/operating income
- Operating margin: operating income/sales

Gazprom's ROE declined sharply in 2014–2015, coinciding with collapsing energy prices, rouble volatility and geopolitical shocks. Although some recovery was observed post-2016, pre-2014 levels were not restored. The profit margin component was severely impacted by declining revenues and increased costs during the initial shock period. Asset turnover exhibited limited volatility but did not significantly recover, pointing to persistent inefficiencies.

The equity multiplier—Gazprom's financial leverage—rose during the post-2014 period, suggesting increased reliance on debt financing as access to equity or foreign capital tightened. This uptick likely reflects strategic substitution, with the company tapping domestic or alternative (non-Western) funding sources to finance ongoing operations and capital expenditure. The interest burden fluctuated, partly due to refinancing needs and exchange rate movements, raising concerns about long-term debt sustainability.

The DuPont analysis supports the conclusion that Gazprom's post-2014 financial recovery was partial and uneven. The firm's ROE trajectory mirrors the sector-wide trends of initial post-2014 contraction followed by incomplete recovery. Although state support helped stabilise operations, structural inefficiencies and financial constraints limited performance rebound.

Gazprom's case exemplifies the broader energy sector's vulnerability to sanctions-induced systemic pressures. It illustrates how even nondesignated firms can experience deteriorating performance when operating within a constrained macro-financial regime shaped by indirect sanctions. These patterns underscore the limits of strategic designation in buffering firms from exogenous geopolitical shocks and highlight the necessity of disaggregated, firm-level analysis in assessing sectoral resilience.

7 | Discussion of Results and Sectoral Implications

7.1 | Overview of Main Findings

Our empirical results reveal marked sectoral divergence in financial performance after the imposition of sanctions in 2014. Using both continuous-time heterogeneous treatment models (CT-HTM) and H-DiD (TWFE and AIPW) approaches, we identify persistent and statistically significant underperformance in the energy sector, alongside resilience in the

TABLE 3 | DuPont decomposition of Gazprom PJSC's financial performance: pre- and post-sanctions periods (2005–2022).

Year	ROE	Equity multiplier	Asset turnover	Net profit margin	Tax burden	Interest burden	Operating margin
2005	11.4	159.6	31.8	22.5	69.1	99.1	32.8
2006	18.3	158.5	40.5	28.5	71.6	108.6	36.6
2007	15.3	157.5	35.2	27.5	71.2	131.7	29.4
2008	15.1	145.9	49.1	21.1	72.0	78.3	37.4
2009	13.8	148.1	35.8	26.1	79.6	113.8	28.8
2010	14.8	141.3	38.9	26.9	76.0	108.9	32.5
2011	16.8	140.5	42.5	28.2	77.8	99.5	36.4
2012	13.6	138.7	38.7	25.3	78.2	116.6	27.2
2013	11.8	139.5	38.3	22.1	76.7	92.6	30.6
2014	1.6	150.0	36.1	2.9	51.8	24.6	22.3
2015	7.2	156.2	35.6	13.0	85.1	73.3	20.8
2016	8.3	147.9	36.1	15.6	74.0	153.2	13.7
2017	5.9	151.8	35.9	10.9	70.2	114.9	13.5
2018	10.6	151.1	39.5	17.7	78.6	98.1	23.0
2019	8.2	149.7	35.0	15.7	73.9	130.5	16.3
2020	0.9	157.7	27.1	2.1	101.4	29.3	7.2
2021	12.3	160.4	37.9	20.3	75.2	96.5	28.0
2022	7.3	158.9	44.7	10.4	55.2	74.3	25.2
Pre-2014 mean	13.2	132.2	34.7	22.9	66.2	95.2	29.0
Post-2014 mean	7.4	151.6	35.7	13.4	76.3	90.3	19.5
Difference (post-pre)	−5.8	19.4	1.0	−9.5	10.2	−4.8	−9.5

Note: The table reports key components of return on equity (ROE) derived using the DuPont framework. ROE is decomposed into net profit margin, asset turnover and equity multiplier, with further breakdown into tax burden, interest burden and operating margin. Figures represent annual average percentage values unless otherwise indicated. The pre-sanctions period covers 2005–2013, whereas the post-sanctions period covers 2014–2022. All values are in percentage terms.
Source: Authors' calculations based on Compustat Global data.

