Yevhenii Shymchenko

METHODOLOGY OF ADAPTIVE PRICING IN INTERNATIONAL LOGISTICS: An Algorithm for Incorporating Geopolitical Risks and Adjusting Tariffs

Kyiv
Internauka Publishing House
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ABSTRACT

The methodology presents an algorithm for adaptive pricing in international logistics, designed to systematically quantify geopolitical risks and integrate them into carriers' tariff policies. The study substantiates its objective, namely, the development of a reproducible, transparent, and responsive pricing instrument that enables a logistics operator to shift from reactive to proactive management of price risks. The relevance of the research is determined by the transition of global logistics from the Just-in-Time paradigm to a supply-chain resilience paradigm amid escalating geopolitical turbulence; the text adduces empirical evidence of this transformation. The scientific novelty lies in formalizing previously intuitive practices of pricing-risk management into a concrete, mathematically tractable model and algorithm. The main conclusions demonstrate that: (1) a data-driven, systematic approach to classifying and quantifying geopolitical risks ensures more precise and timely tariff corrections; (2) a formula and algorithm employing K_{gr} preserve transport profitability amid high volatility, shielding the operator from both explicit and latent costs; (3) a transparent communication protocol and a fine-grained tariff structure enhance invoice accuracy and client trust; (4) implementation of a KPI system (financial, operational, and client metrics) enables controlled evaluation of effectiveness and prevents one-sided optimization to the detriment of a long-term client base. A case involving the rerouting of vessels around the Cape of Good Hope demonstrates practical applicability. The methodology is intended for pricing analysts, logistics managers, commercial directors, and leaders of NVOCCs and other logistics operators responsible for tariff policy and risk management.

Keywords: adaptive pricing, geopolitical risk, international logistics, risk monitoring, communication transparency

INTRODUCTION

Contemporary global logistics operates under unprecedented turbulence precipitated by escalating geopolitical tensions. The era defined by maximal efficiency and cost minimization through just-in-time strategies has yielded to a paradigm in which supply-chain resilience occupies a central position (Risk Ledger, 2025). Statistical evidence corroborates the systemic character of this transformation. The Geopolitical Risk with Trade index (GPRT) rose by approximately 30% between 2020 and 2024, compared with the preceding two decades. In contrast, the Global Supply Chain Pressure Index (GSCPI) nearly tripled over the same period (Teophilo, 2024). This suggests that geopolitical risks have lost their nature of rare force majeure exceptions and have become one of the operational variables with the most direct and unpredictable impact on the cost and timing of international transport.

Nevertheless, while popular and supposedly important, there are few tools available to logistics players, especially NVOCCs, to cope with and hedge against the impacts of geopolitical uncertainty. Risk management literature focuses on financial risks. It focuses on regulatory risks. It focuses on operational risks in particular. Risks from complex international geopolitics exist. These risks are often multi-dimensional. Examples include trade wars and regional conflicts. Discussion of these risks is seldom (Risk Ledger, 2025). NVOCC operators often play a passive role, simply passing on to clients the surcharges imposed by VOCCs. This lack of proactivity may result in tariff lag, margin erosion, and issues with customer confidence. Unexplained fluctuations in shipping costs and prices are frequent and often highly opaque, making them difficult to justify. The core problem, therefore, lies in the disjunction between the velocity and complexity of geopolitical change and the absence of a reproducible, scientifically grounded methodology for its timely quantification and integration into pricing policy.

The objective of this study is to develop and substantiate a methodology of adaptive pricing in international logistics that systematically accounts for geopolitical risks and proactively adjusts tariffs.

To achieve this objective, the following tasks were defined:

1. Systematize and classify key geopolitical risks affecting international transport and analyze the mechanisms by which they transform into specific logistics costs.

2. Develop a step-by-step algorithm for identifying and assessing the qualitative and quantitative geopolitical risk for a given transport route.

3. Formulate a mathematical model of tariff adjustment that integrates the base cost, direct carrier surcharges, and an authorial risk-oriented premium.

4. Propose a standardized client-communication protocol to justify tariff changes while maintaining client loyalty.

5. Develop a system of key performance indicators (KPIs) to evaluate the practical effectiveness of the proposed methodology.

