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# Institutional Transmission into Project-Finance Cash Flows: Evidence from Chinese-Invested Renewable Energy in Kazakhstan

**Hao Zhen[1*], Nizamdinova Arzigul Kamirdinovna[2], Lutpulla Amurullamovich Omarbakiyev[3]**

***Abstract***

Why do renewable energy projects in the same country, using similar technology and identical export credit insurance, end up with realised investment ranging from 15.7 percent below budget to 15.0 percent above? This study examines ten Chinese-invested utility-scale wind and solar projects in Kazakhstan that reached financial close between 2018 and 2026, representing a near-complete set of observable cases with full contractual and audited financial records. The variation is not explained by technology. It arises from how the host-country institutional regime enters project contracts and reshapes cash flows. Three channels are identified. Lender-conditioned loan architecture affects the cost of debt: under identical China Export & Credit Insurance Corporation coverage, direct commercial-bank Chinese-yuan loans carry a 153-basis-point rate advantage and include a six-month principal grace period relative to development-bank refinancing. Dynamic fiscal upgrading alters capital commitments, as investment incentives are renegotiated through supplementary agreements that require 29–57 percent additional capital. Balancing-market asymmetry redistributes operating revenue, with under-generation penalised at roughly 2.8 times the rate of over-generation rewards. Drawing on contract text, audited accounts, and settlement files, the analysis shows that cost variation is partly structured at the contract-design stage rather than arising solely during execution. The findings carry implications for project sponsors, for Kazakhstani policymakers calibrating balancing-market and development-bank rules, and for research on institutional effects in emerging-market project finance.

***Keywords:*** project finance, institutional transmission, renewable energy, Kazakhstan, balancing market

## *Introduction*

Central Asia has become one of the most active frontiers of Chinese outbound energy finance. The 2025 Belt and Road engagement report records Central Asia among the top regions for investment, with Kazakhstan among the principal regional destinations for clean-energy investment (Nedopil, 2026). In parallel, Kazakhstan's auction-based renewable-energy regime — launched in 2017 to replace feed-in tariffs — has brought more than 2.8 GW of installed capacity online and has drawn sustained academic attention to its tariff design, legislative architecture, and project-level effectiveness (del Río & Kiefer, 2023; Khamzina, Mukan, & Tormosov, 2025; Khamzina, Ten, et al., 2025; Lan et al., 2024). For Kazakhstani policymakers calibrating the next phase of the energy transition, the question is no longer whether foreign capital will arrive but on what institutional terms it will operate once it has.

A puzzle sits at the micro level of this investment surge. Among ten Chinese-invested utility-scale wind and solar projects in Kazakhstan for which full contractual and audited financial records are available, realised investment costs diverge from pre-investment budgets by between minus 15.7 and plus 15.0 percent. The projects share a narrow turbine-platform family, overlap substantially in engineering, procurement, and construction (EPC) contractor, insurance regime, and financing template. The technological homogeneity that would ordinarily bound cost dispersion does not do so here. Something else intervenes between identical technology and divergent cash flows.

What intervenes is the host-country institutional regime — and, further, it does so through identifiable, contract-level channels rather than through diffuse environmental friction. Three channels emerge from the cases. Lender-conditioned loan architecture shapes financing costs through interest rates, grace periods, and disbursement structures. Dynamic fiscal upgrading alters capital expenditure through supplementary agreements that link incentive status to investment commitments. Balancing-market asymmetry redistributes operating revenue by penalising under-generation more heavily than it rewards over-generation. Each channel is traceable in primary documents — loan agreements, insurance schedules, investment agreements and their

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addenda, monthly balancing-market invoices — and each produces a directionally predictable effect on the project's budget-to-actual variance.

The purpose of this study is to explain why technologically similar Chinese-invested renewable energy projects in Kazakhstan diverge so widely in realised cost, and to identify the specific, contract-level channels through which the host-country institutional regime enters project cash flows. The object of the study is the population of Chinese-invested utility-scale renewable energy projects in Kazakhstan that reached financial close between 2018 and 2026; its subject is the transmission of the host-country institutional regime into project-finance cash flows through contract structures.

To achieve this purpose, the study pursues four tasks: (1) to identify the channels through which host-country institutions enter project contracts and cash flows; (2) to trace the transmission of each channel in primary loan, investment, and settlement documents; (3) to assess the direction and magnitude of each channel's effect on the budget-to-actual cost variance; and (4) to derive implications for project sponsors and for Kazakhstani policymakers. The tasks are addressed through a multiple-case comparative design with process tracing, and the results are of direct practical significance for sponsors structuring Chinese-financed renewable investments and for Kazakhstani institutions calibrating balancing-market and development-bank rules.

The paper's scientific novelty and working hypotheses are set out in the next section. The remainder of the paper is then organised as follows: the literature review and conceptual framework; the materials and methods; the results for each channel; a discussion of implications and boundary conditions; and the conclusion.

### *Main provisions*

Central hypothesis

Among technologically similar Chinese-invested renewable energy projects in Kazakhstan, the observed cost variance is driven not by technology but by how the host-country institutional regime enters project contracts and reshapes cash flows.

Scientific novelty

First, the study reconceptualises host-country institutions not as country-level distance but as structured inputs that enter project contracts and reshape cash flows, specifying three transmission channels: lender-conditioned loan architecture, dynamic fiscal upgrading, and balancing-market asymmetry.

Second, drawing on a near-complete universe of Chinese-invested utility-scale wind and solar projects in Kazakhstan — ten of approximately fourteen that reached financial close in 2018–2026 (more than 70 percent) — together with confidential loan agreements, investment agreements, and twelve months of balancing-market settlement files, it provides the first project-level, contract-based evidence on the cash-flow consequences of Kazakhstan's post-2023 balancing-market reform.

Third, it shows that lender identity continues to price project debt even under identical coverage from the China Export & Credit Insurance Corporation (Sinosure), extending the project-finance literature on cross-border renewable lending.

Working hypotheses

Guided by the central hypothesis, the study advances three working hypotheses, each corresponding to one transmission channel and tested in the Results:

H1 (loan architecture). Under identical Sinosure coverage, lender identity — direct Chinese commercial-bank lending versus host-country development-bank refinancing — systematically affects the cost and structure of project debt.

H2 (fiscal upgrading). Investment-incentive status is not fixed at signing but renegotiated upward through supplementary agreements that raise committed capital within a predictable range.

H3 (balancing-market settlement). Kazakhstan's post-2023 balancing market is asymmetric, penalising under-generation more heavily than it rewards over-generation, thereby redistributing operating-revenue risk to generators.

### *Literature Review and Conceptual Framework*

Institutions as transmission, not distance

Institutional theory in international business has been dominated by the construct of institutional distance: the greater the regulatory, normative, or cognitive gap between home and host environments, the higher the transaction cost and the higher the likelihood of underperformance (Kostova et al., 2020; Meyer et al., 2009; North, 1990; Scott, 2014). The construct has generated a large empirical literature, but it has a recurrent weakness: distance is measured at the country-pair level and treated as exogenous to the contract, so

when it correlates with performance it does so without specifying how the effect was transmitted. A parallel literature characterises emerging markets by missing intermediaries — institutional voids — where firms substitute internal or contractual solutions for absent market infrastructure (Khanna & Palepu, 2010; Peng, 2003). Useful as that framing is, it still treats institutions as exogenous conditions to be worked around.

Rather than treating institutions as distance between countries, this study focuses on how they enter contract structures and shape project cash flows. The repositioning follows the call by Kostova and colleagues (2020) for micro-level, mechanism-based accounts and aligns with the emerging-market focus of Meyer et al. (2009) on firm-level entry and operating strategies.

Project finance and cost variance

Project finance separates the special-purpose vehicle from its sponsors and loads the risk onto ring-fenced assets and cash flows (Esty, 2004; Gatti, 2013; Sufi, 2007). The classic project-finance literature focuses on three sources of cost variance: commercial risk (demand, price), construction risk (schedule, EPC performance), and political risk (expropriation, currency transfer). Steffen (2018) shows that, for renewable energy specifically, the dominant driver of the levelised cost of electricity is the cost of capital, which in turn is sensitive to the financing structure rather than to technology choice once the technology has matured — a pattern that Hirth and Steckel (2016) document at the system level for decarbonising electricity sectors more broadly. Flyvbjerg (2014) provides a large-N overview of megaproject cost overruns, documenting their ubiquity but leaving the institutional mechanisms underspecified.

What the literature has under-theorised is the inverse case relevant here: projects that share technology, contractor, and insurance yet diverge on cost because their contracts transmit different institutional inputs. The three-channel framework offered in the next section treats institutions as structured inputs to the project's financial architecture — loan pricing and grace periods, tariff status and tax treatment, balancing-market exposure — rather than as environmental friction.

Export credit agencies and lender identity

Export credit agencies (ECAs) underwrite political and commercial risk to support national exporters; their coverage reduces the lender's loss-given-default and compresses the risk premium embedded in the loan margin (Chin & Gallagher, 2019; Stephens, 1999). Sinosure, the Chinese ECA, has become the largest single provider of ECA coverage in emerging-market infrastructure lending (Chen & Liu, 2023; Dreher et al., 2022; Horn et al., 2021). A common assumption in this literature is that once ECA coverage is fixed, the remaining dispersion in loan pricing is driven by sponsor-specific credit characteristics. The cases examined here show that lender identity — direct Chinese commercial bank versus host-country development-bank intermediary — persists as a pricing determinant even after ECA coverage is held constant. This finding speaks to a gap in the project-finance literature on how institutional context enters cross-border lending once conventional credit risk has been insured away.

Kazakhstan as a setting

The Kazakhstani electricity sector occupies an unusual analytic position. The 2009 renewable energy law (Law of the Republic of Kazakhstan No. 165-IV, 2009), the 2017 transition to auctions, the 2023 amendments to the electricity market rules, and the post-2022 expansion of the Damu interest-rate subsidy programme have together produced a layered institutional regime within which a near-complete cohort of Chinese-invested projects has been built (Mouraviev, 2021; Shakeyev et al., 2023; Zhakiyev et al., 2025). Recent analyses have begun to document the distinctive role of the Development Bank of Kazakhstan (DBK) as a sovereign intermediary in cross-border infrastructure finance (Khamzina, Mukan, & Tormosov, 2025; Lan et al., 2024), and the broader literature on Chinese investment in Central Asia has paid increasing attention to project-level outcomes and to the country's transition risks more broadly (De Miglio & Bakdolotov, 2024; O'Neill, 2014; Sulaimanova et al., 2023; Xenarios et al., 2024; Zeng, 2025). What has remained largely outside this literature is the contract-level view: how the Kazakhstani institutional regime appears in the loan agreement, the supplementary investment contract, and the monthly settlement file. That is the gap this paper addresses.

***Materials and Methods***

This study employs a multiple-case comparative design with process tracing. Its inferential logic is analytical generalisation rather than statistical inference: the aim is to identify institutional transmission mechanisms that can be traced in contract text and settlement files and that are expected to operate wherever their preconditions hold. The analysis combines general scientific methods (comparison, analysis and synthesis)

with a case-based comparative method — a matched-pair comparison for Channel 1 and cross-case pattern matching for Channels 2 and 3.

***Research design and case selection***

The ten projects analysed here are not a sample drawn from a larger unknown population. Between 2018 and 2026, approximately fourteen Chinese-invested utility-scale wind and solar projects reached financial close in Kazakhstan according to public records of the Kazakhstani Ministry of Energy and the Financial Settlement Centre for Renewable Energy (IEA, 2024; Ministry of Energy of the Republic of Kazakhstan, 2023). Four of the fourteen are excluded for reasons of data completeness rather than research-design choice: two because their feasibility-study financial models were not made available; one because audited completion accounts were not released; one because the project was suspended prior to commercial operation. The remaining ten cases — labelled A through J throughout the paper to preserve commercial confidentiality — therefore represent more than 70 percent of the universe of observable projects of this type. This constitutes a near-complete enumeration of observable cases rather than a sample, and the generalisation claim that follows is conditional on the universe so defined.

Table 1 summarises the analytical role of each case. Cases A and B are the matched comparison at the heart of Channel 1: they share developer nationality, technology, EPC contractor, power-purchase-agreement (PPA) signing date, and Sinosure buyer-credit coverage at the 95/95 dual-cover level; they differ primarily in lender identity (direct Chinese commercial bank for A, host-country development-bank refinancing for B), while also differing in nameplate capacity (100 versus 50 MW), which we cannot fully control for. Cases C through G extend the institutional variation across tariff regime (feed-in tariff versus auction), construction period, and year of commercial operation, and provide the variance needed to test Channel 2. Case H provides the primary documentation for Channel 3, being the only project in the set for which complete monthly balancing-market settlement files covering a full operational year were made available for this study. The purpose of Case H is mechanism identification rather than population representativeness. Cases I and J are utility-scale solar projects included as within-technology heterogeneity checks.

Table 1. The universe of ten Chinese-invested utility-scale renewable energy projects in Kazakhstan (2018–2026).

| Case | Capacity (MW) | Technology | Lender structure | Tariff regime | Role in the analysis |
|---|---|---|---|---|---|
| A | 100 | Wind | Direct ICBC (Industrial and Commercial Bank of China)/BOC (Bank of China) CNY loan; Sinosure 95/95 | Auction | Channel 1 (matched pair) |
| B | 50 | Wind | Development Bank of Kazakhstan CNY refinancing; Sinosure 95/95 | Auction | Channel 1 (matched pair) |
| C | 50 | Wind | Development Bank of Kazakhstan refinancing | Feed-in (initial) / Auction (later) | Channel 1 robustness; Channel 2 (initial phase); currency variation |
| D | 100 | Wind | Mixed syndicate | Feed-in tariff | Channel 2 (fiscal upgrade) |
| E | 50 | Wind | Mixed syndicate | Feed-in tariff | Channel 2 (fiscal upgrade) |
| F | 50 | Wind | Development Bank of Kazakhstan (DBK) refinancing | Feed-in tariff | Channel 2 (fiscal upgrade) |
| G | 50 | Wind | Development Bank of Kazakhstan refinancing | Feed-in tariff | Cost-deviation outlier; Channel 2 |
| H | 20 | Wind | Domestic commercial | Auction | Channel 3 (balancing market, direct evidence) |
| I | 100 | Solar | Direct ICBC/BOC CNY loan | Auction | Technology-heterogeneity check |
| J | 30 | Solar | Mixed syndicate | Auction | Technology-heterogeneity check |

*Note − Compiled by the authors based on project loan agreements, PPAs, investment agreements, and public registry data. Sinosure = China Export & Credit Insurance Corporation.*

Data sources

Primary data comprise project-company documents made available under confidentiality agreements: investment agreements with the Kazakhstani government and any supplementary agreements; PPAs with the Financial Settlement Centre for Renewable Energy; loan agreements, disbursement schedules, and repayment schedules; insurance certificates from Sinosure and Kazakhstani insurers; feasibility-study financial models; audited completion accounts; and, for Case H only, twelve months of balancing-market settlement files identifying scheduled generation, actual generation, imbalance volumes, imbalance prices, and monthly net settlement amounts. Secondary data are drawn from the Ministry of Energy's public registry, the Financial Settlement Centre's publications, and peer-reviewed analysis of the Kazakhstani regulatory framework (Khamzina, Mukan, & Tormosov, 2025; Lan et al., 2024; Mouraviev, 2021; Shakeyev et al., 2023).

Analytical strategy: process tracing

We use process tracing in the causal-mechanism sense as the inferential technique: for each proposed channel the analysis identifies the institutional input (a clause, a rule, a price formula), traces its transmission through the project's contractual stack, locates the point at which it enters the cash-flow statement, and documents the resulting variance (George & Bennett, 2005; Yin, 2018).

Ten cases limit the kinds of inference the paper can pursue; the study does not claim statistical generalisability. Two features of the design mitigate the small-N concern.

The first is a matched-pair comparison. Cases A and B share developer, turbine platform, EPC contractor, power purchase agreement (PPA) signing date, and Sinosure coverage — the commercial variables ordinarily expected to drive financing cost. They differ primarily in lender identity, while also differing in nameplate capacity (100 versus 50 MW), which cannot be fully controlled for in a two-observation comparison. Given the identical EPC arrangements, PPA counterparty, and Sinosure cover, however, lender identity remains the most plausible driver of the observed pricing differences. Case A is financed directly by a syndicate of Chinese commercial banks led by the Industrial and Commercial Bank of China (ICBC); Case B is refinanced through the Development Bank of Kazakhstan (DBK), acting as intermediary to the same Chinese commercial pool. The pairing isolates lender-identity effects on loan pricing with unusual cleanliness for a project-finance setting. We use the term matched comparison in preference to quasi-experimental, which in econometrics implies a stronger assignment mechanism than two observations can support.

The second feature is pattern matching across institutionally heterogeneous cases. For Channels 2 and 3, the analysis traces the same mechanism across cases that differ on tariff regime (feed-in versus auction), lender (DBK versus direct commercial), and wind-variability profile (high versus low). When the predicted directional effect appears across this variation, the evidence for the mechanism strengthens even with a small N. Where a pattern appears in only a subset of cases — most notably for Channel 3, which is directly documented for Case H and inferred from structural exposure for Cases A and B — the limits are stated explicitly.

***Validity and reliability***

Construct validity is supported by triangulation (Figure 1): each numerical claim is verified against at least two of contract text, feasibility-study model, audited accounts, and settlement files. Internal validity for Channel 1 rests on the matched comparison; for Channel 2, on the direction and consistency of the pattern across five cases in the feed-in tariff cohort; for Channel 3, on rule-based uniformity of the balancing-market pricing formula, documented in the Financial Settlement Centre methodology that applies identically to all renewable generators. External validity is bounded: the findings apply cleanly to Chinese-originated capital, ECA-backed infrastructure, and the Kazakhstani institutional regime as it stood between 2018 and 2026. How far the framework extends to other Central Asian jurisdictions, to non-Chinese capital, or to liberalised electricity markets is a question for replication rather than assertion. Reliability is supported by a full case-protocol database maintained by the author and available on reasonable request, subject to the disclosing parties' written consent.

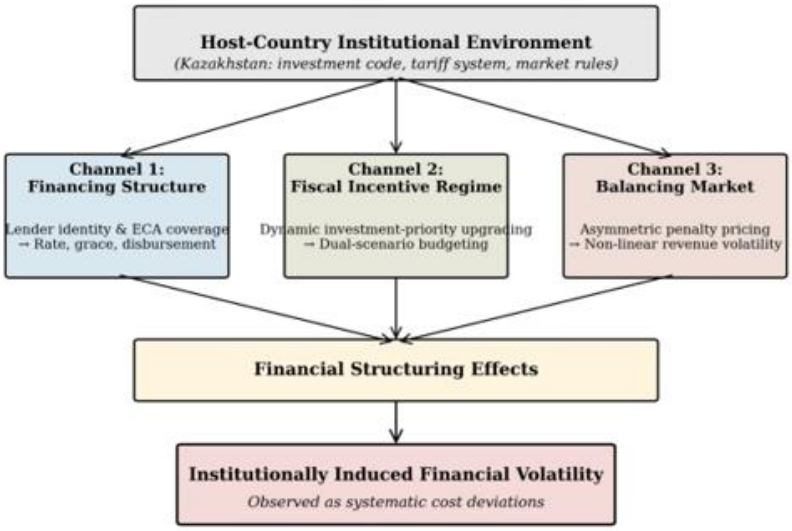



Figure 1. Three institutional transmission channels from the host-country regime into project-finance cash flows.

*Note − The host-country institutional environment is transmitted to project-level cash-flow outcomes through three parallel channels, which jointly produce institutionally induced financial volatility observable as cost deviation.*

***Results***

Cost deviation across the ten projects

Fig. 2 plots realised investment cost as a percentage deviation from the pre-investment budget for each of the ten cases. The range is from minus 15.7 percent (Case A) to plus 15.0 percent (Case G). Case G is the outlier: a feed-in-tariff era project whose cost deviation carries both the fiscal-upgrade effect of Channel 2 and a construction-schedule delay that is outside the institutional scope of this paper. Setting Case G aside, the under-budget cases are disproportionately concentrated in the auction-era cohort (A, B, C, H), while the over-budget cases cluster in the feed-in-tariff cohort (D, E, F) — a pattern consistent with the argument developed across the three channels below.