materials and utilities sectors. Notably, the materials sector exhibits an annualised post-2014 ROE gain of 3.1 percentage points. Relative to this baseline trend, the energy sector lags behind by 3.6 percentage points in ROE and 1.1 in ROA, even after controlling for macroeconomic variables and firm-level fundamentals. The average predicted gaps between the energy sector ROE and ROA in the post-2014 period relative to other sectors in the CT-HTM model (see Figures 3–6) are consistent with the ATET estimates, where TWFE and AIPW models identify overall post-treatment effects for energy of about −10 percentage points for ROE and −3 points for ROA (see Table 3 and Figures 7–9). Our analysis further shows that designation as a state and strategic firm (SSF) does not confer consistent financial advantages; SSF firms generally underperform post-2014, particularly in the energy sector. These findings are corroborated by the Gazprom case study, reinforcing the sector-level inferences with firm-specific dynamics.

7.2 | Sectoral Heterogeneity and Strategic Adaptation

Sanctions directly constrained the energy sector via technology embargoes and reduced access to Western capital. Despite strategic adjustments such as export diversification and increased domestic CAPEX (e.g., Gazprom's pivot to China), financial performance deteriorated. TWFE and AIPW models show significant negative ATETs for energy ROE in 2016, 2017 and 2019. Gazprom's DuPont decomposition confirms these trends: Post-2014 ROE halved compared to the pre-sanctions period, largely due to erosion in operating and net margins.

In contrast, the materials sector demonstrated exceptional adaptability. Firms such as Norilsk Nickel and Rusal benefited from high global commodity prices, rouble depreciation and access to Asian markets (Fitch Ratings 2021b, 2021c). Empirical models show consistent ROE and ROA improvements post-2014. Sectoral trends and valuation data (e.g., MOEX metals and mining outperforming all peers) affirm the strategic repositioning of these firms.

Protected by regulated tariffs and stable revenue streams, utilities remained insulated from international shocks. Firms such as RusHydro and the Federal Grid Company continued investment and maintained steady ROE and ROA. The CT-HTM shows utilities tracking the materials sector closely in ROE trends, though weaker in ROA (Fitch Ratings 2021f, 2022).

Communication services experienced stagnating ROE and declining ROA, consistent with subdued consumer demand, limited pricing power and capital intensity. Despite some state support (e.g., Rostelecom's role in national digital projects), firms lacked export flexibility or significant insulation (Fitch Ratings 2020b).

Industrial firms, particularly those producing capital goods such as HMS Group and Transmashholding, exhibited constrained adaptation capacity (Fitch Ratings 2021d). Although Fitch Ratings acknowledged operational stabilisation in the post-pandemic period, it noted that limited export diversification and reliance on domestic infrastructure projects exposed these firms to cyclical demand risks. Our empirical models show post-2014 underperformance in ROA, reinforcing the interpretation that domestic orientation and sectoral rigidity limited resilience.

Consumer sectors bore the brunt of collapsing imports and weak domestic demand. Post-2014, both consumer discretionary and staples experienced declining or stagnating ROA and ROE. CAPEX contraction and declining asset turnover reflected a defensive corporate posture in the face of structural constraints.

7.3 | Market Valuations and Strategic Signalling

Russian equity market data mirror these divergent trajectories. During eight years from 2014 to 2021, the Russian equity market, as captured by the Russian Trading System Index (RTSI), delivered an annualised US dollar price return of 1.27%,[5] indicative of a turbulence observed in the Russian economy and the corporate sector during the period. The dismal performance of the overall market is mirrored by the performance of sectoral indices displayed in Panel A of Figure 11. The RTS oil and gas index delivered a 1.79% annualised return. The financials, electric utilities and consumer & retail indices declined at annualised rates of −0.14%, −2.33% and 6.52% per annum, respectively. In stark contrast, the MOEX metals and mining index returned an annualised return of 10.06%, far surpassing the performance of other sectoral indices.[6]

Panel B of Figure 11 shows that the dividend policies of Russian corporations bolstered investor sentiment and compensated for geopolitical risk. High dividend payouts of companies increased the annualised market index return by almost 6 percentage points. Accounting for dividends also uniformly boosted sectoral annualised returns, which reached 18.38% for the metals and mining index, 7.25% for oil and gas index, 4.16% for financial index and 3.13 for electric utilities index. Moreover, although the strategic company index (RCI) barely broke even in USD terms by 2021 (0.11% annualised gross return), the state company index (SCI) achieved an annualised gross return of about 6%, underscoring how financial markets internalised sectoral adaptation capacity and adjusted valuations accordingly.