The scientific novelty of the research lies in formalizing intuitive, often situational, risk-pricing practices into a precise, reproducible financial logistics instrument. In contrast to existing approaches that simply pass through external costs, the proposed methodology enables a logistics operator to shift from a passive reaction to proactive price management. The core of the method is the authorial model for calculating a Geopolitical Risk Coefficient, an integral indicator that quantifies qualitative risks (conflict intensity, sanctions pressure, route vulnerability) alongside market data. Using this coefficient as a multiplier of the base rate, rather than merely summing direct surcharges, creates a buffer to cover not only explicit but also indirect costs associated with uncertainty, thereby protecting business profitability during periods of high volatility.

CHAPTER 1. CLASSIFICATION AND ANALYSIS OF THE IMPACT OF GEOPOLITICAL RISKS ON LOGISTICS COSTS

The shift from a world of stable globalization to one of geopolitical ruptures has changed the nature of supply chain management worldwide. Geopolitical risks that were previously seen as exogenous to the supply chain are now endogenous due to their structural effects on costs and profits. Effective pricing management in such an environment requires a broad understanding of the nature of the risks involved, as well as exactly how they convert into costs. The contemporary logistics paradigm is shifting from optimization by cost-and-time criteria (Just-in-Time) toward the construction of antifragile systems capable of adapting to shocks (Althaqafi, 2025). This shift necessitates a systematic approach to risk classification and an analysis of its cascading impact on costs.

1.1. Map of Geopolitical Risks in Logistics

To systematize the analysis of geopolitical threats, risks must be classified by nature and source. Drawing on academic studies and industry practice, several key categories can be distinguished that exert the most significant influence on international maritime logistics, as shown in Figure 1 (Soman & Balasubramanian, 2025).

The first group is related to armed conflicts and internal political instability. It includes interstate wars, such as the crisis preceding the Black Sea port blockade (Soman & Balasubramanian, 2025), and regional security crises involving non-state actors, such as the crisis in the Red Sea (Dawar & Bai, 2024). These include terrorism threatening, piracy occurring in the Gulf of

Aden, and transit countries being politically unstable, including civil unrest, coups, and revolutions that can paralyze port infrastructure (Althaqafi, 2025).

The Ukrainian conflict in 2022 provides a particularly illustrative example of how such shocks reconfigure logistics. Following the closure and blockade of Ukraine's deep-sea Black Sea ports, containerized import and export flows were rapidly diverted to ports in Poland, the Baltic States, Romania, and Bulgaria, with inland legs covered by emergency rail and truck services whose prices surged amid capacity shortages and market adjustment. Reports by the European Parliament and international transport bodies note that rerouting Ukrainian exports via neighbouring EU ports and overland "solidarity lanes" added on the order of USD150 or more per tonne for some bulk cargoes compared with pre-war maritime routes, with comparable step increases in container logistics costs ultimately passed on to final consumers (European Parliament, 2022; ITF, 2022). In parallel, Ukraine accelerated the use and upgrading of Danube river ports such as Izmail and Reni and