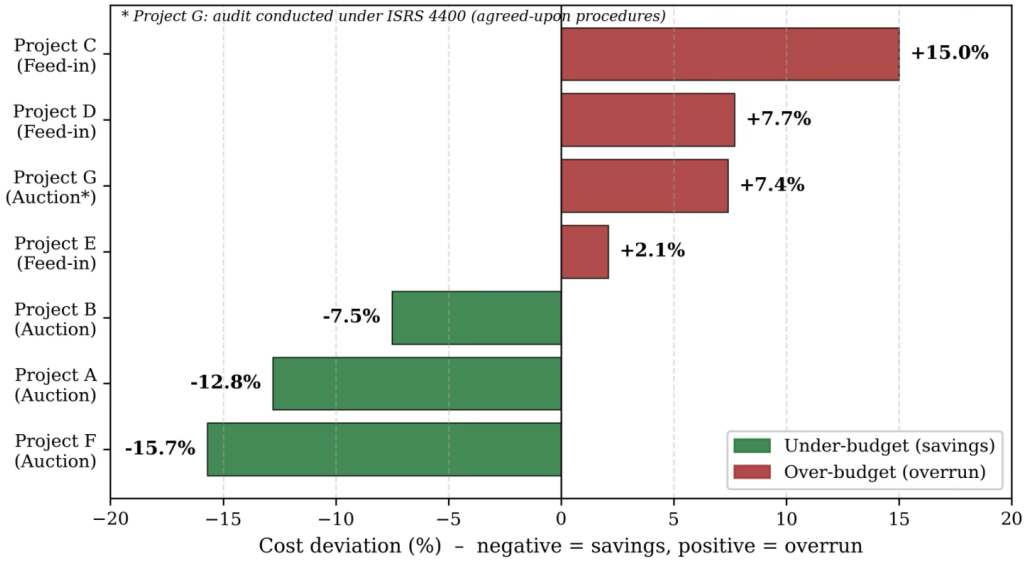



Figure 2. Cost deviation (realised vs. budgeted investment), ten projects, ranked.

*Note − Negative values indicate savings relative to contractual budget; positive values indicate overruns. Auction-era projects (three of four) realise savings; every feed-in-tariff project overruns.*

Channel 1: Lender-conditioned loan architecture

This channel tests H1. The matched comparison of Cases A and B isolates lender identity under identical Sinosure coverage.

Channel 1 is the most isolable of the three. Cases A and B are closely comparable across the major commercial dimensions, while differing primarily in lender identity and, to a lesser extent, project scale (100 versus 50 MW). Table 2 isolates lender-identity effects by holding the major commercial parameters — EPC contractor, PPA counterparty, and Sinosure coverage — constant.

Table 2. Matched comparison: direct Chinese commercial lending versus host-country development-bank refinancing, under identical Sinosure cover.

| Feature | Case A | Case B |
|---|---|---|
| Capacity | 100 MW | 50 MW |
| Technology | Wind (3.6 MW platform) | Wind (3.6 MW platform) |
| EPC contractor | Chinese EPC-1 | Chinese EPC-1 |
| PPA counterparty | Financial Settlement Centre for Renewable Energy | Financial Settlement Centre for Renewable Energy |
| Sinosure coverage | 95 % political / 95 % commercial | 95 % political / 95 % commercial |
| Lender structure | Direct ICBC/BOC CNY syndicate | DBK CNY refinancing (ICBC pool) |
| Loan currency | CNY | CNY |
| Interest rate | 2.90 % fixed | 4.43 % floating (LPR+spread) |
| Grace period | 6 months post- commercial operation date (COD) | None |
| Drawdown | 3 tranches tied to milestones | Single drawdown at refinancing |
| Cost deviation | −15.7 % | −9.1 % |

*Note − Compiled by the authors based on loan agreements and audited completion accounts of Cases A and B. LPR = Loan Prime Rate; COD = commercial operation date; DBK = Development Bank of Kazakhstan.*

Three differences follow from lender identity and together account for the observed cost gap. The interest rate differs by 153 basis points despite identical Sinosure cover. The direct ICBC syndicate prices the loan against the People's Bank of China benchmark with a thin credit spread, reflecting the strategic-industry status of Chinese outbound renewable investment. DBK, acting as intermediary, applies a commercial spread over the Loan Prime Rate plus an intermediation margin, and the resulting 4.43 percent floating rate locks in the institutional cost of routing capital through a host-country development bank rather than accepting it directly.

A second difference lies in repayment timing. The six-month principal grace period in Case A (Fig. 3) shifts the onset of repayment to a point at which the wind farm is producing stabilised revenue, whereas in Case B repayment begins at drawdown. Case A's cumulative debt service in the first post-COD year is approximately 38 percent of Case B's, freeing cash flow for contingency absorption. The third difference is in disbursement structure: the three-tranche drawdown in Case A — with each tranche released against EPC-milestone evidence — compresses interest during construction by approximately 110 basis points over a two-year build, relative to the single drawdown in Case B. Taken together, these features account for the bulk of the 6.6-percentage-point cost gap between A and B.

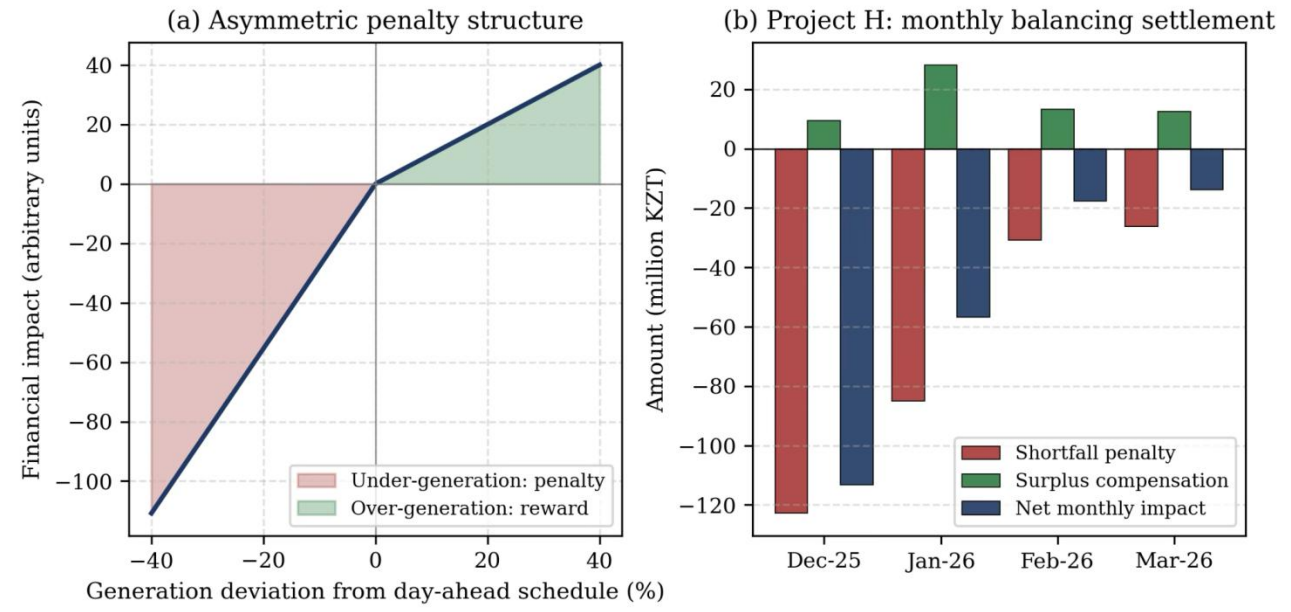



Figure 3. Cumulative debt-service burden in the first post-COD year: Case A (six-month grace, tranched drawdown) versus Case B (no grace, single drawdown).

*Note − Repayment profiles under identical Sinosure coverage. Case A (ICBC syndicate) enjoys a six-month grace window aligned with the generation ramp-up. Case B (DBK refinancing) faces repayment immediately after commercial operation.*

Channel 2: Dynamic fiscal upgrading

This channel tests H2. The five feed-in-tariff-era cases trace how investment-incentive status is renegotiated after signing.

The second channel operates on the capital-investment schedule through the negotiation structure of Kazakhstani investment-incentive status. The country's Investment Promotion Law and its implementing regulations establish a multi-tier incentive regime — reduced corporate income tax, land-tax exemption, customs-duty relief on imported equipment, and, at the priority investment tier, eligibility for in-kind state grants. Formal eligibility thresholds are specified in terms of minimum capital commitment. In practice, the thresholds are anchors for a negotiation rather than bright lines.

Across the five feed-in-tariff-era cases (D, E, F, G, and the earlier phase of C), the pattern is consistent: the initial investment agreement secures the base tier; six to eighteen months later, the project company negotiates a supplementary agreement that upgrades the incentive status in exchange for committing an additional 29 to 57 percent of budgeted capital. The additional commitment is substantial but is recouped over the project's operating life through the upgraded tax treatment. Table 3 documents the magnitude and consistency of these uplifts across cases.

Table 3. Capital-commitment uplifts associated with supplementary-agreement tax-incentive upgrades in feed-in-tariff-era cases.

| Case | Initial tier | Upgraded tier | Capital uplift | Tax relief secured |
|---|---|---|---|---|
| C (phase 1) | Standard | Priority | +39 % | corporate income tax (CIT) 15 % → 0 %, land-tax waived |
| D | Standard | Priority | +57 % | CIT 15 % → 0 %, customs waived |
| E | Standard | Priority | +44 % | CIT 15 % → 0 %, customs waived |
| F | Standard | Priority | +29 % | CIT 15 % → 0 % |
| G | Standard | Priority | +53 % | CIT 15 % → 0 %, customs waived |
| *Note − Compiled by the authors based on investment agreements and supplementary agreements.* | | | | |

The institutional meaning of the pattern is that the investment agreement is not a final commitment but the opening move in a sequence. Sponsors that budget the base scenario are surprised by the supplementary requirement and record it as a cost overrun; sponsors that budget the upgraded scenario from the start treat the same figure as on-plan. While reverse causality cannot be fully ruled out — sponsors planning a larger capital programme might independently seek priority status — the consistent sequencing across cases, in which the initial agreement precedes the upgrade-linked capital commitment by six to eighteen months, supports the interpretation of institutional inducement rather than sponsor-led redesign. The observed +29 to +57 percent capital variation is therefore not random; it is a predictable negotiation feature of the Kazakhstani investment-incentive regime, and it constitutes the second contract-level channel through which institutions enter cash flows.

A note on the contrast with the auction cohort. In the auction-era cases (A, B, H, and the later phase of C), the incentive structure is largely pre-set by the auction protocol and the associated Investment Contract template; the supplementary-agreement dynamic is muted. This difference is part of the reason that the auction cohort clusters under budget while the feed-in-tariff cohort clusters over budget.

Channel 3: Asymmetric balancing-market settlement

This channel tests H3. Case H provides the direct settlement evidence; for Cases A and B the channel is inferred from the uniform market rule.

The third channel is the most consequential for operational cash flow and the one for which the evidence is most concentrated in a single case. Direct monthly settlement files are available for this study only for Case H; for Cases A and B, the channel is inferred from structural exposure to the same market rule rather than directly observed. This is a genuine limit on the cross-case generality of the Channel 3 finding. The balancing-market rule, however, is uniform across all renewable generators by regulation; the documented asymmetry in Case H is a product of that rule rather than of plant-specific idiosyncrasy. The relevance of the Case H finding to Cases A and B therefore rests on rule-based similarity rather than on cross-case replication.

Since the 2023 amendment to the electricity market rules, Kazakhstan operates an asymmetric balancing-market pricing regime: under-generation (scheduled volume exceeding actual delivery) is charged at a penalty price, while over-generation is rewarded at a price that is set structurally below the reference balancing price. Figure 4 sketches the rule schematically and displays the realised monthly settlement balance for Case H over one operational year.

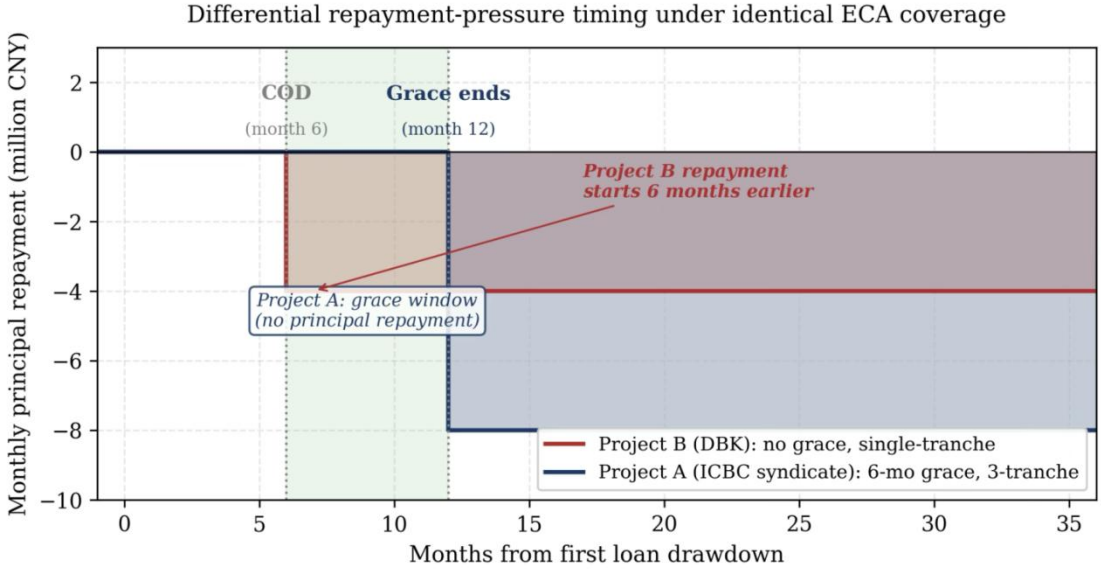



Figure 4. Balancing-market asymmetry (schematic) and Case H monthly settlement, one operational year.

Note − (a) Schematic asymmetry: the slope on the penalty side is 2.77 times the slope on the reward side. (b) Four months of balancing settlements for a 20 MW wind project; December 2025 produced a monthly net impact exceeding the project's PPA revenue for that month.

Table 4 presents the monthly settlement numbers. In December 2025, Case H was charged a shortfall penalty of Kazakhstani tenge (KZT) 122.8 million against monthly PPA revenue of KZT 118.4 million, pro-

ducing a negative operating cash flow for the month. Across the twelve-month period, the ratio of the unit penalty for under-generation to the unit reward for over-generation is approximately 2.8 to 1. The ratio is calculated from the monthly settlement data in Table 4 as the average unit penalty per GWh of under-generation divided by the average unit reward per GWh of over-generation across the twelve months. For a wind generator with forecast variance in the 20 to 30 percent range — a profile documented in Case H and consistent with the wind-resource characteristics of the relevant region (Mouraviev, 2021) — the expected annual net balancing charge exceeds 5 percent of PPA revenue.

Table 4. Case H monthly balancing-market settlement (anonymised illustrative reconstruction from source files).

| Month | Scheduled (GWh) | Actual (GWh) | Imbalance (GWh) | Net settlement (KZT mn) |
|---|---|---|---|---|
| Jan | 6.2 | 5.1 | −1.1 | −14.6 |
| Feb | 5.8 | 6.9 | +1.1 | +8.2 |
| Mar | 5.4 | 4.0 | −1.4 | −19.8 |
| Apr | 4.9 | 5.2 | +0.3 | +2.1 |
| May | 4.2 | 3.1 | −1.1 | −15.9 |
| Jun | 3.8 | 4.4 | +0.6 | +4.3 |
| Jul | 3.5 | 2.8 | −0.7 | −10.8 |
| Aug | 3.9 | 3.2 | −0.7 | −11.2 |
| Sep | 4.6 | 5.8 | +1.2 | +9.1 |
| Oct | 5.7 | 4.9 | −0.8 | −12.5 |
| Nov | 6.1 | 4.2 | −1.9 | −29.7 |
| Dec | 6.5 | 2.1 | −4.4 | −122.8 |

*Note − Compiled by the authors from monthly balancing-market settlement files of Case H. Negative amounts = payment due from project.*

The institutional meaning of Channel 3 is that Kazakhstan's balancing-market design is asymmetric in a way that transfers forecasting risk from the system operator to the generator. For projects that were financially modelled on the assumption of symmetric balancing or pre-2023 rules, the realised revenue falls short of the projected PPA revenue by an amount that scales with wind-forecast variance. Projects financially modelled after the rule change embed a balancing-exposure contingency in the revenue stream from the outset. Channel 3 is therefore the third contract- and rule-level pathway through which the Kazakhstani institutional regime enters the project's cash flows.

***Discussion***

An integrated picture

Taken together, the three channels affect different components of project cash flow. Financing costs are shaped by lender structure; capital expenditure is adjusted through fiscal upgrading; operating revenue is influenced by balancing-market rules. Viewed jointly, these mechanisms provide a coherent explanation for the cost-deviation range observed across the ten cases, and no alternative technological or commercial factor accounts for the pattern. Table 5 maps each channel to the cash-flow line item it affects, the direction of the effect, and the cases in which it is documented.

Table 5. Integrated mapping of the three transmission channels.

| Channel | Institutional input | Cash-flow line item | Direction | Documented in |
|---|---|---|---|---|
| 1 | Lender identity under identical ECA cover | Interest expense; debt-service schedule | Lower cost for direct lending | A, B, C, I |
| 2 | Supplementary-agreement upgrade dynamic | Capital expenditure | Higher CapEx; upgraded tax status | C, D, E, F, G |

| | | | | |
|---|---|---|---|---|
| 3 | Asymmetric balancing-market settlement | Operating revenue | Negative months in high-variance periods | H (direct); A, B (inferred) |
| *Note − Compiled by the authors based on the data summarised in Tables 1–4.* | | | | |

Assessment of the working hypotheses

H1 is supported. The matched comparison of Cases A and B shows that, under identical Sinosure coverage, lender identity alone is associated with a 153-basis-point rate difference and a six-month grace asymmetry — consistent with H1.

H2 is supported. Across the five feed-in-tariff-era cases, incentive status was renegotiated upward through supplementary agreements requiring 29–57 percent additional capital, consistent with the predicted upgrading dynamic in H2.

H3 is supported, with a stated scope limit. Case H confirms the post-2023 asymmetry directly (penalty-to-reward ratio ≈ 2.8:1); for Cases A and B the channel is inferred from the uniform balancing-market rule rather than directly observed, so H3 holds directly for Case H and by rule-based extension elsewhere.

Positioning in the literature

The three-channel framework advances the institutional-theory conversation in a specific direction. Where the distance literature treats institutions as a country-pair scalar and the voids literature treats them as absent intermediaries, the framework here treats them as structured inputs that enter the contract. This repositioning is consistent with the call by Kostova and colleagues (2020) for micro-level, mechanism-based accounts of institutional effects and aligns with the emerging-market-focused strategic-management literature (Meyer et al., 2009; Peng, 2003) on how firms adapt to host regimes at the operational level.

For project finance, the findings extend the Esty (2004) and Gatti (2013) characterisation of project-specific risk allocation by showing that lender identity, even under identical ECA coverage, remains a pricing determinant in cross-border renewable finance — a result that dovetails with the recent documentation of coordinated credit spaces in Chinese outbound lending (Chin & Gallagher, 2019; Dreher et al., 2022; Horn et al., 2021). For the Central Asian renewable energy literature, the paper contributes the first project-level evidence on the cash-flow consequences of the 2023 balancing-market reform, complementing the regulatory and macro-level analyses of Khamzina, Mukan and Tormosov (2025), Lan et al. (2024), and Zhakiyev et al. (2025), and the political-economy reading by Zeng (2025) of Chinese-financed renewable assets in Kazakhstan.

***Implications for sponsors***

From a project-design perspective, three principles follow from the analysis for sponsors structuring Chinese-financed renewable investments in Central Asia. Under identical Sinosure buyer-credit coverage, direct commercial-bank CNY financing through ICBC or BOC delivered a 153-basis-point rate advantage and a six-month principal grace period relative to host-country development-bank refinancing; where project specifications permit, the direct commercial route should be the default. The Kazakhstani investment agreement is best treated as the start of a negotiation sequence rather than a final commitment — budgeting the supplementary-agreement upgrade from the outset, including the additional 29 to 57 percent capital requirement, converts what currently appears as adverse deviation into deliberate design. Balancing-market exposure should be quantified and reserved against at financial close, with a contingency reserve in the range of 5 to 10 percent of annual PPA revenue defensible for sites with wind-variability profiles similar to those documented in Case H, and scaled accordingly for lower-variability sites.