Notably, annual dividend yields in the Russian market in excess of 5% were substantially higher than the 2.64% yield on the MSCI Emerging Markets Index and the 1.82% yield on the MSCI All Country World Index (MSCI ACWI) (MSCI 2025). The observation highlights the importance of dividends as a tool for capital distribution, particularly in state-controlled sectors. Dividend policies also reinforced investor expectations. Nevertheless, such policies may have constrained internal buffers, leaving firms more exposed to future shocks.

7.4 | External Validation and Literature Alignment

Our findings are broadly consistent with recent empirical and theoretical contributions to the literature on sanctions, firm adaptation and state–capital relations. Studies such as Ahn and Ludema (2020) emphasise the role of tradeable input dependence and state shielding in shaping firm responses to Western sanctions. Their framework helps contextualise the divergent outcomes we observe between export-driven materials firms and technologically constrained energy firms.

Gaur et al. (2023) similarly highlight the capacity of strategically positioned firms to adapt through supply chain reconfiguration, ownership restructuring and political lobbying. Their evidence

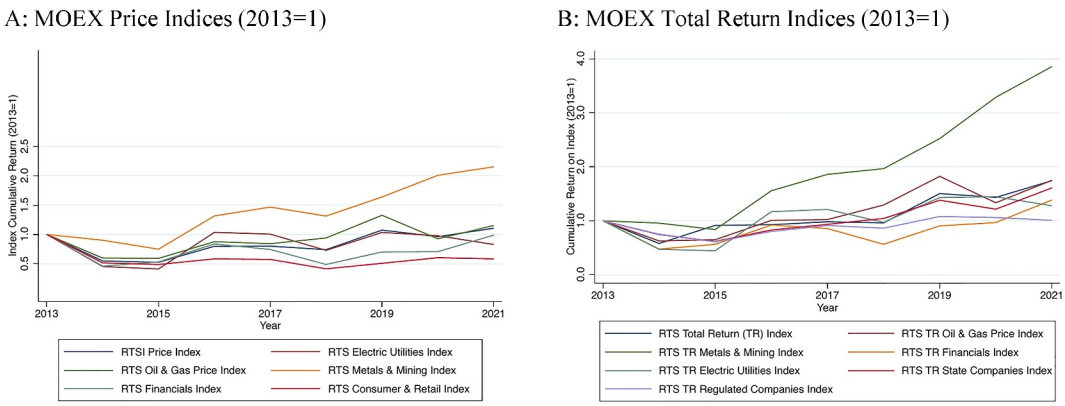

FIGURE 11 | Cumulative returns on MOEX price and total return (TR) indices (USD), 2013–2021. The figure illustrates annually compounded cumulative returns on a selection of MOEX capitalisation-weighted indices, expressed in USD terms and based on an initial investment of $1 at the end of 2013. Panel A depicts price index performance, excluding dividends, whereas Panel B presents total return indices inclusive of reinvested dividends. *Source:* Authors' calculations based on MOEX and Refinitiv Eikon (LSEG) data.

of performance resilience among export-oriented mining firms aligns closely with our sector-level findings for materials and supports the interpretation of sanctions as stressors that reveal latent strategic capacity.

Nigmatulina (2023) provides evidence that shielding policies led to misallocation of capital and productivity losses by favouring sanctioned firms regardless of efficiency. This resonates with our AIPW findings that state-designated firms underperformed on average and supports our interpretation that political affiliation did not ensure resilience. Instead, firms with better structural positioning and global integration achieved stronger post-sanctions performance.

From a macro-financial perspective, our results align with broader institutional analyses of Russia's economic strategy during the sanctions period. The literature emphasises the role of selective state support, increased reliance on domestic capital markets and deeper engagement with Asian trade partners as central pillars of the post-2014 adjustment (Connolly 2018; World Bank 2021).

Fitch Ratings' sectoral assessments (2020–2022) offer independent validation: Gazprom and Tatneft faced financial pressure despite strategic shifts; Norilsk Nickel and Rusal remained profitable; utilities were buffered by policy; communication services were constrained by structural limitations; and industrials showed postpandemic recovery but limited export reach and cyclical vulnerability (Fitch Ratings 2021g).