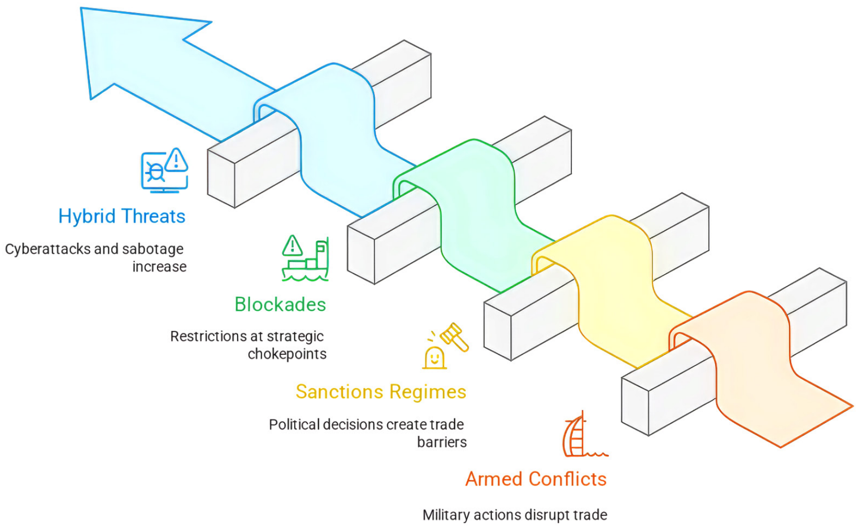

Figure 1. Global Maritime Trade Disruption

established new intermodal chains, including feeder services between Chornomorsk and Constanța and dedicated block trains from the Odesa region and western Ukrainian rail hubs to Polish and Romanian ports, developed jointly by major carriers (e.g., Maersk) and large freight forwarders (Maersk, n.d.). Although grain exports later partially resumed directly from Ukraine under the Black Sea Grain Initiative and subsequent protected corridors, the bulk of containerized Ukrainian trade continues to be routed via foreign gateways, with Romania's Constanța and Poland's Gdańsk emerging as primary hubs for these flows and significantly reshaping cost structures along the entire supply chain (European Council, 2023).

The second type of risk is related to trade policy, such as sanctions regimes and trade wars, for it is associated with tariffs, trade duties, embargoes, and export controls. For example, in the trade war between the US and China, transportation costs increased and the supply chains needed to be restructured (Grossman & Helpman, 2024). Sanctions against certain nations and companies, including their ships, can hamper transportation in the sector and also risk compliance and legality (Teophilo, 2024).

The third type restricts ship movement through straits and canals, such as the Suez Canal, the Panama Canal, the Strait of Hormuz, and the Strait of Malacca. Sometimes this type of blockade is threatened for political reasons. An example is the closure of straits to protect territorial claims in the South China Sea. Physical blockades have occurred. An example is the 2021 blockage of the Suez Canal by the MV Ever Given (Soman & Balasubramanian, 2025). In addition, port closures due to technogenic disasters (the Beirut explosion) and infrastructure collapse (the Baltimore bridge collapse).

The fourth category is hybrid threats. With logistics' accelerating digitalization, vulnerability to cyberattacks on port operating systems, vessel navigation equipment, and carriers' databases is increasing (Teophilo, 2024). Such attacks can cause extensive disruptions, leakage of confidential information, and financial losses, as evidenced by Maersk's experience (Strategic Risk Global, 2018). Deliberate sabotage of infrastructure is likewise a material threat that traditional risk-management models often underestimate.

1.2. Anatomy of Additional Costs

Geopolitical events trigger a complex, cascading mechanism of cost formation that extends far beyond a single direct surcharge, as depicted in Figure 2. An initiating incident, such as a route