***Implications for Kazakhstani policymakers***

For the Kazakhstani policy community — the Ministry of National Economy, the Ministry of Energy, the Financial Settlement Centre for Renewable Energy, the Damu Entrepreneurship Development Fund, DBK, and the Baiterek holding more broadly — the three channels point to specific reforms that would materially reduce the documented distortions while preserving the policy intent of the existing regime.

On the financing channel, extending the Damu interest-rate subsidy programme to foreign-currency facilities, or permitting DBK to offer principal grace periods matched to project ramp-up, would narrow the structural gap between direct Chinese commercial lending and DBK refinancing. The current structure is asymmetric in a way that is rarely articulated in the policy debate — Damu's tenge-denominated subsidy expires part-way through a typical 12-to-15-year project loan, leaving foreign-currency-borrowing developers without a comparable instrument once their grace runs out. Closing that gap would reduce the incentive

for sponsors to bypass domestic financial intermediaries, retain a larger share of intermediation value within the Kazakhstani financial system, and align with the broader strategic objective of building deeper sovereign infrastructure-finance capacity at DBK and Baiterek.

On the fiscal-upgrade channel, codifying the supplementary-agreement upgrade trigger in the Investment Promotion Law's implementing regulations — with a published schedule of capital-commitment thresholds and corresponding tier outcomes — would convert what is now a negotiation into a transparent contracting environment. Sponsors would be able to budget the upgrade scenario at financial close; the state would retain the leverage that the supplementary-agreement device provides; and the observed cost-overrun pattern in the feed-in tariff cohort would be largely eliminated. The reform aligns with the Concept for the Transition to a Green Economy and with the 2023–2030 renewable energy development plan (Ministry of Energy of the Republic of Kazakhstan, 2023).

On the balancing-market channel, introducing forecast-error tolerance bands — under which no balancing charge applies within plus or minus 10 percent of schedule, with symmetric pricing beyond — would preserve the system-stability rationale of the 2023 reform while eliminating the punitive asymmetry documented in Case H. Tolerance bands of this kind are standard in European balancing-market design and would transmit to the Kazakhstani context with minor adjustment. The reform would reduce a recurring source of revenue volatility for renewable generators that currently propagates back into the cost of equity demanded at financial close.

***Strengths and limitations***

Strengths. The design has unusual strengths for a project-finance setting. The matched comparison of Cases A and B isolates lender identity with unusual cleanliness, holding EPC contractor, PPA counterparty, and Sinosure coverage constant. The ten cases constitute a near-complete enumeration — more than 70 percent of the observable universe — rather than a sample, and each numerical claim is triangulated against at least two of contract text, feasibility-study model, audited accounts, and settlement files.

Limitations. Three limits discipline the reach of the findings. First, the small N supports analytical, not statistical, generalisation (H1–H3 are traced mechanisms, not estimated effects). Second, H3 is documented directly only for Case H and inferred for Cases A and B from the uniform balancing-market rule. Third, Cases A and B differ in nameplate capacity (100 versus 50 MW), which cannot be fully controlled in a two-observation comparison, though the identical EPC, PPA, and Sinosure terms leave lender identity the most plausible driver.

Boundary conditions. These findings apply to Chinese-originated capital, ECA-backed infrastructure, and the Kazakhstani regime as it stood in 2018–2026; extension to other jurisdictions, non-Chinese capital, or liberalised markets is a question for replication.

***Conclusion***

Ten Chinese-invested renewable energy projects in Kazakhstan exhibit cost deviations ranging from 15.7 percent below budget to 15.0 percent above it, despite sharing a narrow turbine-platform family and a small circle of contractors. Technology does not explain the spread. The host-country institutional regime does, through three transmission channels that enter the project's financial architecture and reshape cash flows from the inside.

Lender identity, under identical Sinosure coverage, drives a 153-basis-point rate wedge and a six-month difference in repayment onset. Investment-incentive status, rather than being pre-committed at signing, is negotiated upward through supplementary agreements that demand 29 to 57 percent additional capital commitment, and the negotiation dynamic pushes budgeting toward the conservative scenario. The balancing market, for its part, penalises under-generation at roughly 2.8 times the rate at which it rewards over-generation, producing episodic negative monthly revenue for wind projects with high forecast variance. Together, these channels provide a coherent explanation for the observed range, and no alternative technological or commercial factor accounts for the pattern.

The analytical move is to describe institutions in this setting not as distance from the home environment but as structured inputs to the contracts foreign investors sign. That repositioning sharpens the institutional-theory toolkit, deepens the project-finance literature on ECA-covered cross-border lending, and equips the growing Central Asian renewable-energy literature with project-level evidence on the cash-flow consequences of recent regulatory reform. For Kazakhstani policymakers, the framework identifies three concrete reform levers — Damu/DBK financing instrument design, codified investment-incentive thresholds, and bal-

ancing-market tolerance bands — each tractable within the existing institutional architecture and each capable of materially reducing the institutionally induced volatility that the analysis has documented.

Data availability statement

Primary documents underlying the analysis are project-company confidential. Aggregated data and non-confidential extracts are available from the corresponding author on reasonable request and subject to the disclosing parties' written consent.

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# Citizen Behaviour During COVID-19: Determinants of Preventive and Maladaptive Responses in Kazakhstan

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***Abstract***

This study intends to understand the predictors of preventive and maladaptive practices during the COVID-19 pandemic. The association between risk perception, behaviour, knowledge, trusted sources of information, attitudes toward the COVID-19 pandemic, response initiative, and other variables from June to September 2020, and people's behaviour to inform COVID-19 outbreak responses was assessed. Four samples, composed of about 1,000 respondents aged 18 years and above, were interviewed online or via telephone in four rounds every two weeks from June to September 2020. Descriptive and inferential analyses of the data were conducted using Stata 18. Multivariate regression analyses, including logistic and linear regression models, were used to identify predictors of preventive and maladaptive behaviours. The study findings revealed distinct factors associated with both preventive and maladaptive measures. These findings are significant as they provide a deeper understanding of the predictors of preventive and maladaptive practices. The existence of different predictors in favour of maladaptive behaviour calls for policy intervention to increase the uptake of preventive behaviour rather than maladaptive behaviour. Therefore, consideration of all people, regardless of their place of residence, level of education, and health status, is needed through increased exposure to the right information and undertaking measures that will increase trust in the disseminated information. Policy interventions should focus on increasing exposure to accurate information to encourage preventive behaviours.

***Keywords:*** COVID-19, Kazakhstan, maladaptive behaviour, preventive behaviour, attitude.

## *Introduction*

The present study aims to understand the determinants of preventive measures and maladaptive behaviour during COVID-19 in Kazakhstan. The outbreak of coronavirus disease (COVID-19) in China at the end of 2019 had a profound impact on the world, resulting in not only the disruption of people's lives but also many deaths globally (Aidossov et al., 2025; Kuandyk (Sabitova) et al., 2024; Panneer et al., 2022). According to the World Health Organization (WHO), as of January 19, 2023, there were more than 663 million cases with more than 6.7 million deaths globally (World Health Organization, n.d.). To control the spread of the disease, the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recommended adopting non-pharmaceutical interventions (NPIs) such as lockdowns, movement restrictions, mass testing, contact tracing, mask mandates, social distancing, frequent hand washing, and staying at home when feeling sick (Ayouni et al., 2021). These measures were intended to prevent the spread of the virus and the consequent deleterious effects of the outbreak. Countries in the world responded to the pandemic by imposing these measures to protect their population. Understanding behavioural responses in Kazakhstan, where unique cultural and socioeconomic factors may influence health behaviours, is crucial for tailoring effective public health interventions.

In the Republic of Kazakhstan, the first confirmed cases of the infection were registered on 13 March 2020. The transmission rate dramatically rose between 17 March and 25 May 2020, with 8,531 confirmed cases and 35 deaths (World Health Organization, n.d.). Also, since March 26, 2020 (when the first death was registered), the number of severe cases began to rise as well. Additionally, as of June 2022, Kazakhstan had

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1.3 million confirmed cases, 88,815 probable PCR-negative cases, and 13,660 deaths from coronavirus infection (World Health Organization, n.d.). To prevent the overburden on the healthcare system and other complications related to the outbreak of coronavirus, the government of the Republic of Kazakhstan announced the introduction of the emergency state in the country on 16 March 2020, including restrictions on country border crossing, quarantine, and other measures in all regions of the country.

In Kazakhstan, the Ministry of Health had to lead the public communication regarding health issues, including the communication on developing vaccination and other measures. However, the outbreaks of new infectious diseases are associated with uncertainty about the risk factors of the disease, transmission routes, severity of the disease, and immunity resistance. Since the outbreak of COVID-19, the population has faced a large flow of epidemiological information, reports from government agencies, and publications on the internet, social networks, conspiracy theories, misinformation, and divergent opinions of scientists. The Government of Kazakhstan introduced non-pharmacological measures to limit the spread of coronavirus infection, such as careful hand washing, social distancing, wearing masks, restriction of movement and staying in public places, and isolation.

The outbreak and the introduction of non-pharmaceutical interventions caused certain behavioural reactions in the population. People had to decide on protective or risk behaviours in a daily changing information environment. Additionally, their risk of anxiety, loneliness, and depression increased as a result of isolation and worries about health and income losses. By weighing the risks, health consequences, and benefits of preventive behaviour, individuals make health decisions (van der Pligt, 1996). An important role in the commitment of the population to measures to control coronavirus infection is trust in the authorities and the information they provide (Rodríguez-Blázquez et al., 2021). Generally, the outbreak of the pandemic had an impact on people's lives and their adherence to the imposed measures. While others followed the recommended NPIs, others practised maladaptive behaviours such as substance use, avoiding medical treatments, or complete social isolation.

The perception and desire to follow restrictive measures may vary in different populations and geographical regions and may change over time during the pandemic. Additionally, all these determinants might explain behaviours during the pandemic. While it is important to examine determinants of protective behaviours, it is also important to understand maladaptive behaviour and its predictors. In health behaviour theories, behavioural determinants are used to understand and change behaviours. Thus, we explore which determinants are important for protective and maladaptive behaviour in the four representative surveys.

The available literature has identified several factors that influence the use of preventive measures or maladaptive behaviour during a pandemic like COVID-19. As suggested by Ntegwa et al., multifaceted factors include sociodemographic, behavioural, economic, cultural, and political influences on the uptake of services (Ntegwa et al., 2023). Liu and Jiang's study in China revealed that media exposure is associated with increased self-efficacy and compliance through protection motivation (Liu & Jiang, 2023). A study revealed that women participate in more preventive behaviour as they perceive a higher severity of COVID-19 and the benefit of preventive behaviour (Can et al., 2022). Thus, the perceived severity of COVID-19 infection is a protective factor for preventive health behaviour (Can et al., 2022). Also, the perceived severity of the COVID-19 infection predicts social distancing (Hadizadeh-Talasaz et al., 2022). However, a study in South Africa shows little evidence of the severity of the disease if contracted on the decision to wear a mask (Burger et al., 2022). On the other hand, the study shows that being male is a risk factor for preventive behaviour (Can et al., 2022). Another study in Singapore revealed that women were associated with an increase in handwashing frequency and also adopting avoidant behaviour (Long & Liu, 2021).

Furthermore, the study by Vally revealed a greater adherence to preventive measures among those who are educated and/or have chronic illnesses (Vally, 2020). However, chronic illnesses such as hypertension, obesity, or being overweight were not significantly associated with mask-wearing in the study conducted in South Africa (Burger et al., 2022). While the elderly had significantly lower odds of mask-wearing (Burger et al., 2022), younger individuals were more likely to wear face masks (Long & Liu, 2021). A study conducted in Kenya, Uganda, and Tanzania revealed that barriers to hand washing were a lack of trust in the government's recommendations or messaging (Muchangi et al., 2024). On the other hand, the confidence in the government to tackle the pandemic is related to compliance (Wright et al., 2021). Pilch suggested that persuasive communication to the public should be formulated (Pilch et al., 2021). However, the study revealed that the perceived severity, age, gender, and education were not significant predictors of adaptive and maladaptive behaviour (Downing et al., 2023). Also, the low compliance with protective measures was strongly related to younger age and risk attitudes (Wright & Fancourt, 2021).

It is clear from the existing evidence that predictors of preventive and maladaptive behaviour show mixed results depending on the context and time. Thus, it is important to understand the predictors of different behaviours during the pandemic in the context of Kazakhstan and how they change over time. Therefore, we explore determinants such as risk perceptions, emotional reactions to the pandemic, such as fears and worries, trust, and conspiracy beliefs, in addition to sociodemographic factors. We investigate the determinants of uptake of protective behaviour and maladaptive behaviour over time. This study contributes to understanding both the behavioural determinants, uptake of protective behaviour, and uptake of maladaptive behaviour changes over time, and how these changes are important for policies, interventions, and communications during the pandemic. Previous studies focused on these determinants using data from a single period, whereas our study uses four cross-sectional datasets collected at different times to understand how the determinants change over time. While previous research has examined predictors of health behaviours during the pandemic, this study uniquely examines how these predictors change over time in a Central Asian context.

***Methodology***

**Data source**

Data used for this study is part of the COVID-19 Snapshot Monitoring (COSMO) survey created by the WHO in March 2020 in collaboration with the University of Erfurt, Germany. Subsequently, it provided an adaptable protocol and questionnaire for use by stakeholders. Kazakhstan implemented the survey instrument made available by WHO/Europe in the context of the COVID-19 scenario in the nation to understand these aspects better and adapt to the quickly changing situation. Thus, the COSMO Standard protocol variables were adapted to the local cultural context (Rodríguez-Blázquez et al., 2021). Additionally, the survey was modified by updating variables in the policy acceptance section to reflect the Kazakhstan epidemiological situation.

**Study design and settings**

This study uses a repeated cross-sectional survey where cross-sectional data were collected in four rounds on a bi-weekly basis from June to September 2020 by the Centre for Applied Research “TALAP”. Data from a sample of 1029, 1026, 1040, and 1035 individuals were collected during the first, second, third, and fourth rounds, respectively. The sample was representative of Kazakhstan's general population in terms of age, gender, and area of residence. Quota sampling was employed, stratified by age, gender, and area of residence, to ensure representation of the general population of Kazakhstan.A one-stage stratified quota sampling method was used to select respondents from a database of 12,372,754 eligible individuals aged 18 years or older. Selected respondents were invited to complete an online questionnaire. Since an online survey is likely to produce biases against older people and people without access to an internet connection, smartphones, and other digital devices, Computer-Assisted Telephone Interviews (CATI) were utilized to reach older, rural people and other underrepresented populations. A mixed mode was used for data collection: 70 % via an online mobile application survey and 30 % via CATI. The survey took approximately 15-25 minutes to complete.

***Variables***

**Outcome variables**

The outcome variables for this analysis include preventive and maladaptive measures. For the June and July 2020 survey rounds, preventive measures were based on whether participants practised physical distancing, mask-wearing, and hand washing. In the August and September 2020 rounds, the preventive measure was constructed from the average scores of these behaviours, measured on a 5-point Likert scale. Thus, in the August and September 2020 survey rounds, preventive measures, as well as physical distancing, mask-wearing, and hand washing, were treated as continuous variables with values ranging from 1 to 5. Maladaptive behaviour was measured using responses to the question: "Within the last two weeks, have you done the following…?" The behaviours included eating more unhealthy food, drinking more alcohol, exercising less, avoiding the doctor for non-COVID-19 issues, and cancelling treatment. Responses were 1 for "yes" and 2 for "no." Maladaptive behaviour was coded as 1 if the participant engaged in any of these behaviours and 0 if they did not.

**Independent variables**

This study included several independent variables based on previous research examining factors influencing preventive and maladaptive measures related to COVID-19. Sociodemographic variables included gender (male/female) and education level (high/low). Trust in institutions and healthcare was assessed using

responses to the question, "How much confidence do you have that the following can handle the COVID-19 challenge well?" with responses ranging from 1 (very low confidence) to 5 (very high confidence), averaged to form the variable. Emotionality and conspiracy thinking were included based on their potential influence on health behaviours, as suggested by prior research. Emotionality was measured by responses to questions such as "COVID-19 feels... think about it all the time/never think; helpless/able to combat; stressful/not stressful; media-hyped/not media-hyped; fear-inducing/not fear-inducing," also on a scale of 1 to 5. Conspiracy thinking was based on the average of responses to five questions regarding governmental decisions, with responses ranging from 1 (certainly not true) to 5 (certainly true). Additionally, participants were asked about the presence of chronic illness (yes/no), and knowledge of COVID-19 symptoms was determined by whether respondents identified at least five common symptoms, such as fever, cough, and shortness of breath.

Health literacy was evaluated through questions on the ease of finding, understanding, judging, and following COVID-19-related information, with responses ranging from 1 (very difficult) to 5 (very easy). Finally, resilience was measured based on responses to three scenarios assessing how respondents coped with stressful events during the pandemic, such as "It does not take me long to recover from a stressful event" (1: strongly disagree to 5: strongly agree). These variables were chosen due to their relevance to understanding public responses to the COVID-19 pandemic.

**Statistical analysis**

Descriptive statistics were conducted before performing the multivariate regression analysis. Two types of multivariate regression were employed in this study. For the June and July 2020 survey rounds, variables such as physical distancing, mask-wearing, and hand washing were measured as binary outcomes (yes/no). Given the categorical nature of these variables, multiple logistic regression was used to identify predictors of these preventive measures, as well as the overall use of preventive measures (whether individuals practised any of the three behaviours). For the August and September 2020 survey rounds, these variables were measured on a Likert scale from 1 to 5, allowing us to treat them as continuous variables. Consequently, multiple linear regression analysis was conducted for these rounds, reporting results for physical distancing, mask-wearing, hand washing, and overall preventive measures. Additionally, maladaptive behaviour was measured as a categorical variable across all rounds, and multiple logistic regression analysis was used to examine its determinants. Only completed data sets were considered in the analysis. Missing values were treated as missing values and were not imputed. All analyses are conducted using Stata version 18 (StataCorp, 2023).

**Ethical considerations**

This study was conducted in accordance with ethical guidelines to protect participants' rights and well-being and ensure inclusivity. Ethical approval was obtained from the Local Committee on Bioethics of the National Center for Public Health of the Republic of Kazakhstan (Approval No. 2, dated May 11, 2020). All participants were fully informed about the study's purpose, procedures, potential risks and benefits, their voluntary participation, and their right to withdraw at any time without consequences. Informed consent was obtained from all participants in written form. Confidentiality and anonymity were strictly maintained throughout to safeguard personal information and responses. Information confidentiality and protection of personal data were ensured. The study was conducted following the relevant ethical standards and adhered to the principles outlined in the Declaration of Helsinki.

## *Results*

**Descriptive statistics**

Table 1 shows the socio-demographic characteristics of this study sample. While the sample had 43 % males in June, July, and September 2020, there were 44 % males in August 2020. More than 50 % of respondents had higher education, and the study included approximately 60 % of participants from urban and 40 % from rural areas. Additionally, approximately 20 % of the respondents had chronic health issues. Moreover, the average age of the participants was about 40 years in June 2020, 39 years in July 2020, and 41 years in August and September 2020. The level of correct knowledge about the symptoms of COVID-19 was 0.887 in June and 0.854 in July 2020. On the other hand, health literacy remained slightly constant at 3.9 in August and September 2020. Additionally, the estimate of risk perceptions, probability, and severity of infection was included in all four rounds of data collection and remained high above 3 in all four rounds. Detailed socio-demographic characteristics by each round are presented in Table 1.