7.5 | Sanctions as a Strategic Stress Test

Rather than uniformly depressing corporate performance, sanctions exposed latent structural asymmetries across sectors (Fitch Ratings 2021g). Materials and utilities adapted successfully due to global market integration or domestic regulatory support. Energy, despite its political centrality, struggled with path dependency, inflexible inputs and geopolitical exposure.

Sanctions thus functioned as a revealing mechanism—a strategic stress test. They highlighted which sectors possessed the institutional, operational and strategic capacity to endure sustained external pressure. Our results caution against equating state ownership or strategic designation with resilience. Instead, sectoral structure, export orientation and adaptive governance were the likely decisive factors determining post-2014 performance.

8 | Conclusions

This paper has demonstrated that the long-run effects of sanctions on Russian corporate performance are deeply heterogeneous and structurally embedded. Our findings underscore that sectoral resilience and decline are not merely functions of direct sanction designation but instead reflect a complex interplay of institutional exposure, strategic capacity and firm-level adaptability.

By employing a novel continuous-time heterogeneous treatment model (CT-HTM), complemented by robust difference-in-differences (H-DiD) estimates, we uncover persistent underperformance in the energy sector and resilience in the materials and utilities sectors. Our analysis of state and strategic firms (SSF) further reveals that formal strategic designation did not systematically shield firms from performance deterioration. Indeed, the case of Alrosa—a strategically important firm in a resilient sector—illustrates how indirect exposure through financial constraints, compliance burdens and reputational de-risking can impair performance even in the absence of direct sanctions.

A core contribution of this paper lies in its innovative operationalisation of SSF status via MOEX index inclusion, providing a market-based proxy for strategic salience. This measure captures institutional embeddedness more effectively than conventional ownership-based definitions and aligns with how investors and regulators perceive state involvement.

Consistent with other studies, our sector-level analysis underscores that Russia's industrial policy in response to sanctions functioned not just as economic mitigation but as a forced acceleration of strategic restructuring (Baranova et al. 2019; Nusratullin et al. 2020).

More broadly, our findings suggest that sanctions should be conceptualised not merely as instruments of coercion but as institutional stress tests—revealing latent vulnerabilities, misalignments between strategic intent and operational resilience, and the uneven distribution of adaptive capacity across sectors.

The implications extend beyond the Russian case. As geopolitical shocks become more frequent and systemic, understanding how sectors and firms respond under prolonged constraint is critical. Future research should explore whether similar patterns of adaptation and institutional filtering apply in other sanctioned or partially insulated economies. Incorporating environmental, technological and ESG dimensions may further illuminate the resilience strategies firms employ under complex and evolving international pressures.

The paradox captured in our epigraph—'*Some Russians still drive Moskvich. Some already drive Moskvich.*'—resonates more deeply in light of our findings. The revival of this Soviet-era car brand, emblematic of both nostalgia and necessity, mirrors the broader dynamics we uncover: not collapse, but adaptation through reconfiguration. Like Alrosa and Gazprom operating under latent constraint or materials outperforming despite exposure, the Moskvich case embodies path-dependent resilience shaped by institutional memory and geopolitical necessity.

Just as firms repurpose legacy systems under new constraints, so too does the industrial architecture of Russia adapt—sometimes by looking backward to move forward.

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Conflicts of Interest

The author declares no conflicts of interest.

Endnotes

[1] In addition to firm- and sector-level research, macroeconomic studies have explored broader consequences of sanctions on targeted economies. For example, Mariev et al. (2020) model the impact of sanctions on income inequality in sanctioned countries, illustrating how external restrictions interact with internal structural rigidities. Although their focus is on household-level distributional outcomes, their work complements ours by reinforcing the view that sanctions generate differentiated effects across institutional domains and economic strata.

[2] The 2018 Deripaska episode highlights how financial markets react strongly to new sanctions, even when applied to a limited number of firms. In April 2018, market sentiment in Russia deteriorated sharply after U.S. sanctions targeting entities linked to Oleg Deripaska, triggering a substantial equity market downturn. This case illustrates how investor expectations can magnify the economic impact of sanctions beyond their immediate legal scope (JPMorgan Russian Securities 2018).

[3] On average, firms' total assets declined from USD 692 million during 2006–2013 to USD 584 million in 2014–2021. Correspondingly, average sales fell from USD 584 million to USD 433 million over the same periods.