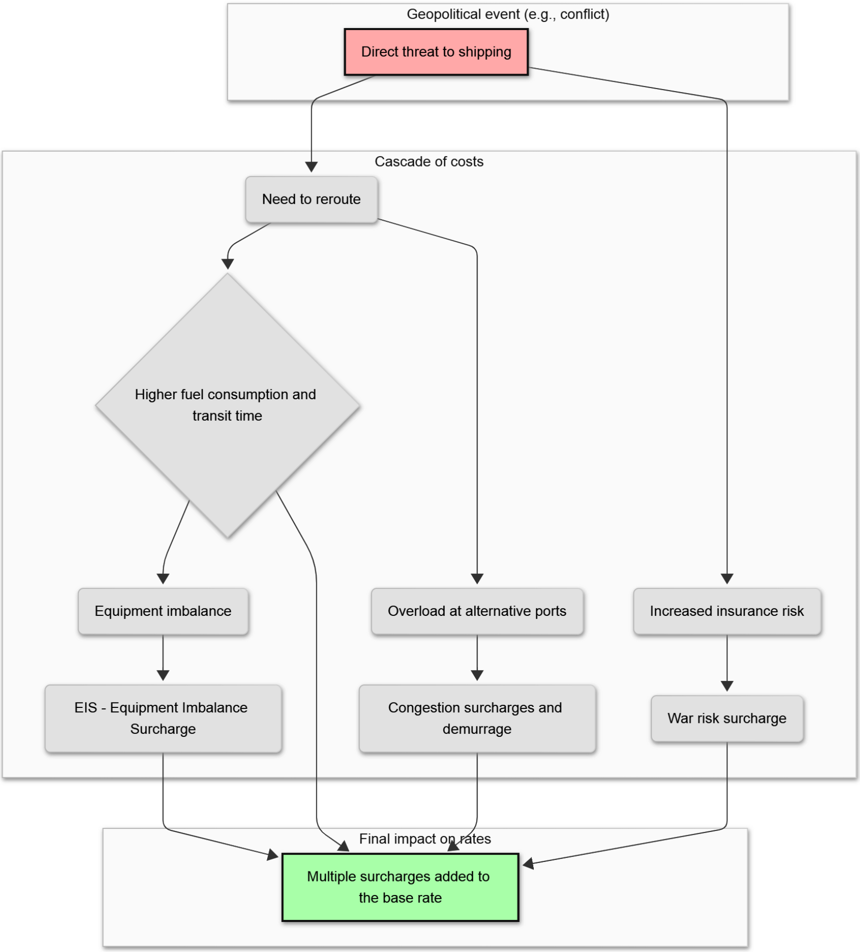

Figure 2. Diagram of the cascading effect of geopolitical risks on logistics costs

blockade or conflict escalation, induces a chain reaction that affects multiple expense lines. Understanding this interdependence is crucial for accurate pricing.

The primary and most direct financial consequence is the increase in insurance premiums. When a vessel transits a zone designated hazardous by insurers (Listed Area), the shipowner must purchase additional war-risk coverage. This leads to the imposition of a War Risk Surcharge. Its basis is an Additional Premium (AP), calculated as a percentage of the agreed hull value, based on the specified period spent in the hazardous zone. This surcharge is passed directly to the charterer.

A second significant factor is fuel cost escalation and route alteration. The need to circumvent hazardous areas, such as rerouting vessels from the Suez Canal to the Cape of Good Hope route during the Red Sea crisis, directly extends voyage length by thousands of nautical miles. This results in a substantial increase in fuel consumption and a 10–14-day increase in transit time (Hamed, 2025). These costs are recouped through adjustments to the Bunker Adjustment Factor (BAF) or via emergency fuel surcharges. BAF and ad hoc fuel surcharges are among many mechanisms to recover additional costs. An additional Emergency Bunker Surcharge (EBS) may be applied if bunker prices rise sharply. At the same time, a Bunker Recovery Charge (BRC) may be used to recover regular costs incurred by carriers. A General Rate Increase (GRI) can be established for a trade lane and a Panama Canal Surcharge (PCS) can be assessed to address increased costs due to canal transit during this period of restricted capacity. A Congestion Surcharge (CGS) may apply if ports in the newly routed lane become congested. An Emergency Risk Surcharge (ERS), a generic temporary surcharge intended to quantify increased regional uncertainty not reflected in more specific fuel or congestion surcharges, may also be applied during periods of heightened geopolitical or macroeconomic uncertainty.

The third component comprises carriers' direct surcharges introduced to offset operational complexities. Sometimes, port facilities may become congested when cargo is rerouted in large volumes to alternative ports. In such cases, a Port Congestion Surcharge may be applied. An Equipment Imbalance Surcharge (EIS) is charged when container handling is disrupted and excess empty containers are located at some ports but not others. A Peak Season Surcharge (PSS) may be applied when demand from disruption increases dramatically.

Other cost items that apply only in the event of geopolitical risk include armed guards on board, convoy services, and

Table 1

Classification of geopolitical risks and their direct impact on the elements of logistics costs

Type of geopolitical risk	Mechanism of impact on logistics	Direct financial consequence (cost item)
Military conflicts and piracy	Direct threat to the vessel, cargo, and crew	War Risk Surcharge; higher base insurance premiums; costs for armed security; crew hazard/bonus payments
Political instability	Port closures, strikes, and disruption of landside logistics	Port Congestion Surcharge; demurrage and storage; costs to reroute to alternative ports
Sanctions regimes	Restrictions on port calls, arrest/seizure of ships or cargo, bans on transporting specific goods	Legal/compliance review costs; fines; losses from delays or confiscation of cargo
Trade wars	Imposition of import/export tariffs	Increased customs duties; need to reroute or restructure supply chains for customs clearance in third countries
Blockades (chokepoints)	Need to use alternative, longer routes	Higher fuel consumption (BAF); increased transit time; Equipment Imbalance Surcharge (EIS)
Cyberattacks	Disruption of port operating systems, data loss, impaired navigation	Direct financial losses; system recovery and cybersecurity costs; penalties for missed delivery windows

increased crew bonuses when passing through areas affected by geopolitical risk (see Table 1). Therefore, when assessing the effect of geopolitical risk, all cost items must be considered, not just a single super-surcharge.