Table 1: Socio-demographic characteristics of the samples in each round of the survey

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | June 2020 | | July 2020 | | August 2020 | | September 2020 | |
| VARIABLES | N | mean | N | mean | N | mean | N | mean |
| Age | 1,029 | 39.81 | 1,026 | 39.31 | 1,040 | 40.67 | 1,035 | 40.91 |
| Male | 1,029 | 0.427 | 1,026 | 0.429 | 1,040 | 0.444 | 1,035 | 0.429 |
| High education | 1,029 | 0.573 | 1,026 | 0.619 | 1,040 | 0.537 | 1,035 | 0.565 |
| Chronic | 968 | 0.246 | 984 | 0.230 | 985 | 0.211 | 968 | 0.195 |
| Urban | 1,029 | 0.576 | 1,026 | 0.593 | 1,040 | 0.593 | 1,035 | 0.603 |
| Perceived probability of infection | 1,029 | 3.294 | 1,026 | 3.358 | 1,040 | 3.215 | 1,035 | 3.125 |
| Perceived severity of an infection | 1,029 | 3.360 | 1,026 | 3.481 | 1,040 | 3.249 | 1,035 | 3.187 |
| Frequency of media consumption | 1,029 | 3.543 | 1,026 | 3.412 | 1,040 | 3.239 | 1,035 | 3.127 |
| Knowledge | 746 | 0.887 | 852 | 0.854 | | | | |
| Trust in institutions and healthcare | 961 | 3.027 | 1,026 | 3.243 | 1,040 | 5.265 | 1,035 | 4.609 |
| Emotionality | 1,029 | 2.895 | 1,026 | 2.814 | 1,040 | 3.052 | 1,035 | 3.141 |
| Conspiracy thinking | 1,029 | 3.189 | 1,026 | 3.038 | 1,040 | 3.418 | 1,035 | 3.398 |
| Health literacy | | | | | 1,040 | 3.902 | 1,035 | 3.933 |
| Resilience | 1,029 | 2.434 | 1,026 | 2.543 | 1,040 | 2.608 | 1,035 | 2.605 |
| Physical distance | 1,012 | 0.822 | 988 | 0.786 | 997 | 4.136 | 1,004 | 4.093 |
| Wearing mask | 1,019 | 0.948 | 1,016 | 0.935 | 987 | 4.314 | 1,003 | 4.273 |
| Hand washing | 1,012 | 0.899 | 1,005 | 0.861 | 1,025 | 4.156 | 1,025 | 4.244 |
| Preventive measure | 1,029 | 0.742 | 1,026 | 0.635 | 1,030 | 4.196 | 1,027 | 4.210 |
| Maladaptive behaviour | 1,029 | 0.716 | 1,026 | 0.779 | 1,040 | 0.640 | 1,035 | 0.590 |

***Predictors of Preventive Behaviour Uptake***

**Predictors of physical distancing**

The predictors of uptake of preventive behaviour (physical distancing, mask-wearing, and hand washing) are shown in Table 2. The result shows that a unit increase in participants' age was associated with a 0.007 increase in the practice of physical distancing in August 2020 ($\beta$=0.007; $p<0.01$). Also, the participants with higher education were 1.502 times more likely to practice physical distancing in July 2020 than participants with low education (OR=1.502; $p<0.05$). Additionally, being an urban resident was associated with a 0.147 increase in the use of physical distancing in August 2020 ($\beta$ =0.147; $p<0.05$). Also, participants with trust in institutions and healthcare were 1.216 times more likely to practice physical distancing in June 2020 (OR=1.216; $p<0.05$). Contrary to expectations, participants who perceived a high probability of being infected with COVID-19 were 18 % less likely to practice physical distancing in June 2020 (OR=0.818; $p<0.10$).

Similarly, participants who perceived the high severity of infection were 21 % less likely to use physical distancing in June 2020 (OR=0.792; p<0.10).

Moreover, a unit increase in emotionality was associated with the increases in the use of physical distancing in August and September 2020 (β=0.081; p<0.05 and β=0.142; p<0.01). Participants with conspiracy thinking in August and September were associated with a 0.066 and 0.104 increase in the use of physical distancing (β=0.066; p<0.05 and β=0.104; p<0.01). Also, the increase in the frequency of information was associated with the increase in the practice of physical distancing in June (OR=1.350; p<0.01) and July 2020 (OR=1.248; p<0.01). Furthermore, an increase in the knowledge about symptoms of COVID-19 was associated with the use of physical distancing in June 2020 (OR=5.506; p<0.01) and July 2020 (OR=4.679; p<0.01). Similarly, an increase in health literacy was associated with an increase in the use of physical distancing in August and September 2020. Also, an increase in resilience was associated with 0.119 and 0.132 increases in the use of physical distancing in August and September, respectively.

**Predictors of mask-wearing**

A unit increase in the age of the participant was associated with a 0.006 increase in mask-wearing in August 2020 (β=0.006; p<0.05). Male respondents were 57 % less likely to wear masks compared to females in June 2020 (OR=0.434; p<0.10). Also, urban participants were 1.904 times more likely to wear masks than rural participants in July 2020 (OR=1.904; p<0.05), and urban participants were associated with a 0.154 increase in mask-wearing compared to rural residents in August 2020 (β =0.154; p<0.05). An increase in the perceived probability of COVID-19 infection was associated with a 30 % lower likelihood of wearing the mask in July 2020 (OR=0.701; p<0.05). Additionally, participants who perceived high severity of COVID-19 infection were 1.326 more likely to wear masks in July 2020 (OR=1.326; p<0.10). Furthermore, an increase in emotionality was associated with 1.266 times increase in wearing masks in July 2020 (OR=1.266; p<0.10). Similarly, a unit increase in emotionality was associated with a 0.088 and 0.184 increase in mask-wearing in August and September 2020, respectively (β=0.088; p<0.05 and β=0.184; p<0.001). Moreover, conspiracy thinking was associated with a 1.324, 0.090, and 0.119 increase in mask-wearing in June, August, and September, respectively (OR=1.324; P<0.10, β=0.090; p<0.01 and β=0.119; p<0.01).

Moreover, the frequency of media consumption was associated with a 0.046 decrease in mask-wearing in August 2020 (β =-0.046; p<0.10). Also, participants with chronic health conditions were associated with a 0.210 increase in mask-wearing (β=0.210; p<0.01). An increase in knowledge about COVID-19 symptoms was associated with 12.463 and 7.674 times increase in the likelihood of wearing masks in June and July 2020, respectively (OR=12.463; p<0.01 and OR=7.674; p<0.01). On the other hand, an increase in health literacy was associated with a 0.488 and 0.498 increase in mask-wearing in August and September 2020, respectively (β=0.488; p<0.01 and β=0.498; p<0.01). Also, resilience is associated with a 0.055 and 0.139 increase in mask-wearing in August and September, respectively (β=0.055; p<0.10 and β=0.139; p<0.01).

**Predictors of hand washing**

The age of the respondent positively influenced hand washing in August (β=0.005; p<0.1) and September (β=0.007; p<0.01). Males were 45 % and 31 % less likely to practice hand washing in June and July, respectively, compared to females (OR=0.554; p<0.05, and OR=0.629; p<0.05). Higher education was associated with a 0.104 decrease in hand washing in September 2020 (β=-0.104; p<0.10). Also, urban residence was associated with a 0.231 increase in hand washing in August 2020 (β=0.231; p<0.01). The increase in trust in institutions and healthcare increases the likelihood of hand washing by 1.165 times more in July 2020 (OR=1.165; p<0.10). An increase in the perceived probability of COVID-19 infection is associated with 24 % less likelihood of washing hands in June 2020 (OR=0.763; p<0.10). The increase in perceived severity of infection was associated with a 29 % lower likelihood of practising hand washing in July 2020 (OR=0.708; p<0.01). Additionally, the increase in emotionality was associated with 1.259 times increase in hand washing in June 2020 (OR=1.259; p<0.10) and was associated with a 0.162 increase in hand washing practices in September 2020 (β=0.162; p<0.01). Conspiracy thinking was associated with a 16 % lower likelihood to practice hand washing in June 2020 (OR=0.838; p<0.05) and was associated with an increase in hand washing practice in August 2020 (β=0.133; p<0.01) and September 2020 (β=0.108; P<0.01). Moreover, the increase in the frequency of media consumption among respondents was associated with a 0.057 decrease in handwashing practice in September 2020 (β=-0.057; p<0.05). Respondents with chronic health issues were associated with a 0.140 increase in hand washing practice in September 2020 (β =0.14; p<0.10). An increase in resilience among respondents was positively associated with hand-washing practices in August (β=0.056; p<0.10) and September (β=0.135; p<0.01). Moreover, the increase in health literacy among re-

spondents was associated with an increase in hand-washing practice in August (β=0.460; p<0.01) and September (β=0.503; p<0.01). The increase in knowledge about COVID-19 symptoms was associated with 6.935 times more likely to practice hand washing in July 2020 (OR=6.935; p<0.01).

Table 2: Regression analysis for the predictors of uptake of preventive measures

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | June 2020 | July 2020 | August 2020 | September 2020 | June 2020 | July 2020 | August 2020 | September 2020 | June 2020 | July 2020 | August 2020 | September 2020 |
| | Physical distancing | | | | Mask wearing | | | | Hand washing | | | |
| Age | 1.014 | 0.999 | 0.007*** | 0.003 | 1.024 | 0.997 | 0.006** | 0.003 | 1.009 | 1.011 | 0.005* | 0.007*** |
| | (0.009) | (0.008) | (0.002) | (0.002) | (0.022) | (0.014) | (0.002) | (0.002) | (0.012) | (0.009) | (0.003) | (0.002) |
| Male | 0.886 | 0.901 | -0.043 | -0.053 | 0.434* | 1.154 | -0.065 | -0.037 | 0.554** | 0.629** | -0.036 | -0.061 |
| | (0.204) | (0.178) | (0.066) | (0.063) | (0.187) | (0.356) | (0.062) | (0.057) | (0.159) | (0.139) | (0.068) | (0.060) |
| High education | 0.977 | 1.502** | -0.046 | 0.057 | 0.802 | 1.298 | -0.021 | -0.013 | 0.735 | 0.849 | 0.017 | -0.104* |
| | (0.232) | (0.304) | (0.067) | (0.064) | (0.335) | (0.396) | (0.061) | (0.058) | (0.215) | (0.197) | (0.070) | (0.061) |
| Urban | 0.946 | 0.812 | 0.147** | -0.106 | 0.859 | 1.904** | 0.154** | -0.062 | 1.130 | 0.936 | 0.231*** | -0.007 |
| | (0.228) | (0.165) | (0.068) | (0.065) | (0.390) | (0.582) | (0.062) | (0.059) | (0.356) | (0.204) | (0.071) | (0.061) |
| Trust in institutions and healthcare | 1.216** | 1.080 | -0.002 | 0.005 | 0.987 | 0.919 | 0.000 | 0.003 | 0.843 | 1.165* | 0.000 | 0.003 |
| | (0.110) | (0.085) | (0.003) | (0.003) | (0.161) | (0.095) | (0.002) | (0.004) | (0.110) | (0.098) | (0.003) | (0.004) |
| Perceived probability of an infection | 0.818* | 1.035 | -0.027 | -0.025 | 1.201 | 0.701** | 0.001 | -0.020 | 0.763* | 0.993 | 0.032 | -0.022 |
| | (0.092) | (0.091) | (0.027) | (0.028) | (0.238) | (0.120) | (0.024) | (0.024) | (0.111) | (0.099) | (0.029) | (0.028) |
| Perceived severity of an infection | 0.792* | 1.002 | -0.005 | 0.014 | 0.737 | 1.326* | -0.026 | 0.003 | 0.993 | 0.708*** | -0.032 | -0.010 |
| | (0.104) | (0.093) | (0.032) | (0.034) | (0.185) | (0.206) | (0.029) | (0.028) | (0.162) | (0.080) | (0.031) | (0.030) |
| Emotionality | 0.917 | 1.097 | 0.081*** | 0.142*** | 1.094 | 1.266* | 0.088*** | 0.184*** | 1.259* | 0.943 | 0.031 | 0.162*** |
| | (0.095) | (0.094) | (0.039) | (0.035) | (0.216) | (0.169) | (0.034) | (0.031) | (0.176) | (0.090) | (0.040) | (0.035) |
| Conspiracy thinking | 0.958 | 0.911 | 0.066*** | 0.104*** | 1.324* | 0.972 | 0.090*** | 0.119*** | 1.058 | 0.838*** | 0.133*** | 0.108*** |
| | (0.089) | (0.068) | (0.033) | (0.031) | (0.221) | (0.101) | (0.029) | (0.030) | (0.108) | (0.069) | (0.033) | (0.031) |
| Frequency of media consumption | 1.350*** | 1.248*** | 0.035 | 0.002 | 1.151 | 1.058 | -0.046* | -0.026 | 1.205 | 1.119 | -0.015 | -0.057** |
| | (0.146) | (0.099) | (0.028) | (0.032) | (0.260) | (0.110) | (0.024) | (0.027) | (0.179) | (0.105) | (0.028) | (0.029) |
| Chronic | 0.837 | 0.838 | -0.067 | 0.086 | 0.806 | 1.290 | 0.013 | 0.210*** | 1.374 | 0.951 | 0.097 | 0.140* |
| | (0.252) | (0.196) | (0.094) | (0.085) | (0.519) | (0.563) | (0.083) | (0.075) | (0.635) | (0.266) | (0.090) | (0.079) |
| Knowledge | 5.506*** | 4.679*** | | | 12.463*** | 7.674*** | | | 1.779 | 6.935*** | | |
| | (2.749) | (1.691) | | | (9.722) | (3.479) | | | (1.401) | (2.611) | | |
| Resilience | 0.966 | 0.986 | 0.119*** | 0.132*** | 0.874 | 1.017 | 0.055* | 0.139*** | 0.913 | 1.006 | 0.056* | 0.135*** |
| | (0.110) | (0.082) | (0.032) | (0.033) | (0.193) | (0.130) | (0.029) | (0.030) | (0.129) | (0.101) | (0.033) | (0.034) |
| Health literacy | | | 0.506*** | 0.533*** | | | 0.488*** | 0.498*** | | | 0.460*** | 0.503*** |
| | | | (0.040) | (0.039) | | | (0.037) | (0.037) | | | (0.042) | (0.036) |
| Constant | 1.216 | 0.460 | 1.094*** | 0.772*** | 1.284 | 1.517 | 1.652*** | 1.026*** | 9.151* | 3.803 | 1.393*** | 1.086*** |
| | (0.997) | (0.344) | (0.256) | (0.235) | (2.153) | (1.795) | (0.246) | (0.229) | (10.672 | (3.526) | (0.271) | (0.234) |

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | June 2020 | July 2020 | August 2020 | September 2020 | June 2020 | July 2020 | August 2020 | September 2020 | June 2020 | July 2020 | August 2020 | September 2020 |
| | Physical distancing | | | | Mask wearing | | | | Hand washing | | | |
| | | | | | | | | | ) | | | |
| Observations | 668 | 798 | 948 | 940 | 669 | 815 | 937 | 939 | 664 | 811 | 971 | 958 |
| R-squared | | | 0.262 | 0.353 | | | 0.282 | 0.397 | | | 0.228 | 0.362 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Predictors of preventive measures**

Overall, the age of the respondents had a positive impact on using preventive measures in June, August, and September 2020 (OR=1.015; p<0.10, β=0.005; p<0.05, and β=0.005; p<0.05). Male participants were 34 % less likely to use preventive measures in June 2020 than female participants (OR=0.663; p<0.05). On the other hand, participants with higher education were 1.416 times more likely to use preventive measures than their counterparts, participants with lower education levels in July 2020 (OR=1.416; p<0.05). Moreover, participants living in urban areas were associated with a 0.169 increase in the use of preventive measures in August 2020 than rural participants (β=0.169; p<0.01). The increase in the perceived probability of COVID-19 infection was associated with a 21 % decrease in the likelihood of using preventive measures in June 2020 (OR=0.788; p<0.05). On the other hand, the increase in the perceived severity of infection was associated with a 14 % lower likelihood to use preventive measures in July 2020 (OR=0.863; p<0.10). Participant's emotionality was significantly associated with increases in the use of preventive measures in August 2020 (β=0.065; p<0.10) and September 2020 (β=0.161; p<0.01).

Also, an increase in conspiracy thinking among participants was associated with a 0.102 and 0.112 increase in the use of preventive measures in August and September 2020 (β =0.102; p<0.01 and β =0.112; p<0.01). The increase in the frequency of media consumption was associated with the increase in the likelihood of using preventive measures in June 2020 (OR=1.253; p<0.05) and July 2020 (OR=1.178; p<0.05). Participants having chronic conditions were significantly associated with increased preventive measures in September 2020 (β=0.150; p<0.05). The increase in participants' knowledge about symptoms of COVID-19 was 3.902, and 5.911 times more likely to practice preventive measures in June 2020 (OR=3.902; p<0.01) and July (OR=5.911; p<0.01). Similarly, an increase in health literacy was associated with an increase in the use of preventive measures in August 2020 (β=0.470; p<0.01) and September (β=0.509; p<0.01). Moreover, increased resilience was associated with an increase in the use of preventive measures in August (β=0.077; p<0.01) and September 2020 (β=0.137; p<0.01).

Table 3: Predictors of preventive measures

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | June 2020 | July 2020 | August 2020 | September 2020 |
| Age | 1.015* | 0.997 | 0.005** | 0.005** |
| | (0.008) | (0.006) | (0.002) | (0.002) |
| Male | 0.663** | 0.850 | -0.052 | -0.051 |
| | (0.132) | (0.137) | (0.057) | (0.052) |
| High education | 0.937 | 1.416** | -0.023 | -0.016 |
| | (0.192) | (0.234) | (0.058) | (0.053) |
| Urban | 1.126 | 0.801 | 0.169*** | -0.058 |
| | (0.231) | (0.132) | (0.057) | (0.055) |
| Trust in institutions and healthcare | 1.075 | 1.040 | -0.000 | 0.003 |
| | (0.088) | (0.066) | (0.002) | (0.003) |
| Perceived probability of an infection | 0.788** | 0.953 | 0.003 | -0.021 |
| | (0.082) | (0.070) | (0.023) | (0.024) |
| Perceived severity of an infection | 0.885 | 0.863* | -0.016 | -0.003 |
| | (0.105) | (0.067) | (0.027) | (0.027) |
| Emotionality | 1.037 | 1.003 | 0.065* | 0.161*** |
| | (0.096) | (0.073) | (0.035) | (0.030) |
| Conspiracy thinking | 0.954 | 0.929 | 0.102*** | 0.112*** |
| | (0.077) | (0.058) | (0.028) | (0.028) |
| Frequency of media consumption | 1.253** | 1.178** | -0.011 | -0.023 |

| | | | | |
|---|---|---|---|---|
| | (0.120) | (0.079) | (0.023) | (0.026) |
| Chronic | 0.973 | 1.023 | 0.018 | 0.150** |
| | (0.261) | (0.203) | (0.077) | (0.069) |
| Knowledge | 3.902*** | 5.911*** | | |
| | (1.794) | (2.204) | | |
| Resilience | 0.882 | 0.985 | 0.077*** | 0.137*** |
| | (0.087) | (0.071) | (0.028) | (0.029) |
| Literacy | | | 0.470*** | 0.509*** |
| | | | (0.035) | (0.034) |
| Constant | 1.369 | 0.691 | 1.439*** | 0.966*** |
| | (1.013) | (0.449) | (0.233) | (0.210) |
| Observations | 672 | 821 | 976 | 960 |
| R-squared | | | 0.292 | 0.425 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Maladaptive behaviour**

An increase in participant age was negatively associated with the practice of maladaptive behaviour in July (OR=0.983; p<0.05), August 2020 (OR=0.979; p<0.01), and September 2020 (OR=0.988; p<0.05). Males were less likely to practice maladaptive behaviour than females in July (OR=0.677; p<0.05) and August (OR=0.702; p<0.05). Participants with higher education levels were 41 % less likely to practice maladaptive behaviour than participants with lower education in July 2020. Urban residents were 23 % and 30 % less likely to practice maladaptive behaviour in August (OR=0.769; p<0.10) and September (OR=0.697; p<0.05), respectively. Also, an increase in trust in institutions and healthcare was positively associated with the use of maladaptive behaviour in August 2020 (OR =1.020; p<0.05) and September (OR=1.025; p<0.05). The increase in the perceived probability of COVID-19 infection was associated with a 15 % lower likelihood of practising maladaptive behaviour in August 2020 (OR=0.854; p<0.01). On the other hand, the increase in the perceived severity of COVID-19 was associated with 1.250 times increase in the practice of maladaptive behaviour in August 2020 (OR=1.250; p<0.01).

The increase in emotionality was 38 %, 22 % and 24 % less likely to use maladaptive in June (OR=0.622, p<0.01), July (OR=0.775; p<0.01), and September (OR=0.764; p<0.01), respectively. Moreover, an increase in conspiracy thinking was associated with 1.498 times more likely to practice maladaptive behaviour in July 2020 (OR=1.498; p<0.01) but 14 % less likely associated with the practice of maladaptive behaviour in August 2020 (OR=0.861; p<0.05). The increase in the frequency of media consumption was associated with 25 % and 14 % less likelihood to practice maladaptive behaviour in August (OR=0.752; p<0.01) and September (OR=0.859; p<0.05), respectively. Also, individuals with a chronic health condition were 1.585 and 1.521 times more likely to practice maladaptive behaviour in June (OR=1.585; p<0.10) and August (OR=1.521; p<0.05), respectively. Further, the increase in participants' resilience was 1.354 times more likely to practice maladaptive behaviour in June (OR=1.354; p<0.01). The increase in health literacy was associated with a 26 % lower likelihood of practising maladaptive behaviour in August 2020 (OR=0.739; p<0.01).