[4] We also used multiplier bootstrap (with 999 replications) to compute the simultaneous confidence intervals for our estimates, which provided further support to our inference.

[5] The reported figures are based on annual compounding.

[6] Notably, by February 2025, the market capitalisation of metals and mining surpassed that of oil and gas ($9.02bn vs. $7.52bn), marking a significant realignment of strategic prominence (MOEX 2025).

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Appendix A

TABLE A1 | Summary statistics of Russian firm-level indicators, 2006–2021.

	Num. of obs.	Mean	Median	St. dev.	5th %	95th %
2006–2013						
Return on assets (ROA)	1763	0.11	0.11	0.13	−0.06	0.32
Return on equity (ROE)	993	0.10	0.09	0.25	−0.23	0.48
Size	1784	6.54	6.66	1.92	3.39	9.84
Log of sales	1795	6.37	6.51	2.08	3.02	9.52
Liquidity	1776	0.10	0.05	0.12	0.00	0.36
Leverage	1792	0.24	0.24	0.19	0.00	0.58
CAPEX	1534	0.08	0.07	0.06	0.00	0.20
Asset turnover	1780	1.34	0.79	1.70	0.14	5.42
2013–2021						
Return on assets (ROA)	1459	0.11	0.11	0.11	−0.05	0.30
Return on equity (ROE)	1237	0.11	0.08	0.29	−0.28	0.62
Size	1446	6.37	6.39	2.07	3.00	9.75
Log of sales	1463	6.07	6.28	2.38	2.03	9.48
Liquidity	1424	0.09	0.05	0.11	0.00	0.30
Leverage	1454	0.27	0.26	0.20	0.00	0.62
CAPEX	1350	0.06	0.05	0.05	0.00	0.15
Asset turnover	1478	1.24	0.74	1.54	0.10	5.14
2006–2021						
Return on assets (ROA)	3222	0.11	0.11	0.12	−0.05	0.31
Return on equity (ROE)	2230	0.11	0.09	0.27	−0.27	0.55
Size	3230	6.46	6.57	1.99	3.11	9.79
Log of sales	3258	6.23	6.41	2.23	2.34	9.50
Liquidity	3200	0.09	0.05	0.11	0.00	0.34
Leverage	3246	0.25	0.25	0.20	0.00	0.61
CAPEX	2884	0.07	0.06	0.06	0.00	0.18
Asset turnover	3258	1.30	0.77	1.63	0.12	5.33
Observations			3295			

Note: The table presents summary statistics for selected firm-level indicators of Russian listed firms drawn from the S&P Compustat Global database. The statistics are reported separately for the subperiods 2006–2013 (pre-2014) and 2014–2021 (post-2014), as well as for the full sample period from 2006 to 2021.
Source: Authors' calculations based on S&P Compustat Global data.

TABLE A2 | Sectoral differences in average firm-level indicators in post-2014 and pre-2014 periods.

Variable	Sector	Difference (post-pre)	*p*-value	Direction
ROE	Energy	−0.064	0.008	Post < pre
ROE	Materials	0.045	0.085	Post > pre
ROA	Energy	−0.017	0.109	Post < pre
ROA	Comm. serv.	−0.036	0.011	Post < pre
ROA	Utilities	0.009	0.099	Post > pre
Size	Industrials	−0.513	0.008	Post < pre
Size	Comm. serv.	−0.584	0.098	Post < pre
Leverage	Materials	0.031	0.043	Post > pre
Leverage	Utilities	0.057	0.000	Post > pre
Liquidity	Industrials	0.016	0.141	Post > pre?
Liquidity	Cons. staples	−0.025	0.014	Post < pre
Liquidity	Comm. serv.	0.019	0.100	Post > pre
Liquidity	Utilities	−0.038	0.000	Post < pre
CAPEX	Energy	−0.020	0.000	Post < pre
CAPEX	Materials	−0.021	0.000	Post < pre
CAPEX	Industrials	−0.009	0.069	Post < pre
CAPEX	Cons. discr.	−0.027	0.001	Post < pre
CAPEX	Comm. serv.	−0.033	0.000	Post < pre
CAPEX	Utilities	−0.021	0.000	Post < pre
Asset turnover	Energy	−0.142	0.001	Post < pre
Asset turnover	Materials	−0.068	0.076	Post < pre
Asset turnover	Cons. discr.	−0.535	0.000	Post < pre
Asset turnover	Cons. staples	−0.284	0.057	Post < pre
Asset turnover	Comm. serv.	−0.050	0.115	Post < pre
Sales	Industrials	−0.529	0.015	Post < pre
Sales	Cons. discr.	−0.718	0.019	Post < pre
Sales	Comm. serv.	−0.795	0.051	Post < pre
Sales	Utilities	−0.195	0.029	Post < pre