Table 1 illustrates that geopolitical risks, armed conflicts and piracy, political instability and regime changes, sanctions, trade wars and embargoes, blockades at planned straits, low-intensity conflicts, cyberattacks, through limited operational mechanisms (port closures, route diversions, cargo confiscations, tariffs, cyber-intrusions, damage to and destruction of goods) can induce costs (higher insurance premiums and surcharges, increased fuel costs, demurrage, legal and recovery costs) that add to the system exposure and, hence, the cost of the maritime logistics chain.

1.3. Monitoring System

To identify and assess risks early, a two-tier monitoring system was proposed, utilizing operational information and authoritative planned information.

The level 1: operational (tactical) information will often be based on alerts from VOCC partners themselves. In practice, ocean carriers operating in high-risk waters diffuse warnings and changes to routes or surcharges beforehand, often to their customers, but sometimes as open source information to the general public. Such alerts might contain instructions for cargo rerouting, port call cancellations, and new fees. This channel is the most valuable for rapid tactical decisions.

Level 2: Strategic monitoring. This level serves to verify, contextualize, and deepen analysis of information received from VOCCs, as well as to track global conditions independently. It should rely on authoritative industry and international sources, as outlined below.

- IMO. These include the International Ship and Port Facility Security Code (ISPS Code), recommended and circularized by the International Maritime Organization (IMO), which prescribes three security levels which may be uniform for a port or ship (Security Level 1, Security Level 2 and Security Level 3) or which governments may designate for a ship or port in response to an increased level of risk (IMO, n.d.).

- BIMCO (Baltic and International Maritime Council). BIMCO develops standard charter parties and clauses, such as CONWARTIME, that govern the allocation of war risks and costs between shipowner and charterer. Analysis of these documents and BIMCO publications provides practical instruments for legal and financial risk management (BIMCO, 2025).
- Marine insurers and P&I clubs (e.g. the members of the Joint War Committee) issue regularly updated lists of Listed Areas where risk is heightened. A region can also be added to this list, allowing for an additional war-risk premium (AP) to be charged under certain conditions.
- Freight-rate indices. Industry indices on freight rates such as the Drewry World Container Index (WCI) or the Freightos Baltic Index (FBX) may help to update in real-time how markets react to geopolitical developments amid the overall volatility on major container trade routes.

The advantage of merged NVOCC and VOCC levels is that an NVOCC operator can independently evaluate the risk and basis for active pricing, without having to respond to instructions from the VOCC.

CHAPTER 2. AUTHORIAL ALGORITHM OF ADAPTIVE PRICING

The proposed algorithm is a four-step sequence designed to systematize pricing processes under conditions of geopolitical instability. It entwines qualitative analysis, quantitative assessment, formulaic modeling, and a communication strategy, as illustrated in Figure 3.

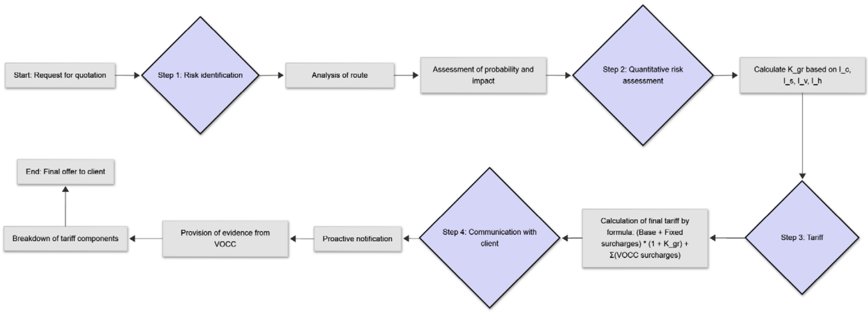

Figure 3. Step-by-step diagram of the adaptive pricing algorithm

A defining feature of the algorithm is the synthesis of a reactive posture (incorporation of direct surcharges from VOCC) with a proactive component, the calculation of a proprietary Geopolitical Risk Coefficient that shields margins from non-obvious and indirect costs. This hybridized approach enables the construction of a more resilient and adaptive pricing model.