Table 4: Predictors of maladaptive behaviour

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | June 2020 | July 2020 | August 2020 | September 2020 |
| Age | 0.996 | 0.983** | 0.979*** | 0.988** |
| | (0.007) | (0.007) | (0.005) | (0.005) |
| Male | 0.749 | 0.677** | 0.702** | 0.968 |
| | (0.139) | (0.118) | (0.100) | (0.132) |
| High education | 0.952 | 0.594*** | 1.160 | 1.085 |
| | (0.181) | (0.116) | (0.169) | (0.148) |
| Urban | 1.337 | 0.904 | 0.769* | 0.697** |
| | (0.251) | (0.161) | (0.113) | (0.099) |
| Trust in institutions and healthcare | 0.962 | 0.935 | 1.020** | 1.025** |
| | (0.080) | (0.067) | (0.009) | (0.010) |
| Perceived probability of an infection | 1.116 | 1.081 | 0.854*** | 0.933 |
| | (0.096) | (0.090) | (0.050) | (0.056) |
| Perceived severity | 1.136 | 1.021 | 1.250*** | 0.994 |

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | June 2020 | July 2020 | August 2020 | September 2020 |
| of an infection | | | | |
| | (0.099) | (0.089) | (0.086) | (0.066) |
| Emotionality | 0.622*** | 0.775*** | 1.014 | 0.764*** |
| | (0.055) | (0.067) | (0.078) | (0.057) |
| Conspiracy thinking | 0.968 | 1.498*** | 0.861** | 0.921 |
| | (0.083) | (0.117) | (0.060) | (0.059) |
| Frequency of media consumption | 0.966 | 0.887 | 0.752*** | 0.859** |
| | (0.084) | (0.071) | (0.047) | (0.054) |
| Chronic | 1.585* | 1.181 | 1.521** | 1.303 |
| | (0.407) | (0.270) | (0.293) | (0.238) |
| Knowledge | 1.944 | 0.746 | | |
| | (0.820) | (0.360) | | |
| Resilience | 1.354*** | 1.083 | 1.105 | 1.031 |
| | (0.139) | (0.093) | (0.082) | (0.078) |
| Literacy | | | 0.739*** | 0.989 |
| | | | (0.063) | (0.073) |
| Constant | 1.903 | 10.712*** | 38.369*** | 15.142*** |
| | (1.283) | (8.294) | (21.582) | (8.191) |
| Observations | 672 | 821 | 985 | 968 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

***Discussion***

This study's analysis revealed different factors associated with the practice of preventive measures or maladaptive behaviour over time. The multivariate regression revealed that the increased age of the participants, urban residents, emotionality, increase in conspiracy thinking, media consumption frequency, having a chronic disease condition, increased knowledge about COVID-19 symptoms, increased health literacy, and resilience were positively associated with the practice of preventive measures. On the other hand, in male participants, increased perceived probability and severity were associated with a decrease in the practice of preventive behaviours.

Moreover, the practice of maladaptive behaviour was positively associated with increased trust in institutions and healthcare, an increase in the perceived severity and chronic health conditions, and resilience. An increase in age, male participants, higher education, urban residence, increased perceived probability, increased emotionality, and increased media frequency predict less practice of maladaptive behaviour. However, the increase in conspiracy thinking was associated with increased practice of maladaptive behaviour in July, then decreased practice of maladaptive behavior in August 2020. The unexpected positive association between trust in institutions and maladaptive behaviours in Kazakhstan may be due to cultural factors, such as historical skepticism towards government interventions.

Results showed that increased media consumption is positively related to the practice of preventive measures. Other studies have revealed that media consumption is positively related to self-efficacy, which is related to compliance with preventive measures (Liu & Jiang, 2023). Media increases awareness, which in turn makes participants informed about their decisions and practices, and thus results in a decrease in the practices of maladaptive behaviour. Dissemination of COVID-19 information through television, healthcare providers, and health officials contributes to greater adherence to infection prevention behaviour.

Moreover, the results show that male participants were less likely to practice both preventive and maladaptive behaviour compared to female participants. This is consistent with a previous study, which revealed that being male is a risk factor for preventive behaviour, and females predict the practices of preventive behaviour in China (Can et al., 2022). Also, a study in Singapore revealed that females were more likely to practice both preventive measures and maladaptive measures in Singapore (Long & Liu, 2021). However, other studies indicated that gender is not a significant predictor of preventive measures (Downing et al., 2023).

Additionally, the increased perceived severity of COVID-19 was associated with a decrease in the practice of preventive measures and an increase in the practice of maladaptive behaviour in Kazakhstan. This could be attributed to increased worries that influence the practices of maladaptive behaviours. This contradicts previous studies' findings that revealed that an increase in the perceived severity of COVID-19 predicts

an increase in the practices of preventive measures (Can et al., 2022; Hadizadeh-Talasaz et al., 2022). However, other studies have revealed there is little evidence of perceived severity to influence the practice of preventive measures (Burger et al., 2022; Downing et al., 2023). Further, education was found to be associated with preventive measures in this study. This is consistent with the study conducted, which revealed that education influences preventive measures practices (Vally, 2020). However, the study revealed no significant association between the practice of preventive measures and the education of the participants (Downing et al., 2023). Moreover, results show that people with chronic diseases predicted preventive and maladaptive measures. However, the previous study showed that chronic diseases predicted preventive measures (Vally, 2020). Still, in South Africa, the study revealed that chronic diseases were not a significant predictor of preventive measures (Burger et al., 2022).

Also, results show that increased age was associated with increased preventive measures and decreased maladaptive behaviour. This could be driven by an individual's understanding of the risk that may be associated with the practice of maladaptive behaviour and adherence to preventive measures. This contradicts the previous study's results, which revealed the lower practice of preventive measures (Burger et al., 2022), higher practices for young people (Long & Liu, 2021; Wright & Fancourt, 2021), and age as not a predictor of the practices (Downing et al., 2023). Moreover, results show that an increase in trust in institutions and healthcare predicts increased practices of maladaptive behaviour. This is contrary to the expectations that trust in institutions and healthcare would predict increased practices of preventive measures or lower maladaptive practices. However, the study conducted in East Africa revealed that a lack of trust in government acts as a barrier to handwashing (Muchangi et al., 2024).

***Policy and Economic Implications***

The finding suggests several important economic and policy implications. First, it highlights the need for targeted public health investment, as differences in age, education, and place of residence influence behavior. This means governments should allocate resources more efficiently by designing tailored communication strategies for specific groups, rather than relying on uniform approaches, thereby improving the cost-effectiveness of interventions. Second, addressing maladaptive behaviors has significant economic benefits, since such behaviors can increase infection rates, place a heavier burden on healthcare systems, and reduce labor productivity through illness and absenteeism. Promoting preventive practices through education and trust-building can therefore help lower public health expenditures and minimize economic disruptions. Third, the findings emphasize the importance of trust and equitable access to accurate information. Policies that ensure all population groups, regardless of background, receive reliable and understandable information can improve compliance with preventive measures, reduce the spread of misinformation, and ultimately support more stable economic activity during a pandemic.

***Strengths and limitations***

This study's strength is based on the four repeated cross-section data collected with a representative sample of the Republic of Kazakhstan, as opposed to previous studies. However, the study had limitations. The use of online data collection limits the participation of certain important population groups, such as older people (a risk group for COVID-19), migrants, refugees, young people who are under 18 years old, homeless people, and other vulnerable groups. Thus, the results of the research should be interpreted in this context. The findings that are related to the general population may not apply to specific disadvantaged groups, and this affects the generalizability of the study results. In addition, this study used a cross-sectional design, which may lead to recall bias, and the results are drawn from self-reported data. Comparison with objective data, such as direct observation of people wearing masks in a certain context, would be necessary to increase the external validity of the study. Future studies should employ longitudinal designs to track changes in behaviour over time and include objective measures of preventive behaviours to validate self-reported data.

***Conclusion***

The results conclude that people's behaviour during a pandemic like COVID-19 is affected by different factors. Participants' age, education, place of residence, health condition, and knowledge of COVID-19 predict their practices of preventive and maladaptive behaviours. The existence of different predictors in favour of maladaptive behaviour calls for policy intervention aimed at increasing the uptake of preventive behaviour rather than maladaptive behaviour. Therefore, consideration of all people regardless of their place of residence, level of education, and health status is needed through increased exposure to the right information and undertaking measures that will increase the trust in the disseminated information. Public health authorities in

Kazakhstan should develop tailored communication strategies to improve adherence to preventive measures, particularly among younger and less educated populations. Future research should explore the impact of targeted educational interventions on reducing maladaptive behaviours in high-risk groups.

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**Clinical trial number**

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**Declarations**

**Ethical approval and consent to participate**

The study was approved by the Local Committee on Bioethics of the National Center for Public Health of the Republic of Kazakhstan (№ 2 dated 11 May 2020). All respondents provided informed consent for both survey methods (online and CATI). Confidentiality of information and protection of personal data were strictly ensured. The study was conducted following the relevant ethical standards and adhered to the principles outlined in the Declaration of Helsinki.

**Consent for publication**

Not applicable.

**Competing interest**

The authors declare no competing interests.

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# School Types and Educational Outcomes in Kazakhstan

**Kuandyk Tleuzhanuly**[1]

***Abstract***

Kazakhstan's secondary education system encompasses a remarkably diverse array of school types, ranging from highly selective exam-based institutions to small rural schools. This study examines how school type is associated with academic performance and post-secondary destinations using administrative data on the full population of 499,150 high school graduates from 2021 to 2023. We classify schools into 19 mutually exclusive categories and estimate ordinary least squares regressions for log-transformed Unified National Test scores and logistic regressions with average marginal effects for five post-secondary outcomes: university enrollment, vocational education, study abroad, employment, and not in education, employment, or training status. Graduates of the most selective schools score 24 to 33 percent higher on the Unified National Test and are 12 to 25 percentage points more likely to enroll in university than regular urban school graduates. At the other end of the spectrum, sport school graduates score 24 percent lower and are channeled primarily into vocational education, while military school graduates are 45 percentage points more likely to be not in education, employment, or training, likely reflecting post-graduation service obligations. We argue that these large associations between school type and outcomes primarily reflect selection: families with greater resources sort their children into higher-performing school types, and the observed school type premiums capture the combined effects of student selection, peer composition, and institutional quality that cannot be disentangled in an observational framework.

***Keywords:*** school types, educational outcomes, Kazakhstan, Unified National Test, post-secondary destinations, selection, school effects.

## *Introduction*

A central question in the economics and sociology of education is the extent to which schools matter for student outcomes. The landmark Coleman Report (Coleman et al., 1966) challenged the prevailing assumption that differences in school resources were the primary driver of achievement gaps. Using data on nearly 650,000 students across more than 3,000 schools in the United States, Coleman and colleagues found that variations in school quality showed surprisingly modest associations with student achievement once family background was accounted for, concluding that students' socioeconomic origins were far more consequential than the characteristics of the schools they attended.

The Coleman Report ignited decades of research on the relative importance of school and family factors. Hanushek (1986, 2003) demonstrated that simple measures of school resources bear little systematic relationship to student performance, while individual teacher quality matters enormously. Meta-analytic evidence has reinforced the primacy of family background: Sirin (2005) found a medium-to-strong association between socioeconomic status and academic achievement across four decades of research. School composition has emerged as a particularly powerful channel: Rumberger and Palardy (2005) showed that the socioeconomic makeup of a school's student body had effects on achievement as large as a student's own SES, and van Ewijk and Sleegers (2010) confirmed through meta-analysis that peer socioeconomic status exerts a meaningful influence on individual achievement net of individual background. Compositional effects help explain why between-school variance is often confounded with selection. Raudenbush and Willms (1995) demonstrated that proper estimation of school effects requires multilevel models that separate compositional effects from genuine institutional effects. Cross-national analyses using PISA data have documented wide variation in the share of achievement variance lying between schools, with some highly tracked systems exceeding 50 percent (OECD, 2019). Yet even in these systems, it remains difficult to distinguish true school value-added from the sorting of students across institutions. Downey and Condron (2016) argued that schools may function more as equalizers than as engines of inequality, since achievement gaps narrow during the school year and widen over summers, complicating any simple narrative of school ineffectiveness.

This distinction between school effects and selection effects is particularly salient in systems that offer a diverse menu of school types from which families can choose. Research on selective and exam-based

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schools in the United States, the United Kingdom, and developing countries has shown that the observed performance advantages of elite schools often shrink dramatically or disappear entirely when selection is accounted for through regression discontinuity or lottery-based designs (Abdulkadiroglu et al., 2014; Barrow et al., 2020; Clark, 2010; Jackson, 2010). Evidence from China corroborates this pattern: Shi (2020) exploited admission cutoffs to elite boarding schools and found negligible effects on academic performance, and Wu et al. (2019) obtained comparable null results at selective school thresholds using similar regression-discontinuity designs. The policy implication is sobering: what appears to be an institutional effect may largely reflect the prior advantages of students who gain admission to selective schools. At the same time, even in the absence of causal school effects on test scores, school type may still shape post-secondary trajectories through peer networks, institutional reputations, and the signaling value of elite school credentials.

Kazakhstan offers a compelling setting to study this relationship. The country has developed one of the most differentiated secondary education systems in the post-Soviet region, encompassing elite exam-based schools such as Nazarbayev Intellectual Schools (NIS) and Bilim-Innovation Lyceums (BIL), Soviet-era specialized schools, a growing private sector, and a large system of regular public schools ranging from well-resourced urban institutions to small rural schools. These school types differ in curricula, resources, selectivity, and the socioeconomic composition of their student bodies, creating a landscape in which school type serves as a proxy for both institutional quality and family background.

Despite the prominence of school differentiation in Kazakhstan's education system, no study has systematically examined how these diverse school types are associated with student outcomes across the full population of graduates. Existing research on Kazakhstan's education system has focused on specific school networks, such as NIS (Shamshidinova et al., 2014), or on particular aspects of the admissions system. A comprehensive mapping of outcomes across the full spectrum of school types is missing.

This study addresses this gap by classifying every general secondary school in Kazakhstan into one of 19 mutually exclusive school types and examining how school type is associated with two sets of outcomes: performance on the Unified National Test (UNT), Kazakhstan's centralized college admissions examination, and post-secondary destinations including university enrollment, vocational education, study abroad, employment, and NEET status. Using administrative data on the full population of 499,150 graduates from 2021 to 2023, we estimate OLS regressions for log UNT scores and logistic regressions with average marginal effects for binary post-secondary outcomes, controlling for student and school characteristics with region-by-year fixed effects and school-level clustered standard errors.

We do not claim to estimate causal school effects. Our framework, following the Coleman tradition, recognizes that families sort into school types based on ability, preferences, and resources, and that the observed associations between school type and outcomes reflect the combined influence of selection, peer effects, and institutional quality. Our contribution is descriptive but policy-relevant: we provide the first comprehensive mapping of how Kazakhstan's diverse school landscape relates to both academic performance and the full set of post-secondary pathways available to graduates.

## *Literature Review*

### School Effects and Family Background

The question of whether schools or families matter more for educational achievement has been at the center of education research since the Coleman Report (Coleman et al., 1966). Coleman's key finding, that school resources explained relatively little variation in student achievement compared to family socioeconomic status, generated a research program spanning six decades. Early work reinforced this conclusion: Jencks et al. (1972) argued that family background and individual ability dominated educational and economic outcomes to such a degree that school reform alone could not substantially reduce inequality. Together, these foundational studies established a powerful baseline expectation: when we observe large differences in outcomes across schools, the most likely explanation is that different kinds of students attend different kinds of schools, not that the schools themselves are producing the differences.

Subsequent research introduced more sophisticated methods that refined but did not overturn this basic insight. The extensive production function literature, synthesized by Hanushek (1986, 2003), concluded that there is no consistent, systematic relationship between school expenditures and student performance. What does matter at the school level is teacher quality, but even here the variation is largely within schools rather than between them: longitudinal evidence shows that between-school differences in average teacher quality are modest compared to within-school variation (Rivkin, Hanushek, & Kain, 2005). The implication is that

aggregate school-level measures, which is what school type captures, are blunt instruments for identifying the mechanisms through which schools affect learning.

Multilevel modeling approaches have formalized this distinction. Raudenbush and Willms (1995) separated "Type A" school effects, which measure the total difference in outcomes associated with attending a particular school, from "Type B" effects, which isolate the school's contribution net of student intake characteristics. A school that appears highly effective in Type A terms may simply enroll more advantaged students, with little genuine value-added. Cross-national evidence from PISA confirms that this confounding varies enormously across education systems: countries with early tracking and extensive school differentiation show between-school variance exceeding 50 percent of total variance, while comprehensive systems show between-school variance below 10 percent (OECD, 2019). Kazakhstan, with its highly differentiated school landscape, is likely to fall toward the high end of this spectrum, but the extent to which this reflects institutional quality versus student sorting remains an open empirical question.

**School Choice, Selective Schools, and Student Sorting**

A parallel literature on school choice has examined the mechanisms through which diverse school types create stratification. When families can choose among schools that vary in quality, selectivity, and prestige, those with more information, resources, and social capital tend to secure access to the most desirable options (Epple & Romano, 1998; Hoxby, 2003). Theoretical models predict that competitive school markets amplify stratification by ability and income, as higher-performing students are selected into better-resourced institutions while disadvantaged students are left behind. This sorting means that observed performance differences across school types inevitably confound institutional effects with the prior advantages of selected students.

Rigorous evaluations of elite and exam-based schools have confirmed this prediction across diverse contexts, consistently finding that their apparent performance advantages are substantially overstated by naive comparisons. Using regression discontinuity designs at admission cutoffs, Abdulkadiroglu, Angrist, and Pathak (2014) found negligible effects of attending exam schools in Boston and New York on test scores, despite the large observed performance gaps between exam school students and their peers. Similar results emerged in the United Kingdom, where Clark (2010) documented modest effects of attending elite grammar schools on achievement. Even in developing countries, where school quality varies more widely and one might expect larger institutional effects, the evidence is nuanced: Pop-Eleches and Urquiola (2013) reported positive effects of attending better schools in Romania, but these operated partly through peer composition rather than school resources per se. The consistent message across this literature is that the large raw performance gaps between selective and non-selective schools are driven primarily by who attends these schools, not by what the schools do.

Yet the literature on test score effects may understate the broader impact of school type on life outcomes. Even when exam schools do not raise test scores at the margin, they may shape post-secondary trajectories through peer networks, institutional reputation, and access to university counseling and international opportunities. Jackson (2010) demonstrated this distinction in Trinidad and Tobago, where attending a better school had significant effects on exam-taking behavior and university enrollment even without large test score effects. Dobbie and Fryer (2014) found that high-performing charter schools in New York, while boosting test scores, had more muted effects on longer-run outcomes, reinforcing the complexity of how school environments translate into life trajectories. This possibility is particularly relevant for our study, which examines not only UNT performance but also the full range of post-secondary destinations. Genetic evidence further complicates the picture: Smith-Woolley et al. (2018) showed that school-level differences in achievement in the United Kingdom are substantially explained by heritable student characteristics, suggesting that even peer-composition effects may partly reflect genetic sorting rather than genuine environmental influences.

**Kazakhstan's Secondary School Landscape**

Kazakhstan's secondary education system has evolved from a uniform Soviet-era model into one of the most differentiated school landscapes in Central Asia. Following independence in 1991, the country embarked on extensive education reforms that introduced new school types, expanded private provision, and created a multi-tiered system of selective institutions alongside the inherited network of regular public schools. We provide a brief description of each school type included in our classification.

***Nazarbayev Intellectual Schools (NIS)*** are a national network of 21 highly selective, publicly funded STEM-focused schools established in 2008. Instruction is trilingual, in Kazakh, Russian, and English, and the curriculum integrates national standards with international frameworks, including the International Bac-

calaureate. Admission is through a competitive national examination, and the schools serve as a model for broader education reform in Kazakhstan. NIS students take Cambridge examinations rather than the standard UNT, making their test scores not directly comparable to those of other school types.

***Bilim-Innovation Lyceums (BIL)*** are a network of 28 schools originally established in 1992 as Kazakh-Turkish Lyceums under a partnership with Turkish educational foundations. Renamed in 2016, BIL schools are highly selective boarding institutions with an in-depth focus on natural sciences. Instruction is multilingual, in Kazakh, Russian, English, and Turkish, and the schools have produced thousands of international Olympiad medalists. The student body is predominantly male, reflecting both the boarding school format and STEM orientation.