Note: The table reports statistically significant and borderline results from Welch's *t*-test for unequal variances, applied to selected firm-level indicators of Russian listed firms sourced from S&P Compustat Global. We compare the mean values of these indicators across sectors between two periods: 2006–2013 (pre-2014) and 2014–2021 (post-2014).
Source: Authors' calculations based on S&P Compustat Global data.

TABLE A3 | Continuous-time heterogeneous treatment model (CT-HTM) estimation results, 2009–2021.

Variable	ROE model	ROA model	ROE model	ROA model
	CT-HTM (firm-level FE)		CT-HTM (firm and sector-level FE)	
Panel A				
Sectoral interactions with annual returns of Bloomberg Commodity Index				
Energy	−0.145* (0.075)	−0.083** (0.040)		
Materials	−0.345** (0.153)	−0.193*** (0.044)		
Industrials	−0.083 (0.220)	0.091* (0.051)		
Consumer discretionary	−0.511* (0.297)	−0.084 (0.085)		
Consumer staples	0.559 (0.393)	0.107 (0.078)		
Communication services	0.078 (0.118)	0.014 (0.047)		
Utilities	−0.171 (0.118)	0.043 (0.039)		
Sectoral interactions with annual % change in Urals crude oil price				
Energy	0.093** (0.038)	0.032*** (0.011)		
Materials	0.235*** (0.066)	0.047*** (0.014)		
Industrials	0.188 (0.136)	−0.011 (0.019)		
Consumer discretionary	0.045 (0.103)	0.035* (0.020)		
Consumer staples	−0.090 (0.062)	−0.046* (0.025)		
Communication services	−0.004 (0.038)	−0.004 (0.016)		
Utilities	−0.005 (0.041)	−0.022** (0.010)		
Sectoral interactions with lagged GDP growth				
Energy	−0.002 (0.002)	−0.002** (0.001)		
Materials	−0.016*** (0.004)	−0.006*** (0.001)		
Industrials	−0.004 (0.005)	−0.000 (0.002)		
Consumer discretionary	−0.011 (0.008)	−0.004*** (0.002)		
Consumer staples	0.004 (0.006)	0.004* (0.002)		
Communication services	0.007 (0.004)	0.000 (0.001)		
Utilities	−0.005 (0.003)	−0.002 (0.001)		
Sectoral interactions with nominal effective exchange rate of rouble				
Energy	−0.022 (0.078)	−0.058 (0.038)		
Materials	−0.177* (0.097)	−0.053 (0.035)		
Industrials	0.052 (0.192)	0.013 (0.049)		
Consumer discretionary	0.308** (0.145)	−0.014 (0.050)		
Consumer staples	−0.365 (0.260)	−0.054 (0.057)		
Communication services	−0.125 (0.127)	0.009 (0.046)		
Utilities	0.054 (0.109)	0.014 (0.031)		
Firm-level indicators				
Size	0.030 (0.023)	0.001 (0.009)	0.029 (0.021)	−0.004 (0.008)
Leverage	−0.195* (0.102)	0.001 (0.028)	−0.211** (0.1)	0.005 (0.027)
Liquidity	0.352*** (0.093)	0.118*** (0.040)	0.357*** (0.093)	0.128*** (0.039)
CAPEX	0.334 (0.277)	0.239*** (0.078)	0.311 (0.275)	0.238*** (0.079)
Asset turnover	0.048** (0.024)	0.040*** (0.008)	0.049** (0.024)	0.040*** (0.008)
Panel B				
Baseline trend				
Materials—pre-2014 baseline trend	0.001 (0.012)	−0.004 (0.004)	−0.025** (0.01)	0.000 (0.004)
Materials—post-2014 baseline trend	0.031*** (0.009)	0.009*** (0.003)	0.042*** (0.01)	0.007*** (0.003)
Sectoral deviations from pre-2014 baseline trend				
Energy	−0.016*** (0.014)	0.000*** (0.006)	0.001 (0.013)	−0.003 (0.06)
Industrials	0.038 (0.028)	0.005 (0.007)	0.029* (0.015)	−0.003 (0.06)