2.1. Step 1: Identification and Assessment of Risk for a Specific Route

The first step entails a structured qualitative analysis of risks inherent to a given route. For this purpose, the Probability–Impact Matrix is proposed, a standard risk management instrument. The procedure is as follows: for each material segment of the route (e.g., passage through a particular strait, a call at a port in an unstable region), the analyst evaluates two parameters: the

Table 2

Scale for qualitative assessment of the probability and impact of risks on the route

Level	Probability	Probability, description	Impact	Impact, description
5	Almost certain	The event is expected to occur in most circumstances.	Catastrophic	Total loss of cargo, inability to complete the voyage, threat to vessel and crew safety, and long-term route closure.
4	Likely	The event is likely to occur.	Significant	Severe delays (more than 2 weeks), substantial cost increase (>50%), need for transshipment, risk of cargo damage.
3	Possible	The event may occur at some point.	Moderate	Noticeable delays (up to 2 weeks), moderate cost increase (15–50%), and need for minor route adjustments.
2	Unlikely	The event could occur only in exceptional circumstances.	Minimal	Minor delays (a few days), slight cost increase (up to 15%).
1	Rare	The event is highly unlikely.	Negligible	Minimal operational inconvenience with no material effect on cost or schedule.

probability of a geopolitical incident and the prospective magnitude of its impact on the carriage.

To ensure consistency and objectivity of judgments, standardized qualitative scales must be used (see Table 2). These scales establish a common lexicon for risk analysts and lay the groundwork for the subsequent transition to quantitative metrics.

The outcome of this step is a risk profile for the route in which each potential risk is assigned coordinates in the Probability–Impact Matrix. Risks falling into the red and orange zones (high probability and/or high impact) require further quantitative appraisal and must be incorporated into the tariff.

2.2. Step 2: Model for Quantitative Risk Assessment (Digitization)

This stage forms the methodological core and is aimed at transmuting qualitative judgments into a unified quantitative indicator, the route's Geopolitical Risk Coefficient K_{gr}. This coefficient does not replace direct surcharges from VOCC; rather, it serves to evaluate systemic, non-quantified risk and to create a buffer that safeguards margins. The K_{gr} model rests on a weighted sum of four normalized indicators, thereby enabling a synoptic appraisal of disparate threat facets.

The formula for calculating the coefficient takes the following form:

$$K_{gr} = w_1 I_c + w_2 I_s + w_3 I_v + w_4 I_h$$

where:

I_c (Intensity of Conflict) — Index of conflict/threat intensity in the region.

I_s (Sanctions) — Index of sanctions pressure on the route.

I_v (Vulnerability) — Index of route vulnerability (transit through critical chokepoints).

I_h (Historical Volatility) — Index of historical rate volatility on the route.

Table 3.

Parameters and weighting factors for the calculation of K_{gr}

Parameter	Description & assessment methodology	Data source	Weight (w_n)	Weight justification
I_c	Assesses the level of direct threat. Normalized on the scale: 0 (peaceful region), 0.25 (elevated tension), 0.5 (local incidents/piracy), 0.75 (risk of hostilities), 1 (active combat zone).	IMO security levels (ISPS), insurers' Listed Areas lists, and VOCC reports.	0.40	The highest weight is due to direct security threats, which most immediately affect the cost and feasibility of carriage.
I_s	Assesses the impact of trade restrictions/sanctions. Normalized: 0 (no sanctions), 0.25 (tariffs on specific goods), 0.5 (sectoral sanctions), 0.75 (sanctions targeting key ports/companies), 1 (full embargo).	Official government sources (OFAC, EU), VOCC advisories.	0.20	Significant factor: may not produce immediate loading surcharges, but creates operational and legal risk and disrupts cargo flows.
I_v	Assesses the route's physical vulnerability. Normalized according to the number and criticality of traversed chokepoints. Example scale: 0 (open ocean), 0.5 (one non-critical strait), 1 (transit via Strait of Hormuz or Bab-el-Mandeb during heightened tension).	Nautical charts, analytical reports on maritime corridors.	0.10	Lower weight because vulnerability alone does not create cost; it acts as a multiplier for other risks (I_c, I_s).