***Physics-Mathematics schools (FIZMAT)*** trace their origins to the Soviet network of specialized physics and mathematics academies. The flagship institution, the Zhautykov Republican Specialized Physics and Mathematics Secondary School in Almaty, was established in 1972 as the seventh such academy in the Soviet Union. FIZMAT schools maintain highly rigorous curricula developed by leading Soviet-era scholars, admit students through competitive examinations with acceptance rates as low as 4 percent, and have produced some of Kazakhstan's most influential leaders in government, business, and science.

***Daryn schools*** are specialized schools for gifted children operated under the Republican Scientific and Practical Center "Daryn," established in 1998 under the Ministry of Education. The Daryn network coordinates over 130 specialized schools across the country and administers a system of national and international Olympiads. Between 1998 and 2020, Daryn students won over 10,000 medals at international competitions. Daryn schools are boarding institutions that recruit talented students from across the country, with a strong emphasis on academic Olympiad preparation.

***Other selective schools*** encompass various regional and national institutions with competitive admission that do not fall into the NIS, BIL, FIZMAT, or Daryn categories. These include regional specialized schools for gifted children, specialized lyceums with advanced curricula in particular subjects, and schools associated with national centers of academic excellence.

***Military schools*** are boarding institutions that combine general secondary education with military training to prepare cadets for service in the armed forces. The most prominent is the Zhas Ulan Republican School, established in 1999, which admits male students through competitive physical and psychological examinations. Graduates typically proceed to military higher education institutions or direct service, which explains their high NEET rate in administrative data that tracks civilian post-secondary outcomes.

***Sport schools*** are specialized institutions that provide general secondary education alongside intensive athletic training. These schools serve student-athletes pursuing competitive careers in sports and typically feature adjusted academic schedules to accommodate training and competition. Their academic outcomes tend to be lower than those of general schools, reflecting the emphasis on athletic rather than academic development.

***Music schools*** are specialized schools that combine general secondary education with intensive music education. These include institutions originally established during the Soviet era to identify and develop musically talented children from across the country, with curricula spanning traditional Kazakh instruments alongside Western classical training.

***Gymnasiums and lyceums*** represent a tier of schools with enriched curricula that stands between regular public schools and the most selective institutions. In the post-Soviet tradition, gymnasiums typically emphasize humanities and foreign languages, while lyceums focus on science and mathematics. In practice, the distinction varies by institution. Both types operate selective admissions, though less competitive than NIS or BIL. They tend to be located in urban areas and attract families seeking a more rigorous academic environment than regular schools provide.

***Binom schools*** are a new generation of large-format schools built since 2020 under a public-private partnership. Each Binom school is designed for up to 4,000 students and equipped with advanced facilities including specialized science laboratories, robotics classrooms, TV studios, and 3D printing workshops. The educational approach draws on Finnish, British, and South Korean models. As of 2024, eight Binom schools operate in major cities.

***Private international schools*** include institutions offering international curricula such as the International Baccalaureate, British A-Levels, or American high school programs. Prominent examples include Haileybury (established 2008, the first British school affiliate in Central Asia), Miras International School (the first IB-authorized school in Kazakhstan), and QSI International Schools. These schools cater primarily to expatriate families and affluent Kazakhstani families seeking international university placement, with in-

struction predominantly in English. Their high study-abroad rates and elevated NEET rates likely reflect international pathways not fully captured in domestic administrative records.

***IQanat/Burabay school*** is a boarding school for 200 talented students in grades 10 to 11, selected from rural areas through the IQanat national Olympiad. Founded in 2020 by a private philanthropic initiative, the school is located on the shores of Lake Burabay and employs a pedagogical model synthesizing Finnish and Japanese approaches. Despite its small size and recent establishment, IQanat graduates achieve exceptional outcomes: 84 percent win university scholarship grants, and the school has the highest average UNT scores in our sample.

***Other private schools*** include a heterogeneous group of privately operated schools that do not fall into the international school category. These range from schools offering enhanced versions of the national curriculum to institutions catering to specific communities. Quality and resources vary widely within this group.

***Boarding schools*** (excluding those classified in other categories) are general secondary schools with residential facilities. Kazakhstan maintains over 200 boarding schools, many located in rural areas to serve students from remote settlements that lack their own secondary schools. These institutions provide free housing and meals, making them a critical access mechanism for rural students pursuing general secondary education.

***Hub schools (resource centers)*** are a reform initiative introduced to improve educational quality in rural areas. A hub school serves as a resource center for a cluster of 3 to 5 nearby small schools, consolidating educational resources, conducting periodic in-person sessions, and administering assessments for students who otherwise receive instruction in understaffed small schools. The model was piloted in Karaganda region and expanded nationally, with facilities receiving modernization investments including STEM laboratories and digital infrastructure.

***Small-scale schools*** (malokomplektnye shkoly) are schools with combined multi-grade classes, typically located in rural areas with small populations. They account for nearly half of all schools in Kazakhstan and about 70 percent of rural schools. These schools face chronic challenges including teacher shortages, limited infrastructure, multi-grade instruction where a single teacher covers multiple grade levels simultaneously, and geographic isolation that limits students' access to supplementary educational resources.

***Regular rural and urban schools*** constitute the backbone of Kazakhstan's secondary education system, enrolling about 76 percent of all graduates in our sample. Regular urban schools serve as the reference category in our analysis. Regular rural schools, while following the same national curriculum, tend to have fewer resources, lower teacher qualification ratios, and less access to supplementary educational services. The urban-rural divide is a longstanding feature of Kazakhstan's education landscape, documented across multiple international assessments (Chankseliani et al., 2020).

## *Data and Methods*

### Data

We use administrative data from the National Educational Database of Kazakhstan, maintained by the National Center for Educational Research and Evaluation “Taldau” under the Ministry of Education of the Republic of Kazakhstan. The dataset covers the full population of high school graduates in Kazakhstan and links student-level records with school characteristics, post-secondary enrollment outcomes, and labor market indicators.

Our analytic sample includes all students who graduated from general secondary education between 2021 and 2023. Unlike studies that restrict the sample to Unified National Test (UNT) takers, we retain the full population of graduates to examine both UNT performance and post-secondary destinations. The full sample for binary outcome analyses comprises 499,150 students. For analyses of UNT performance, we restrict the sample to 373,649 graduates who sat for the UNT, excluding students from Nazarbayev Intellectual Schools (NIS) whose UNT-equivalent scores are transferred from Cambridge examinations and are therefore not directly comparable.

### Variables

Dependent variables. We examine two sets of outcomes. The first set consists of log-transformed UNT scores: total score, history of Kazakhstan, reading literacy, and math literacy. Log transformation facilitates the interpretation of coefficients as approximate percentage differences. The second set consists of five mutually exclusive post-secondary destinations, constructed by imposing a priority ordering on overlapping administrative records: (1) university enrollment, (2) vocational education, (3) study abroad, (4) employment,

and (5) not in education, employment, or training (NEET). Students are assigned to the highest-priority category for which they qualify, ensuring that every graduate falls into exactly one destination.

Independent variables. The main independent variable is school type, classified into 19 mutually exclusive categories using a hierarchical coding scheme applied to administrative school identifiers. The hierarchy assigns each school to a single category based on the following priority ordering: Nazarbayev Intellectual Schools (NIS), Bilim-Innovation Lyceums (BIL), Physics-Mathematics schools (FIZMAT), Daryn schools for gifted children, other selective schools, military schools, sport schools, music schools, gymnasiums, lyceums, Binom schools, private international schools, IQanat/Burabay schools, other private schools, boarding schools, hub/resource center schools, small-scale schools, regular rural schools, and regular urban schools. The reference category is regular urban schools.

Student-level covariates include an indicator for general secondary education completed with honors, an indicator for the Altyn Belgi gold medal, gender, language of instruction at the student's school (Kazakh, Russian, or other, with Russian as the reference), receipt of government support by the student's family, household internet access, and orphan status.

School-level covariates include the ratio of highest-category teachers in the school-year, class size measured as the number of students in the student's class (school-year-grade-letter combination), total number of students, and total number of staff.

***Methodology***

To examine the association between school types and UNT performance, we estimate the following ordinary least squares (OLS) specification:

$$\text{Log}(\text{UNTis}) = \alpha 0 + \text{SchoolTypes}\beta + \text{Xis}\gamma + \delta\text{ry} + \varepsilon\text{is}$$

where Log(UNTis) is the log-transformed UNT score of student i from school s; SchoolTypes is a vector of 18 school type indicators (with regular urban schools as the omitted category); Xis is a vector of student- and school-level covariates; δry denotes region-by-year fixed effects that absorb time-invariant regional differences and region-specific trends; and εis is the error term. We estimate this model separately for total score, history of Kazakhstan, reading literacy, and math literacy. NIS students are excluded from the OLS sample because their UNT-equivalent scores are Cambridge examination transfers.

To examine post-secondary destinations, we estimate logistic regressions for each of the five binary outcomes and report average marginal effects (AME). The specification mirrors the OLS model, with the binary destination indicator replacing the log UNT score as the dependent variable. All 19 school types, including NIS, enter the logistic models, as post-secondary outcomes are observed for the full sample of graduates.

In all models, standard errors are clustered at the school level to account for within-school correlation in unobserved factors. Region-by-year fixed effects are included throughout to control for geographic differences in educational infrastructure, labor markets, and time-varying regional shocks.

***Results***

**Descriptive Statistics**

Table 1 presents descriptive statistics for the full sample of 499,150 graduates from 2021 to 2023. The sample is dominated by regular school graduates: regular urban and regular rural schools together account for about 76 percent of students, with regular rural schools alone contributing 35 percent. Among selective and specialized institutions, gymnasiums are the most common (3.4 percent), followed by other private schools (2.8 percent), other selective schools (2.4 percent), and boarding schools (3.4 percent). The most elite school types are relatively rare: NIS accounts for 1.3 percent, BIL for 1.0 percent, and Daryn for just 0.2 percent of the sample.

Student characteristics show meaningful variation. Approximately 10 percent of graduates earned honors diplomas and 1 percent received the Altyn Belgi gold medal. Female students constitute 53 percent of the sample. The majority of students (70 percent) attended Kazakh-language schools, about 27 percent attended Russian-language schools, and a small share attended schools with other languages of instruction. Socioeconomic indicators suggest that the population is relatively disadvantaged in some dimensions: only about 88 percent report internet access at home, 2 percent of families receive government support, and 0.2 percent of students are orphans.

The post-secondary destination distribution reveals that 56 percent of graduates enrolled in university, 13 percent entered vocational education, 5 percent studied abroad, 9 percent were employed, and 17 percent

were in the NEET category. These shares vary substantially across school types. University enrollment rates range from 31 percent among private international school graduates to 84 percent for Daryn school graduates. The NEET rate is particularly high among military school graduates (63 percent) and private international school graduates (43 percent), and lowest among Daryn (11 percent) and other selective school graduates (13 percent).

Table 1. Descriptive statistics

| Variable | Mean (SD) |
|---|---|
| *Panel A: School type distribution* | |
| NIS | 0.01 (0.11) |
| BIL | 0.01 (0.10) |
| FIZMAT | 0.002 (0.04) |
| Daryn | 0.002 (0.05) |
| Other Selective | 0.02 (0.15) |
| Military | 0.004 (0.06) |
| Sport | 0.01 (0.07) |
| Music | 0.001 (0.03) |
| Gymnasium | 0.03 (0.18) |
| Lyceum | 0.01 (0.12) |
| Binom | 0.002 (0.04) |
| Private International | 0.002 (0.05) |
| IQanat Burabay | 0.001 (0.03) |
| Other Private | 0.03 (0.17) |
| Boarding | 0.03 (0.18) |
| Hub/Resource Center | 0.02 (0.13) |
| Small-Scale | 0.05 (0.21) |
| Regular Rural | 0.35 (0.48) |
| Regular Urban | 0.41 (0.49) |
| *Panel B: Student characteristics* | |
| Honors diploma | 0.10 (0.30) |
| General diploma | 0.90 (0.30) |
| Altyn Belgi | 0.01 (0.12) |
| Female | 0.53 (0.50) |
| Male | 0.47 (0.50) |
| Kazakh language | 0.70 (0.46) |
| Russian language | 0.27 (0.44) |
| Other language | 0.04 (0.19) |
| *Panel C: Family SES* | |
| Government support (ASP) | 0.02 (0.15) |
| No government support | 0.98 (0.15) |
| Internet at home | 0.88 (0.33) |
| No internet at home | 0.12 (0.33) |
| Orphan | 0.002 (0.04) |
| *Panel D: School characteristics* | |
| Highest category teacher ratio | 0.04 (0.06) |

| | |
|---|---|
| Class size | 20.20 (16.60) |
| School size (students) | 1177.34 (894.85) |
| Staff count | 145.71 (77.09) |
| *Panel E: Region* | |
| Astana/Almaty | 0.14 (0.35) |
| North | 0.16 (0.37) |
| West | 0.16 (0.37) |
| South | 0.48 (0.50) |
| East | 0.05 (0.23) |
| *Panel F: Year* | |
| 2021 | 0.32 (0.47) |
| 2022 | 0.34 (0.47) |
| 2023 | 0.34 (0.47) |
| *Panel G: Post-secondary outcomes (all graduates, N = 499,150)* | |
| University enrolled | 0.56 (0.50) |
| Vocational education | 0.13 (0.34) |
| Studies abroad | 0.05 (0.22) |
| Employed | 0.09 (0.28) |
| NEET | 0.17 (0.38) |
| *Panel H: UNT score outcomes (UNT takers, N = 373,649)* | |
| Total UNT score | 73.74 (23.42) |
| History of Kazakhstan | 11.59 (3.72) |
| Reading literacy | 16.37 (3.18) |
| Mathematical literacy | 9.67 (3.34) |

*Notes: Sample restricted to 2021–2023 graduates with non-missing values on all regression covariates (listwise deletion). Panel A shows school type indicators as proportions with standard deviations. Panels B–C report mean (SD) for binary variables including reference categories. Panel D reports school-level continuous variables. Panels E–F show region and year distributions. Panel G reports mutually exclusive post-secondary destinations (priority: university > vocational > abroad > employed > NEET). Panel H reports raw UNT scores for the OLS subsample of UNT takers.*

Figure 1 presents mean UNT total scores by school type for the 2023 cohort. The variation is substantial: FIZMAT schools achieve the highest average scores, followed by IQanat/Burabay, Daryn, and other selective schools. At the other end, sport schools and small-scale schools have the lowest average scores. Regular urban schools, the reference category, fall in the middle of the distribution.

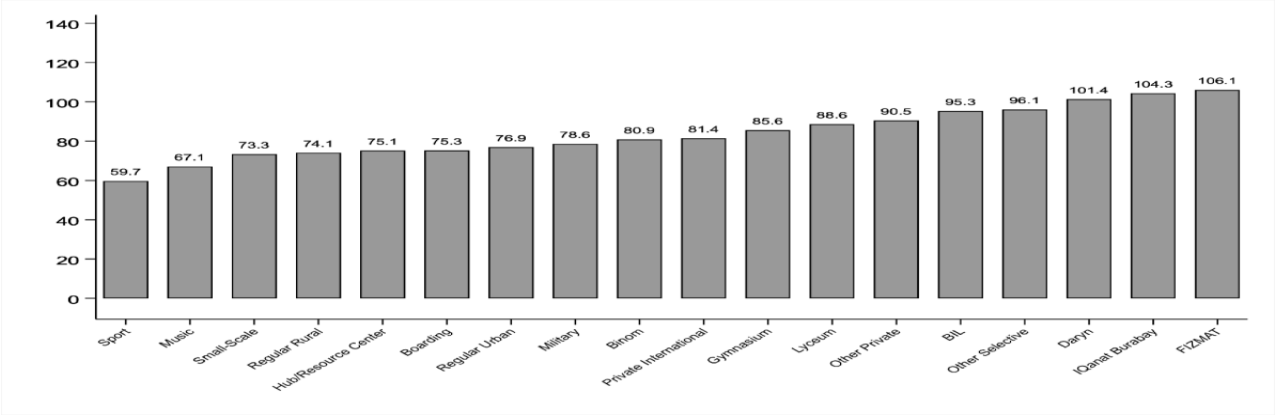



Figure 1. Average Total UNT Scores by School Type, 2023

***Regression Estimates***

**School Types and UNT Performance**

Table 2 presents OLS estimates of the association between school type and log-transformed UNT scores, controlling for student and school characteristics with region-by-year fixed effects. The reference category is regular urban schools. The R-squared values range from 0.15 for math literacy to 0.42 for reading literacy, with total scores at 0.22, indicating that the model explains a meaningful but not exhaustive share of the variation in UNT performance.

The most selective school types show large and statistically significant advantages in UNT performance. IQanat/Burabay school graduates score approximately 33 percent higher on the total UNT than their regular urban peers, the largest premium observed across all school types. BIL graduates score about 24 percent higher, FIZMAT graduates 29 percent higher, and Daryn graduates 26 percent higher. Other selective schools show a premium of 21 percent. These advantages are broadly consistent across subjects, though math literacy tends to show the largest differentials: BIL graduates score 29 percent higher in math, FIZMAT graduates 34 percent higher, and IQanat/Burabay graduates 32 percent higher.

Gymnasiums and lyceums, which represent a tier below the most selective schools, also show significant positive associations with UNT performance. Gymnasium graduates score about 10 percent higher in total scores and 12 percent higher in math, while lyceum graduates score 16 percent higher overall and 17 percent higher in math. Other private schools show an advantage of about 16 percent in total scores.

At the lower end, sport schools show a substantial negative association: their graduates score approximately 24 percent lower in total UNT scores and 31 percent lower in math literacy, consistent with the specialized, non-academic orientation of these institutions. Music school graduates also score lower, by about 8 percent in total scores and 11 percent in math. Regular rural schools show a modest but significant disadvantage of about 4 percent in total scores and 6 percent in math relative to regular urban schools. Small-scale schools, hub/resource center schools, and boarding schools show small negative associations with total scores that are close to zero and generally not substantively large.

Military school graduates show no statistically significant difference in total UNT scores relative to regular urban school peers, despite the large NEET rate observed in descriptive statistics. Binom school graduates show a modest positive association of about 4 percent in total scores, driven primarily by a 7 percent math advantage.

Among control variables, the strongest predictors of UNT performance are prior achievement indicators. Graduates with honors diplomas score about 30 percent higher and Altyn Belgi recipients about 35 percent higher than graduates with general diplomas. Female students score about 8 percent higher in total scores but 3 percent lower in math. Students from families receiving government support and orphans score 3 to 5 percent lower across subjects. Internet access at home is associated with a modest 2 percent advantage.