(Continues)

TABLE A3 | (Continued)

Variable	ROE model	ROA model	ROE model	ROA model
	CT-HTM (firm-level FE)		CT-HTM (firm and sector-level FE)	
Consumer discretionary	−0.017 (0.028)	0.006 (0.007)	0.019 (0.026)	−0.001 (0.007)
Consumer staples	0.036 (0.049)	−0.002 (0.007)	0.049* (0.027)	−0.003 (0.006)
Communication services	0.005 (0.026)	0.005 (0.006)	0.035* (0.019)	0.001 (0.005)
Utilities	−0.027 (0.017)	0.001 (0.007)	0.009 (0.016)	−0.002 (0.006)
Sectoral deviations from post-2014 baseline trend				
Energy	−0.036*** (0.013)	−0.011*** (0.004)	−0.045*** (0.014)	−0.009** (0.004)
Industrials	−0.020 (0.021)	−0.015*** (0.005)	−0.014 (0.018)	−0.009* (0.004)
Consumer discretionary	−0.024* (0.013)	−0.009* (0.005)	−0.045*** (0.014)	−0.005 (0.005)
Consumer staples	−0.045*** (0.017)	−0.010* (0.005)	−0.046*** (0.012)	−0.008 (0.06)
Communication services	−0.010 (0.018)	−0.020*** (0.005)	−0.023 (0.018)	−0.017*** (0.005)
Utilities	−0.002 (0.012)	−0.004 (0.004)	−0.020* (0.012)	0.000 (0.004)
State and strategic firms' pre-2014 trends				
Energy	0.022* (0.013)	0.004 (0.006)	0.022* (0.012)	0.004 (0.006)
Materials	−0.017 (0.012)	0.026*** (0.004)	−0.004 (0.01)	0.023*** (0.004)
Industrials	−0.089 (0.064)	−0.002 (0.006)	−0.089 (0.063)	−0.001 (0.006)
Communication services	−0.030 (0.026)	0.007** (0.003)	−0.034 (0.023)	0.007** (0.003)
Utilities	0.014 (0.014)	0.005 (0.006)	0.012 (0.014)	0.004 (0.006)
State and strategic firms' post-2014 trends				
Energy	−0.000 (0.011)	0.003 (0.003)	0.001 (0.010)	0.003 (0.003)
Materials	−0.020* (0.012)	−0.007** (0.003)	−0.023* (0.011)	−0.007** (0.003)
Industrials	0.054 (0.056)	0.007* (0.004)	0.056 (0.054)	0.006 (0.004)
Communication services	0.001 (0.018)	0.012** (0.005)	0.003 (0.018)	0.012** (0.005)
Utilities	−0.017* (0.010)	−0.003 (0.003)	−0.017 (0.010)	−0.003 (0.003)
Constant	−0.201 (0.174)	0.022 (0.064)	−0.205 (0.161)	0.055 (0.056)
R-squared	0.470	0.610	0.446	0.596
No. of observations	1753	2251	1753	2251

Note: Panels A and B present the results from estimating the continuous-time heterogeneous treatment model (CT-HTM) specified in Equation (1), as well as a specification that includes firm- and sector-level fixed effects. The sample comprises Russian listed firms drawn from S&P Compustat Global. BCOM denotes the percentage change in the Bloomberg Commodity Index; Urals crude is the percentage change in the price of Urals oil; NEER represents the percentage change in the nominal effective exchange rate of the Russian rouble; GDP Growth refers to lagged Russian GDP growth; and SSF is a binary indicator identifying state-owned or strategically important firms listed in the MOEX state-owned and regulated companies indices. Pre-2014 and post-2014 are continuous-time trend variables covering the periods 2009–2013 and 2014–2021, respectively. Robust standard errors, clustered at the firm level, are reported in parentheses. Statistical significance is denoted as follows: $p < 0.10$ (*), $p < 0.05$ (**), and $p < 0.01$ (***).

Source: Authors' calculations based on S&P Compustat Global and Refinitiv Eikon (LSEG) data.

TABLE A4 | Variable sources and definitions.

Panel A: Firm-level indicators from Compustat Global data		
Variable	**Definition**	**Compustat Global codes**
ROE	Consolidated net income/shareholders' equity	Nicon/teq
ROA	Earnings before interest, tax, depreciation and amortisation/assets	Ebitda/at
Size	Log of total assets (USD, mil.)	ln (at)
Leverage	Total debt to assets	(dlc + dltt)/at
Liquidity	Cash and marketable securities/assets	che/at
CAPEX	Capital expenditures/assets	Capx/at
Asset turnover	Total revenues/assets	Revt/at
Log of sales	Log of total revenues (USD, mil.)	ln (revt)

Panel B: Refinitiv Eikon (LSEG) indicator codes				
Instrument code	**Instrument description**	**Indicator type**	**Source**	**Unit**
.aRUWD3QBGR	Russia, GDP growth (annual %)	National accounts	World Bank WDI	*Percent*
.aRUINECE/C	Russia, nominal effective exchange rate (NEER) based on consumer price index (2010 = 100, not SA), price index	Exchange rates	IMF—international financial statistics	*Index*
.BCOM	Bloomberg Commodity Index	Commodity Index	IOM	*Index*
.URL-NWE-E	Urals crude delivered to north-west Europe	Commodity spot	TRC	*Spot price*

BOX A1 STATE AND STRATEGIC FIRMS (SSF) INDICATOR.

We construct our indicators for state and strategic firms using the constituent lists of the MOEX state-owned companies index (MOEX SCI) and the MOEX regulated companies index (MOEX RCI), both introduced in December 2011 (MOEX 2025). These indices include companies that play a central role in Russia's economic and geopolitical strategy, often benefitting from state ownership, regulatory privileges and strategic importance.

The MOEX SCI is a composite stock market index comprising companies in which the Russian government—represented by the Prime Minister, Deputy Prime Minister or the Federal Agency for State Property Management (Rosimushchestvo)—holds equity stakes or exercises strategic oversight. Similarly, the MOEX RCI covers natural monopolies and other firms designated as strategically regulated, based on recommendations by the Federal Tariff Service and Rosimushchestvo.

Both indices are reviewed by MOEX at most once annually, barring exceptional circumstances. Proposed changes must be submitted by Rosimushchestvo at least 1 month before taking effect, based on liquidity assessments over the preceding 12 months. Final inclusion decisions are communicated to MOEX at least 3 weeks prior to the update.

The MOEX RCI is centred on critical infrastructure, covering sectors such as electricity transmission and distribution (e.g., FGC UES, Rosseti), telecommunications (e.g., Rostelecom, Tattelecom) and transportation (e.g., Transneft, NCSP). These firms typically operate as regional monopolies under direct state oversight. The MOEX SCI, in contrast, is more energy-oriented, encompassing oil and gas giants (e.g., Gazprom, Rosneft, Tatneft), state-owned banks (e.g., Sberbank, VTB) and strategic enterprises in aviation and mining (e.g., United Aircraft Corporation, Alrosa, Aeroflot). This reflects the resource-centric nature of Russia's political economy.

Our sample includes all *nonfinancial* firms that have appeared in either index since 2012. We treat inclusion in the MOEX SCI or RCI as a proxy for state or strategic status, applying this classification retroactively across the full sample period. Although this assumption may imperfectly capture changes in ownership or strategic designation over time, it reflects persistent patterns of state involvement. Firms classified as state or strategic post-2012 likely operated under similar influence in earlier years. This approach captures long-term government control rather than temporary shifts.

Notably, utilities and energy sectors show the highest concentration of SSF firms, consistent with state priorities in natural monopolies and energy security. The materials sector includes only one state firm (Alrosa), whereas consumer staples and consumer discretionary sectors have no representation. Industrial and communication services firms also feature in both indices, though less consistently.

The number of constituents in the MOEX SCI declined from 31 in 2012 to 24 in 2020, whereas the MOEX RCI saw a drop from 19 to 16 over the same period. In total, 19 firms appeared in both indices (not necessarily simultaneously), yielding a set of 31 unique companies classified as state or strategic at any point during 2012–2021.

Although our classification may over- or underestimate state influence, particularly in earlier years, the main patterns remain robust: SSF firms are predominantly concentrated in energy, utilities, communication services and selected industrial sectors, with limited presence elsewhere.