Table 2. School types and UNT scores (OLS)

| | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| | **Log Total** | **Log History** | **Log Reading** | **Log Math** |
| ***School type (ref: Regular Urban)*** | | | | |
| BIL | 0.24*** | 0.12*** | 0.06*** | 0.29*** |
| | *(0.018)* | *(0.015)* | *(0.006)* | *(0.015)* |
| FIZMAT | 0.29*** | 0.00 | 0.05*** | 0.34*** |
| | *(0.021)* | *(0.028)* | *(0.006)* | *(0.017)* |
| Daryn | 0.26*** | 0.18*** | 0.06*** | 0.26*** |
| | *(0.026)* | *(0.026)* | *(0.009)* | *(0.027)* |
| Other Selective | 0.21*** | 0.13*** | 0.05*** | 0.23*** |
| | *(0.012)* | *(0.010)* | *(0.004)* | *(0.012)* |
| Military | 0.02 | 0.08* | 0.02* | 0.03 |
| | *(0.047)* | *(0.038)* | *(0.011)* | *(0.048)* |
| Sport | -0.24*** | -0.23*** | -0.09*** | -0.31*** |
| | *(0.017)* | *(0.022)* | *(0.010)* | *(0.027)* |
| Music | -0.08*** | -0.02 | -0.03 | -0.11*** |

| | | | | |
|---|---|---|---|---|
| | *(0.011)* | *(0.013)* | *(0.017)* | *(0.015)* |
| Gymnasium | 0.10*** | 0.06*** | 0.04*** | 0.12*** |
| | *(0.010)* | *(0.008)* | *(0.003)* | *(0.011)* |
| Lyceum | 0.16*** | 0.09*** | 0.04*** | 0.17*** |
| | *(0.022)* | *(0.014)* | *(0.006)* | *(0.025)* |
| Binom | 0.04** | 0.00 | 0.01 | 0.07*** |
| | *(0.015)* | *(0.013)* | *(0.009)* | *(0.013)* |
| Private International | 0.07** | -0.08** | 0.01 | 0.12*** |
| | *(0.024)* | *(0.027)* | *(0.012)* | *(0.026)* |
| IQanat Burabay | 0.33*** | 0.23*** | 0.07*** | 0.32*** |
| | *(0.005)* | *(0.005)* | *(0.002)* | *(0.006)* |
| Other Private | 0.16*** | 0.10*** | 0.04*** | 0.17*** |
| | *(0.019)* | *(0.017)* | *(0.005)* | *(0.019)* |
| Boarding | -0.02 | 0.00 | 0.00 | -0.03* |
| | *(0.010)* | *(0.009)* | *(0.004)* | *(0.011)* |
| Hub/Resource Center | -0.02** | 0.02 | -0.01 | -0.04*** |
| | *(0.009)* | *(0.009)* | *(0.004)* | *(0.011)* |
| Small-Scale | -0.02*** | 0.01 | 0.00 | -0.04*** |
| | *(0.006)* | *(0.006)* | *(0.003)* | *(0.007)* |
| Regular Rural | -0.04*** | -0.02*** | -0.02*** | -0.06*** |
| | *(0.005)* | *(0.004)* | *(0.002)* | *(0.006)* |
| Student characteristics | Yes | Yes | Yes | Yes |
| Family SES | Yes | Yes | Yes | Yes |
| School characteristics | Yes | Yes | Yes | Yes |
| Region × Year FE | Yes | Yes | Yes | Yes |
| Clustered SE | School | School | School | School |
| Observations | 373,649 | 373,649 | 373,649 | 373,649 |
| R-squared | 0.22 | 0.33 | 0.42 | 0.15 |

*Notes: OLS estimates. Dependent variables are log-transformed UNT scores (total, history, reading, mathematics). Reference category: Regular Urban schools. Student characteristics include honors diploma, Altyn Belgi, female, language of instruction. Family SES includes government support (ASP), internet at home, orphan status. School characteristics include highest category teacher ratio, class size, school size, staff count. Standard errors clustered at the school level in parentheses.*

** $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

**School Types and Post-Secondary Destinations**

Table 3 reports average marginal effects from logistic regressions predicting five mutually exclusive post-secondary destinations. Coefficients represent percentage-point differences in the probability of each outcome relative to regular urban school graduates, holding other factors constant.

***University enrollment.*** Most selective school types are associated with significantly higher university enrollment. NIS graduates are 12 percentage points more likely to enroll in university, BIL graduates 13 percentage points, Daryn graduates 25 percentage points, and other selective school graduates 17 percentage points more likely than regular urban school graduates. IQanat/Burabay graduates show an 18 percentage-point advantage. Gymnasium and lyceum graduates are 8 and 10 percentage points more likely to enroll, respectively. Other private school graduates show a 17 percentage-point advantage. In contrast, military school graduates are 19 percentage points less likely to enroll in university, and private international school graduates are 15 percentage points less likely.

***Vocational education.*** The vocational education pathway shows a striking pattern. Most selective and private school types are associated with lower vocational enrollment, often showing near-zero rates. BIL, NIS, and other selective school graduates are approximately 10–12 percentage points less likely to enter vo-

cational education than regular urban peers. In contrast, sport school graduates are 21 percentage points more likely to enter vocational education, and boarding school graduates 6 percentage points more likely. Small-scale schools and regular rural schools also show positive associations of 6 and 4 percentage points, respectively.

***Study abroad.*** Private international school graduates are 11 percentage points more likely to study abroad, the largest effect in this category, consistent with their international orientation. Gymnasium graduates are 4 percentage points more likely and other selective school graduates 3 percentage points more likely to study abroad. Most other school types show either no significant difference or a small negative association. NIS and military school graduates are each about 5 percentage points less likely to study abroad, possibly reflecting the strong domestic pipeline of NIS into local universities and the specific career trajectories of military school graduates.

***Employment.*** Almost all school types are associated with lower employment rates relative to regular urban schools, consistent with the fact that post-secondary education channels students away from immediate labor market entry. The negative effect is approximately 10 percentage points for NIS, BIL, Daryn, other selective, sport, Binom, and private international school graduates.

***NEET.*** The NEET category, which captures graduates not observed in any education, employment, or training pathway, shows the most dramatic variation across school types. Military school graduates are 45 percentage points more likely to be in the NEET category, a striking finding that likely reflects the specific post-graduation service requirements or delayed transitions characteristic of military school graduates rather than genuine economic inactivity. NIS graduates are 13 percentage points more likely to be NEET, and private international school graduates 20 percentage points more likely, which may reflect gap years, unobserved international placements, or delayed university enrollment not captured in the administrative data. Regular rural school graduates are 3 percentage points more likely to be NEET than regular urban peers.

Among control variables, prior academic achievement strongly predicts post-secondary outcomes. Graduates with honors diplomas are 26 percentage points more likely to enroll in university and 22 percentage points less likely to enter vocational education. Altyn Belgi recipients show even larger effects: 32 percentage points more likely to attend university and 40 percentage points less likely to enter vocational education. Female students are modestly more likely to enroll in university (2 percentage points) and vocational education (3 percentage points). Kazakh-language students are 22 percentage points more likely to enroll in university but 9 percentage points less likely to study abroad, reflecting language-specific pathways. Students from families receiving government support are 4 percentage points less likely to study abroad and 3 percentage points more likely to be employed.

Table 3. School types and post-secondary outcomes (average marginal effects)

| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
|---|---|---|---|---|---|
| | **University** | **Vocational** | **Abroad** | **Employed** | **NEET** |
| ***School type (ref: Regular Urban)*** | | | | | |
| NIS | 0.12*** | -0.12*** | -0.05*** | -0.10*** | 0.13*** |
| | *(0.035)* | *(0.003)* | *(0.004)* | *(0.015)* | *(0.032)* |
| BIL | 0.13*** | -0.12*** | 0.03 | -0.11*** | 0.06*** |
| | *(0.018)* | *(0.003)* | *(0.014)* | *(0.011)* | *(0.018)* |
| FIZMAT | 0.05 | 0.00 | -0.01 | 0.00 | 0.07 |
| | *(0.030)* | *(.)* | *(0.027)* | *(.)* | *(0.054)* |
| Daryn | 0.25*** | 0.00 | 0.00 | -0.11*** | -0.05* |
| | *(0.041)* | *(.)* | *(0.022)* | *(0.014)* | *(0.019)* |
| Other Selective | 0.17*** | -0.11*** | 0.03** | -0.11*** | -0.03** |
| | *(0.020)* | *(0.004)* | *(0.012)* | *(0.010)* | *(0.009)* |
| Military | -0.19*** | -0.09*** | -0.05*** | -0.09*** | 0.45*** |
| | *(0.020)* | *(0.020)* | *(0.009)* | *(0.019)* | *(0.029)* |
| Sport | -0.08 | 0.21*** | -0.04*** | -0.10*** | 0.02 |
| | *(0.040)* | *(0.054)* | *(0.005)* | *(0.010)* | *(0.029)* |
| Music | 0.14 | -0.08*** | -0.02 | -0.05** | 0.01 |

| | | | | | |
|---|---|---|---|---|---|
| | *(0.077)* | *(0.021)* | *(0.009)* | *(0.017)* | *(0.064)* |
| Gymnasium | 0.08*** | -0.07*** | 0.04*** | -0.08*** | -0.02* |
| | *(0.011)* | *(0.007)* | *(0.007)* | *(0.009)* | *(0.008)* |
| Lyceum | 0.10*** | -0.09*** | 0.02 | -0.09*** | 0.03 |
| | *(0.017)* | *(0.008)* | *(0.012)* | *(0.012)* | *(0.024)* |
| Binom | 0.04* | -0.11*** | -0.04** | -0.11*** | 0.04 |
| | *(0.019)* | *(0.009)* | *(0.015)* | *(0.011)* | *(0.029)* |
| Private International | -0.15*** | 0.00 | 0.11*** | -0.11*** | 0.20* |
| | *(0.026)* | *(.)* | *(0.032)* | *(0.010)* | *(0.093)* |
| IQanat Burabay | 0.18*** | 0.00 | -0.02*** | 0.00 | 0.09*** |
| | *(0.008)* | *(.)* | *(0.002)* | *(.)* | *(0.008)* |
| Other Private | 0.17*** | -0.10*** | 0.02* | -0.10*** | 0.02 |
| | *(0.022)* | *(0.006)* | *(0.009)* | *(0.013)* | *(0.013)* |
| Boarding | 0.00 | 0.06*** | -0.03*** | -0.06*** | -0.01 |
| | *(0.013)* | *(0.009)* | *(0.004)* | *(0.013)* | *(0.008)* |
| Hub/Resource Center | 0.04** | 0.02** | -0.03*** | -0.06*** | 0.00 |
| | *(0.013)* | *(0.009)* | *(0.006)* | *(0.012)* | *(0.010)* |
| Small-Scale | 0.00 | 0.06*** | -0.04*** | -0.07*** | 0.00 |
| | *(0.011)* | *(0.007)* | *(0.002)* | *(0.012)* | *(0.007)* |
| Regular Rural | -0.04*** | 0.04*** | -0.03*** | -0.02 | 0.03*** |
| | *(0.010)* | *(0.005)* | *(0.003)* | *(0.012)* | *(0.006)* |
| Student characteristics | Yes | Yes | Yes | Yes | Yes |
| Family SES | Yes | Yes | Yes | Yes | Yes |
| School characteristics | Yes | Yes | Yes | Yes | Yes |
| Region × Year FE | Yes | Yes | Yes | Yes | Yes |
| Clustered SE | School | School | School | School | School |
| Observations | 499,150 | 495,466 | 499,150 | 497,842 | 499,150 |

*Notes: Average marginal effects from logit regressions. Outcomes are mutually exclusive post-secondary destinations (priority: university > vocational > abroad > employed > NEET). Reference category: Regular Urban schools. Student characteristics include honors diploma, Altyn Belgi, female, language of instruction. Family SES includes government support (ASP), internet at home, orphan status. School characteristics include highest category teacher ratio, class size, school size, staff count. Standard errors clustered at the school level in parentheses.*

** $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

### *Discussion*

This study provides the first comprehensive mapping of how school type is associated with academic performance and post-secondary destinations across the full population of high school graduates in Kazakhstan. The findings reveal striking variation: graduates of the most selective schools score 24 to 33 percent higher on the UNT than regular urban school peers, and are 12 to 25 percentage points more likely to enroll in university. At the other end, sport school graduates score 24 percent lower, and military school graduates show a 45 percentage-point elevation in NEET status. These patterns demonstrate that school type is among the strongest correlates of educational outcomes in Kazakhstan, rivaling or exceeding the predictive power of individual-level characteristics such as gender, language, or family socioeconomic indicators.

How should these large associations be interpreted? The Coleman Report (Coleman et al., 1966) established that observed school-level differences primarily reflect student composition rather than institutional effectiveness. The elite illusion literature reinforces this: performance advantages of selective schools largely disappear at admission cutoffs (Abdulkadiroglu et al., 2014; Clark, 2010; Pop-Eleches & Urquiola, 2013; Shi, 2020; Wu et al., 2019), suggesting that selection rather than school quality drives the observed gaps.

Our results are consistent with this interpretation. The school types that show the largest performance advantages, BIL, FIZMAT, Daryn, and IQanat/Burabay, all employ competitive entrance examinations that select students on the basis of prior achievement. These schools also serve student populations with distinc-

tive socioeconomic profiles: higher rates of internet access, lower rates of government welfare receipt, and higher concentrations of honors diploma holders. The performance premiums we estimate therefore reflect the combined effects of ability-based selection, family socioeconomic sorting, peer composition, and whatever genuine institutional value-added these schools provide. Our observational design cannot disentangle these mechanisms.

The post-secondary destination patterns add a dimension beyond test scores. Even if selective schools do not causally raise achievement at the margin (Abdulkadiroglu et al., 2014; Barrow et al., 2020), they may shape life trajectories through peer networks, institutional reputations, and university counseling. The high university enrollment rates of Daryn (84 percent) and NIS (69 percent) graduates, and the high study-abroad rates of private international school graduates (24 percent), likely reflect both selection and institutional channels.

The findings on specialized non-academic schools are particularly informative. The high NEET rate among military school graduates (63 percent) almost certainly reflects post-graduation military service obligations not captured in civilian records. Similarly, the channeling of sport school graduates into vocational education (35 percent) reflects these institutions' orientation toward athletic career pathways. These patterns underscore that school type shapes not only academic achievement but also the institutional pipeline through which graduates transition into adult life.

The modest but consistent disadvantages of rural, small-scale, and hub/resource center schools relative to regular urban schools point to persistent geographic inequalities. While these gaps are smaller than those between selective and regular schools, they affect a far larger share of the student population: rural and small-scale schools together account for nearly 40 percent of all graduates.

***Policy Implications***

These findings carry important policy implications. If school type associations reflect selection more than institutional effectiveness, the most impactful policy lever is not expanding access to selective schools but strengthening the regular schools that serve the majority of students. Regular urban, rural, and small-scale schools collectively educate approximately 80 percent of graduates, so even modest quality improvements in these institutions would affect far more students than further investments in the selective sector.

The persistent disadvantages of rural and small-scale schools are a particular concern. Small-scale schools, which account for nearly half of all schools in Kazakhstan, face teacher shortages, multi-grade instruction, and geographic isolation. Hub/resource center schools represent a promising reform, but our results suggest their effects remain modest. Targeted investments in teacher quality and digital infrastructure for rural and small-scale schools should be a priority. Equal per-student financing with supplementary allocations for remote and low-density settings would help ensure that the quality of a student's education does not depend on the accident of where they were born.

Second, the strong associations between prior academic achievement indicators (honors diplomas, Altyn Belgi) and outcomes suggest that the school system creates cumulative advantages: students who perform well in secondary school gain access to selective institutions and subsequently achieve better post-secondary outcomes. Policies that support academic achievement in the early years of schooling, particularly in underserved communities, could help mitigate the sorting mechanisms that drive the observed school-type gaps.

***Limitations and Future Research***

Several limitations should be acknowledged. Our analysis is observational, and the estimated associations between school type and outcomes cannot be interpreted as causal effects. We lack detailed measures of family income, parental education, and other socioeconomic variables that would allow more precise control for selection. The NEET category is a residual that likely conflates genuine economic inactivity with unobserved pathways such as military service, international education, or informal employment not captured in administrative records.

Future research could exploit admission cutoffs at selective schools to estimate causal effects using regression discontinuity designs. Longitudinal studies tracking students from primary school through post-secondary education would illuminate how early sorting into different school types compounds over time. Finally, qualitative research on the mechanisms through which school type shapes post-secondary transitions, whether through academic preparation, peer networks, institutional reputation, or counseling, would complement the quantitative patterns documented here.

### *Conclusion*

This study has documented associations between 19 school types and educational outcomes for the full population of Kazakhstan's high school graduates from 2021 to 2023. The results reveal a highly stratified system in which school type is strongly correlated with both UNT performance and post-secondary destinations.

We emphasize that these findings are descriptive rather than causal. The large performance premiums associated with selective schools likely reflect student selection and family sorting at least as much as institutional effectiveness, consistent with the international evidence on elite schools (Abdulkadiroglu et al., 2014; Clark, 2010; Smith-Woolley et al., 2018) and the broader Coleman tradition attributing school-level differences primarily to student intake.

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# Geopolitical Risk and Chinese Investment Financing in Kazakhstan

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***Abstract***

This article examines how geopolitical tensions and Western secondary sanctions imposed since 2022 have restructured the financial architecture supporting Chinese investment in Kazakhstan. Drawing on the theoretical frameworks of weaponized interdependence and infrastructural geoeconomics, the study integrates qualitative analysis of policy documents and regulatory cases with quantitative evidence on banking de-risking, payment-system fragmentation, and yuan internationalization. Empirical findings show that, despite intensifying compliance pressures, Chinese investment has accelerated rather than retreated: Kazakhstan was the largest single recipient of Belt and Road Initiative investment in 2025 (USD 25.8 billion), while bilateral trade reached USD 43.8 billion in 2024. The architecture of that investment, however, has been recomposed. The yuan share of Kazakhstan-China trade settlement rose from approximately 4 per cent in 2022 to 12 per cent by mid-2024, with a Ministry of Trade target of 20 per cent by end-2025. Kazakhstan became the first Central Asian state with direct CIPS access; the Astana International Financial Centre hosted the region's first panda bond in April 2026; and the Sberbank Kazakhstan-Bereke Bank-Lesha Bank divestiture sequence demonstrates the operational logic of correspondent-banking de-risking. The study concludes that Kazakhstan exemplifies a strategy of infrastructural multi-alignment: parallel exposure to Western and Chinese financial systems engineered to preserve sovereign autonomy under conditions of accelerating geoeconomic fragmentation. The contribution extends the small-state literature on weaponized interdependence by showing that, at the periphery of the dollar system, agency operates recompositionally rather than substitutionally — through the layering of parallel infrastructures rather than the replacement of dominant ones.

***Keywords:*** geopolitical risk; secondary sanctions; banking de-risking; CIPS; yuan internationalization; Belt and Road Initiative; Kazakhstan; infrastructural geoeconomics.

## *Introduction*

The Russian invasion of Ukraine in February 2022, and the unprecedented Western sanctions regime that followed, have triggered a structural reconfiguration of cross-border finance in Eurasia. Kazakhstan, sharing a 7 591-kilometre land border with Russia and serving as China's principal Belt and Road Initiative (BRI) partner in Central Asia, occupies a uniquely exposed position. The country's banking system depends on dollar-denominated correspondent relationships for the settlement of hydrocarbon and uranium exports; its membership in the Eurasian Economic Union ties it to Russian payment infrastructure; and its accumulated stock of Chinese foreign direct investment, which the Eurasian Development Bank estimates at USD 11.4 billion across seventy-one active projects by mid-2025, is increasingly channelled through yuan-denominated instruments rather than through traditional dollar-clearing routes (Vinokurov et al., 2025).

These three gravitational fields — the dollar-centred Western financial order, the sanctioned Russian economic space, and China's expanding payment infrastructure — generate a policy dilemma codified in United States Executive Order 14114 of December 2023, which extends secondary sanctions extraterritorially to foreign financial institutions deemed to facilitate transactions with Russia's military-industrial base. For Kazakh banks maintaining correspondent relationships with Russian counterparties or with Chinese state-owned enterprises holding Russian equity stakes, the choice is binary: continued access to dollar clearing or continued business with sanctioned counterparties, but not both. The aim of this study is to identify how that dilemma has reshaped the channels, instruments, and institutional architecture of Chinese investment financing into Kazakhstan, and to characterise the adaptive strategies that have emerged from the Kazakh state, Chinese policy banks, and multilateral actors.

The article advances a central empirical claim: geopolitical risk has not deterred Chinese investment into Kazakhstan but has restructured its financing channels. Dollar-denominated correspondent banking, alt-

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hough still dominant, is being supplemented by yuan settlement infrastructure, Cross-Border Interbank Payment System (CIPS) connectivity, and resource-backed lending models. Kazakhstan's policy response — sanctions compliance framed as macroeconomic prudence rather than as foreign-policy alignment — has preserved access to both Western capital markets and Chinese investment simultaneously. Table 1 summarises the theoretical frameworks that organise the analysis.

Table 1. Theoretical frameworks organising the analysis.

| Framework | Core analytical claim | Application to Kazakhstan case |
|---|---|---|
| Weaponized interdependence (Farrell & Newman, 2019, 2023) | Hub states exploit asymmetric financial networks via panopticon (intelligence) and chokepoint (denial) effects. | OFAC enforcement and Executive Order 14114 operate as chokepoint mechanisms on Kazakh banks. |
| Infrastructural geoeconomics (Nölke, 2025; Petry, 2023) | Politicisation of dominant Western infrastructure triggers competing payment systems and reshapes structural power. | CIPS, mBridge, and AIFC panda issuance constitute parallel infrastructure layered onto existing dollar rails. |
| Banking de-risking (FATF, 2014; Rice et al., 2020) | Western banks terminate relationships to avoid rather than manage compliance risk, reducing trade-finance availability. | Sberbank Kazakhstan and Alfa-Bank Kazakhstan were divested in 2022; payment-rejection rates rise to about 30 per cent. |
| Multi-vector hedging (Cooley, 2012) | Small states balance relations across competing patrons to maximise autonomy. | Kazakhstan unbundles alignment across compliance, settlement, and capital-market dimensions — infrastructural multi-alignment. |

***Literature Review***

The intersection of geopolitical risk, sanctions enforcement, and cross-border investment finance has generated three influential bodies of recent scholarship that frame this study. The first concerns the structural dimensions of financial dominance. Farrell and Newman's account of weaponized interdependence (Farrell & Newman, 2019; Farrell & Newman, 2023) argues that hub states exploit asymmetric financial networks through panopticon effects (intelligence) and chokepoint effects (denial), with the dollar-centred correspondent-banking system and SWIFT as canonical examples. Their work has been extended by de Goede and Westermeier (de Goede & Westermeier, 2022), who show that contemporary geopolitical contestation operates increasingly through the politicisation of cross-border financial infrastructures rather than through tariffs or sovereign debt.

A second strand theorises the institutional response to such infrastructural politicisation. Nölke (2025) and Petry (2023) develop the concept of infrastructural geoeconomics to argue that the weaponisation of dominant Western payment systems has accelerated the construction of competing payment infrastructures, including CIPS, mBridge, and regional clearing platforms. This literature, however, remains concentrated on great-power dynamics; Central Asian small-state experiences remain markedly under-represented despite the region's structural exposure to both Russian and Chinese influence.

A third strand addresses the operational consequences for the banking system. Rice and colleagues' analysis of correspondent-banking retreat (Rice et al., 2020) documents how the number of correspondent banks fell by about 20 per cent between 2011 and 2018, with potential implications for access to cross-border payments and the broader global financial system. The Financial Action Task Force (Financial Action Task Force [FATF], 2014) distinguishes risk-based compliance from wholesale de-risking, while the International Monetary Fund (International Monetary Fund [IMF], 2025) tracks the macroeconomic transmission of such retreat into emerging markets. Unresolved in the existing literature is how small, multi-vector states such as Kazakhstan reconcile compliance with Western enforcement against continued integration with Chinese investment finance — the gap this study addresses.

***Materials and Methods***

This study employs a mixed-methods design combining theoretical synthesis with empirical analysis of secondary data covering February 2022 to April 2026. Three analytical strands are integrated. The structural strand examines how the dollar-centred SWIFT system and correspondent-banking networks shape investment-financing flows and create vulnerability to sanctions pressure (Farrell & Newman, 2023; Petry, 2023). The institutional strand analyses how banking regulations, compliance frameworks, and risk-management practices respond to geopolitical uncertainty (FATF, 2014). The strategic strand explores how state actors and multilateral institutions develop alternative infrastructures to mitigate sanctions exposure (Nölke, 2025; de Goede & Westermeier, 2022).

Empirical evidence is triangulated from four source categories: (i) official statistical publications including the Bureau of National Statistics of the Republic of Kazakhstan, the National Bank of Kazakhstan, the People's Bank of China RMB Internationalization Reports, the SWIFT RMB Tracker, the CIPS annual participant announcements, and the IMF Country Report No. 25/30 of 2025; (ii) regulatory and enforcement records from the Office of Foreign Assets Control SDN list, sanctions packages eleven through fifteen published in the Official Journal of the European Union, and Kazakhstan's Agency for Regulation and Development of the Financial Market; (iii) peer-reviewed academic literature in Review of International Political Economy, New Political Economy, International Studies Quarterly, Eurasian Geography and Economics, and Central Asian Survey; and (iv) transactional case evidence from regional news outlets, with corroboration sought across at least two sources for each material claim. Methodological caveats apply: CIPS does not publicly disclose Kazakhstan-specific transaction volumes, the People's Bank of China does not publish utilisation data on bilateral swap lines, and Kazakhstan does not report reserve composition to the IMF Currency Composition of Official Foreign Exchange Reserves.

***Results***

The empirical evidence converges on three interconnected transformations: contraction of Western correspondent banking and divestiture of Russian-owned banks; rapid scaling of yuan-denominated settlement infrastructure; and Kazakhstan's policy architecture for proactive sanctions compliance. Each is examined in turn before the discussion turns to theoretical implications.

**Banking de-risking and the divestiture cascade**

Banking de-risking — defined by the Financial Action Task Force as the termination or restriction of business relationships to avoid rather than manage compliance risk — has been the primary financial channel through which sanctions pressure has reached Kazakhstan since 2022 (FATF, 2014). Bank for International Settlements data indicate that the number of correspondent banks declined by 20 per cent between 2011 and 2018 (Rice et al., 2020). For an oil-exporting economy in which crude petroleum represented approximately 50.5 per cent of 2025 export revenue and uranium a further 5.3 per cent, severed correspondent relationships translate directly into reduced trade-finance availability and higher funding costs.

Table 2 details the operational sequence through which Western enforcement reached the Kazakh banking system. The Sberbank Kazakhstan-Bereke Bank-Lesha Bank case is paradigmatic: rapid Russian divestiture under enforcement pressure, followed by institutional rehabilitation, then ultimate sale to a Gulf-based Qatari acquirer at 39.8 per cent of book capital. The parallel Alfa-Bank Kazakhstan case follows the same logic. As of January 2025, VTB Bank Kazakhstan remained the only locally licensed SDN-listed financial institution in the country.

Table 2. Sanctions enforcement and Kazakh banking divestitures, 2022-2026

| Date | Event / Entity | Mechanism and outcome |
|---|---|---|
| 06 April 2022 | Sberbank SDN designation | OFAC adds Sberbank to SDN list. Kazakh subsidiary loses about 38 per cent of customer funds within one month. |
| 06 May 2022 | Alfa-Bank Kazakhstan sale | Bank CenterCredit acquires Alfa-Bank Kazakhstan for USD 111 million; SDN removal 14 July 2022. |
| 01-15 Sept 2022 | Bereke Bank rebrand | Baiterek National Holding acquires Sberbank Kazakhstan; tenge 130 billion dividend transfer; rebrand to Bereke Bank. |
| 21 Sept 2022 | Halyk Mir restrictions | Halyk Bank suspends Russian Mir card acceptance; subsequently followed by other Kazakh banks. |
| 23 Dec 2023 | Executive Order 14114 | US authorises secondary sanctions on foreign financial institutions facilitating Russia's military-industrial base. |
| Feb 2024 | Kazakh CEOs to Treasury | Deputy Treasury Secretary Adeyemo confirms Kazakh bank executives requested meetings to ensure dollar access. |
| Jul 2024 | Payment rejection rates | Documented payment-rejection rate of approximately 30 per cent for Russian-client transactions at Kazakh banks (Times of Central Asia, 2026). |
| 08 Oct 2024 | Lesha Bank acquisition | Qatar's Lesha Bank acquires Bereke Bank for about USD 135 million (39.8 per cent of book capital). |
| 17 Mar 2026 | EU envoy assessment | EU Sanctions Envoy O'Sullivan, on fifth Astana visit, characterises Kazakh bank compliance as 'very strong and very high'. |

Despite this compliance cascade, the Kazakh banking system has remained well capitalised. The capital adequacy ratio remained above 20 per cent throughout the 2019-2026 period, well above the Basel III mini-

mum; non-performing loans fell from 8.6 per cent in 2019 to 2.9 per cent in 2023; and deposit dollarization fell by approximately half, from 42.3 per cent in 2019 to 20.7 per cent in 2026 (IMF, 2025). These indicators support the interpretation that de-risking has been managed rather than systemic.

**CIPS, AIFC, and the recomposition of payment channels**

Parallel to the contraction of Western correspondent banking, yuan-denominated settlement infrastructure has scaled rapidly. CIPS annual transaction value rose nearly fourfold between 2020 and 2024, from RMB 45.27 trillion to RMB 175.49 trillion, with the strongest growth (42.6 per cent year on year) recorded in 2024. Cumulative throughput since the October 2015 launch reached approximately RMB 675 trillion (USD 94 trillion) by May 2025, with direct and indirect participation expanding from 195 institutions in 2015 to 1 766 across 122 countries by December 2025. Kazakhstan's interface with CIPS runs through three institutions: the Industrial and Commercial Bank of China Almaty branch, designated yuan settlement bank for the Kazakhstan Stock Exchange; the China Construction Bank Astana branch, AIFC yuan clearing bank; and Altyn Bank, a China CITIC subsidiary registered as CIPS indirect participant.

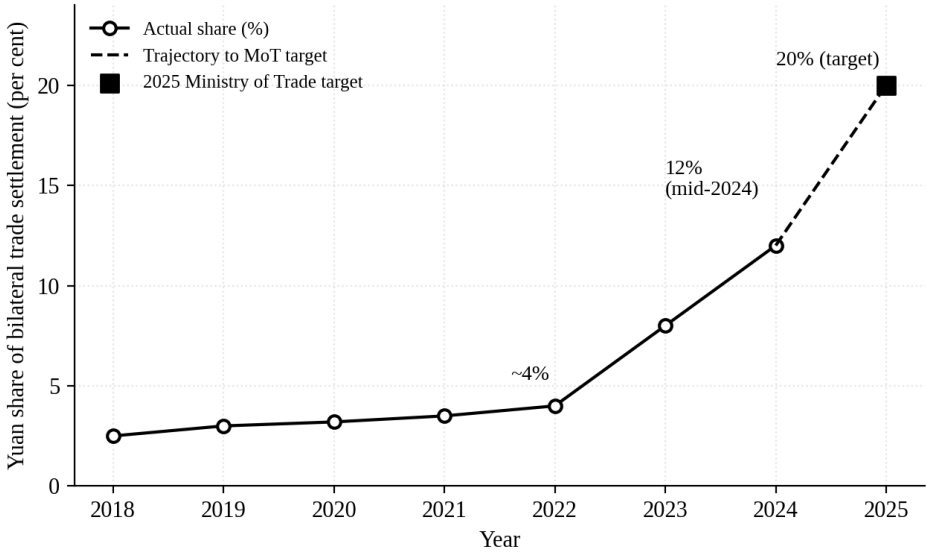



Figure 1. Yuan share of Kazakhstan-China bilateral trade settlement, 2018-2025.

*Note − author's construction based on data from (Omarova, 2025; SWIFT, 2025).*

The shift is most visible in trade settlement. Figure 1 traces the rise of the yuan share of Kazakhstan's bilateral trade with China from approximately 4 per cent in 2022 to a Ministry of Trade target of 20 per cent by end-2025 (Omarova, 2025). Bilateral trade reached USD 24.0 billion in 2022, USD 41.0 billion in 2023, and USD 43.8 billion in 2024 — already surpassing the USD 40 billion target set by President Tokayev for 2030 (Omarova, 2025).

Table 3 summarises the major Chinese policy-bank financing structures channelled through this evolving infrastructure. The architecture is no longer dominated by USD-denominated sovereign loans against oil collateral, as it was during the 2009 to 2014 period; the most recent flagship deals — the Samruk-Kazyna debut Panda Bond, the DBK-CDB facility, and the East Hope Group aluminium complex — mix yuan-denominated tranches, AIFC listings, and joint-venture equity. The Samruk-Kazyna issuance of 13 April 2026 priced at a record-low 2.18 per cent, with Bank of China, China International Capital Corporation, China Construction Bank, and Deutsche Bank China as bookrunners (Astana International Exchange [AIX], 2026).

Table 3. Major Chinese policy-bank financing in Kazakhstan, 2009-2026

| Year | Project | Lender | Amount (USD) | Currency / Structure |
|---|---|---|---|---|
| 2009 | Samruk-Kazyna oil-for-loan facility | CDB | 5.0 bn | USD; resource-backed |
| 2009 | MangistauMunaiGas acquisition support | EXIM-DBK | 5.0 bn | USD; LIBOR+3.5 % |
| 2011 | KAZ Minerals Aktogay copper | CDB | 1.5 bn | USD/RMB split tranches |
| 2017 | Shymkent Refinery Phase II | CDB | 0.6 bn | USD; LIBOR+2.7 % |

| | | | | |
|---|---|---|---|---|
| 2024 | KazMunayGas Dim Sum bond | AIX listing | 0.18 bn | CNY 1.25 bn at 2.95 % |
| 2025 | East Hope Green Aluminum complex | Multi-source | 12.0 bn | Resource-backed; mixed |
| 2025 | DBK-CDB General Agreement | CDB-DBK | 1.0 bn | USD or CNY drawable |
| 2026 | Samruk-Kazyna debut Panda Bond | AIX listing | 0.42 bn | CNY 3 bn at 2.18 % (3y) |

The Cross-Border Interbank Payment System nonetheless remains a partial rather than total alternative to SWIFT. SWIFT RMB Tracker data indicate that the yuan accounted for 3.79 per cent of global payments in January 2025, ranking fourth behind the dollar (50.17 per cent), the euro (21.98 per cent), and the British pound (6.91 per cent) (SWIFT, 2025). The mBridge platform, developed by the central banks of China, Hong Kong, Thailand, and the United Arab Emirates with the BIS Innovation Hub, processed transactions worth more than USD 22 million in its 2022 pilot and reached minimum viable product stage in June 2024 with the addition of the Saudi Central Bank (Bank for International Settlements [BIS], 2024). By November 2025, cumulative transaction volume had reached approximately USD 55.49 billion across 4,047 transactions (Chhangani, 2026). Kazakhstan participates only as an observer through its digital tenge programme.

**Kazakhstan's compliance architecture and policy responses**

Kazakhstan's response to this dual pressure has been to operationalise compliance as macroeconomic risk management rather than as foreign-policy alignment. Subsequent measures included the Law on Control of Specific Goods of 1 March 2023, an online re-export tracking system from 1 April 2023, restrictions on Russian Mir card acceptance from 21 September 2022, and tightened account-opening requirements at Halyk, ForteBank, Kaspi, and Jusan banks (Times of Central Asia, 2026). The European Union Special Envoy for Sanctions Implementation, David O'Sullivan, visited Astana five times between April 2023 and March 2026, characterising compliance by Kazakh banks during his final visit as 'very strong and very high'.

Quantitative evidence on transit reinforces both exposure and compliance response. Kazakh exports of electronics and mobile phones to Russia rose from USD 30.7 million in 2021 to USD 575.1 million in the first ten months of 2022, while microchip exports rose from USD 245 000 in 2021 to USD 18 million in 2022 — more than seventy-fold. United States Ambassador Daniel Rosenblum stated in January 2025 that sanctioned dual-use products constituted less than two per cent of Kazakhstan's total exports to Russia. OFAC had nonetheless designated at least eight Kazakh entities by September 2024, including Elem Group LLP and Da Group 22 LLP. Council of the European Union sanctions packages thirteen, fourteen, and fifteen named further Kazakh entities including Sber Vostok LLP, Defence Engineering LLP, and Tynys JSC (Times of Central Asia, 2026).

Macroeconomic stability has been preserved. According to the IMF, gross domestic product grew by 4.3 per cent in 2021, 3.2 per cent in 2022, 5.1 per cent in 2023, and an estimated 4.8 to 5.0 per cent in 2024, with 2025 estimates of 6.3 to 6.5 per cent (IMF, 2025). National Bank gross reserves rose to approximately USD 62.1 billion by November 2025; the National Fund of Kazakhstan held approximately USD 63.6 billion. Standard and Poor's revised the outlook on its BBB- rating to Positive in August 2025; Moody's upgraded Kazakhstan to Baa1 in September 2024; and the country placed a USD 1.5 billion five-year Eurobond at 4.412 per cent in October 2025, a record-low yield over the United States Treasury benchmark, with an order book of USD 4.4 billion. Investment-grade ratings from all three major agencies have been maintained throughout the period.

**Infrastructural multi-alignment as middle-power strategy**

The Kazakh case complicates established theoretical accounts of how small states respond to weaponized interdependence. The chokepoint mechanism articulated by Farrell and Newman (2023) operates here precisely because Astana permits it to operate. The high payment-rejection rate at Kazakh banks, the voluntary suspension of Mir services, the Bereke divestiture, and the December 2025 export-control tightening are not signs of failed sovereignty but of strategic compliance designed to preserve dollar access. Yet that same compliance creates the operational space for the parallel CIPS architecture, AIFC panda bond market, and DBK-CDB yuan facility documented above. Kazakhstan does not choose between Western and Chinese financial systems; it operationalises parallel exposure to both.

This pattern is consistent with the conceptual frame of infrastructural geoeconomics developed by Nölke (2025) and Petry (2023), who argue that the politicisation of dominant Western financial infrastructure

has triggered the development of competing payment infrastructures. Kazakhstan's experience suggests a refinement: at the periphery of the dollar system, infrastructural geoeconomics operates not by replacing the dollar but by layering parallel rails that small states can selectively deploy. The mode of agency is recompositional rather than substitutional. The label proposed here is infrastructural multi-alignment: a configuration in which a state wires itself into competing financial systems precisely so that no single chokepoint can be decisive. Three boundary conditions limit generalisability: absence of direct conflict between Western compliance demands and Chinese investment requirements; institutional capacity in compliance, financial supervision, and special-jurisdiction infrastructure; and oil rents underwriting policy autonomy. Table 4 places Kazakhstan in comparative regional context.

Table 4. Comparative Central Asian sanctions navigation strategies

| Country | China debt / GDP | OFAC designations | Yuan / CIPS access | Strategy classification |
|---|---|---|---|---|
| Kazakhstan | ~5.7 % | 8+ entities | Direct CIPS; AIFC panda bonds | Infrastructural multi-alignment |
| Kyrgyzstan | ~40 % | Keremet Bank (2025); others | Indirect CIPS only | Asymmetric dependence |
| Tajikistan | ~50 % | Limited | Limited yuan exposure | Asset-transfer dependence |
| Uzbekistan | ~25 % | Promcomplektlogistic (2022); Datavice (2024) | Indirect CIPS | Cautious diversification |
| Turkmenistan | Opaque | None public | Limited | Single-buyer dependence (gas) |

Comparison with regional peers reinforces these boundary conditions. Kyrgyzstan, where Chinese debt represents approximately forty per cent of gross domestic product and where Keremet Bank was sanctioned by OFAC on 15 January 2025, has not built a comparable compliance architecture. Tajikistan's debt-to-China ratio of approximately fifty per cent of GDP, much of it reportedly settled through asset transfers including the 2011 cession of 1 158 square kilometres of Pamir territory, illustrates an alternative pattern of asymmetric dependence rather than infrastructural multi-alignment. The Kazakh configuration is therefore unusual rather than typical. Theoretically, the case suggests that the geopolitics of finance now operates not at the level of currencies but at the level of infrastructures: the yuan's share of global SWIFT payments has remained in a narrow 3 to 5 per cent band since 2022 despite extensive policy effort, yet the institutional architecture (CIPS direct participation, AIFC panda issuance, the digital tenge, the Middle Corridor as logistical bypass) has been transformed. The relevant unit of analysis for understanding fragmentation is the payment system, not the currency. This finding aligns with arguments by de Goede and Westermeier (de Goede & Westermeier, 2022) but extends their scope to a Central Asian case under-represented in the literature on geoeconomic fragmentation.

***Conclusion***

The geopolitical and sanctions environment since February 2022 has not deterred Chinese investment financing into Kazakhstan; it has restructured its architecture. The principal empirical finding is that Kazakhstan has operationalised parallel exposure to both Western and Chinese financial systems. Kazakhstan was the largest single recipient of BRI investment in 2025 at USD 25.8 billion; bilateral trade with China reached USD 43.8 billion; the country became the first in Central Asia with direct CIPS access; and the AIFC hosted the region's first panda bond in April 2026 at a record-low yield of 2.18 per cent. Simultaneously, Kazakhstan maintained investment-grade sovereign ratings from all three major agencies, divested itself of two major Russian-owned bank subsidiaries under OFAC pressure, and built a compliance architecture sufficient to satisfy the European Union Special Envoy by 2026. This configuration is best understood as infrastructural multi-alignment: a strategic posture in which a state wires itself into competing financial systems precisely to ensure that no single chokepoint can be decisive.

Several research priorities follow. First, granular monitoring of CIPS Kazakhstan-corridor flows is essential and currently impossible from public data. Second, comparative analysis with Turkiye, the United Arab Emirates, and Georgia would test the boundary conditions of infrastructural multi-alignment. Third, scenario analysis of OFAC designation of major Chinese state-owned enterprises with Russian equity stakes would clarify the conditions under which the strategy unravels. Policy implications follow: for Kazakhstan, the dual-track approach is the strategic optimum but requires active management; for Chinese investors,

structuring resource-backed financing in yuan via CIPS reduces compliance exposure for Kazakh project partners; and for Western governments, applying secondary sanctions with jurisdictional precision avoids triggering the very correspondent-banking de-risking that accelerates yuan integration. The Kazakh experience suggests that the financial geography of the next decade will be defined not by which currency dominates but by which infrastructures interconnect, and on what terms.

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