I_h	Assesses market reaction to risk historically. Calculated as a normalized coefficient of variation of spot rates on the same or comparable route over the past 6–12 months.	Market index data (Drewry WCI, FBX).	0.30	High weight because it captures the market's realized valuation of aggregated risk and uncertainty, an objective financial indicator.

w_n — weighting coefficients determined by expert judgment, with the condition that

$$\sum w_n = 1 .$$

Each indicator is evaluated on a 0–1 scale, where 0 denotes the absence of risk and 1 denotes the maximum level of risk. Table 3 presents the parameters and weights for the calculation.

Application of this formula yields an objective, data-grounded coefficient that reflects the aggregate level of geopolitical risk for a specific shipment.

2.3. Step 3: Tariff Adjustment Formula

At this step, the calculated Geopolitical Risk Coefficient K_{gr} and carriers' direct surcharges are integrated into the final tariff rate. The proposed formula is hybrid: it incorporates a proactive risk premium (via the K_{gr}, multiplier) and a reactive component (VOCC direct surcharges). This approach accords with the canons of dynamic pricing, which presuppose flexible price corrections in response to evolving market conditions, costs, and exogenous factors in real time.

The final tariff formula is as follows:

$$Final\,Tariff = \left(Base\,Rt\right) \times \left(1 + K_{gr}\right) + Fixed\,Surchrgs + \sum Surchrgs_{VOCC},$$

where

$Base\,Rt$ (Base Rate), the basic freight cost for a container on the given route, excluding surcharges.

$Fixed\,Surchrgs$ (Fixed Surcharges), standard, relatively stable fees such as Terminal Handling Charges (THC) and the standard Bunker Adjustment Factor (BAF).

$\left(1+K_{gr}\right)$ — the risk multiplier. This component increases the base price by the magnitude of systemic geopolitical risk. It establishes a margin buffer to cover indirect costs, such as potential increases in operating expenditures, delay risks, and generalized uncertainty not covered by VOCC direct surcharges.

$\sum Surchrgs_{VOCC}$, the sum of all direct, document-supported surcharges announced by the ocean carrier. These include War Risk Surcharge, Emergency Risk Surcharge, Port Congestion Surcharge, and others. These costs are passed through to the client directly, without additional markup, since they constitute a transit payment.

This tariff structure allows, on the one hand, transparent transmission to the client of objective external costs (VOCC surcharges) and, on the other, systematic and reasoned protection of proprietary profitability against less obvious risks through application of the K_{gr} coefficient.

2.4. Step 4: Client Communication Protocol

The effectiveness of adaptive pricing depends not only on computational accuracy but also on the capacity to convey its rationale to the client. Transparent and timely communication is an integral part of the pricing mechanism, preserving trust and long-term relationships. Based on an analysis of B2B best practices and the provided inputs, the following stepwise protocol is developed, as shown in Figure 4.

1. Proactive notification. Upon receiving information about the emergence or escalation of geopolitical risk on the client's route,

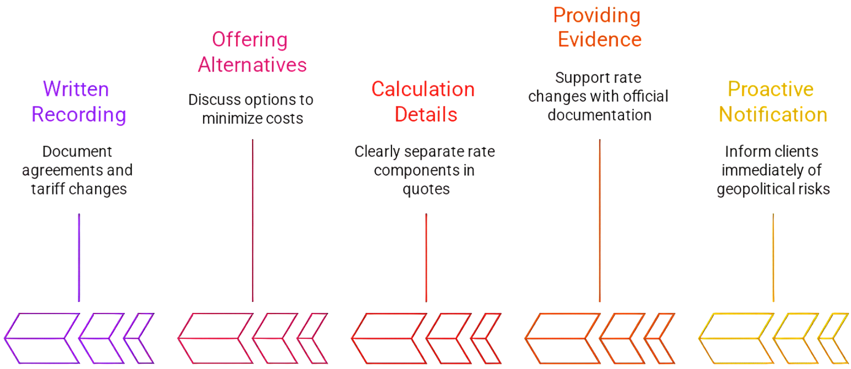

Figure 4. Client communication protocol

immediate notification must be provided, even if exact financial implications are not yet known. This signals diligence and allows the client to prepare for potential changes.

2. Provision of evidence. Official documents must accompany any tariff change related to geopolitical surcharges. These may include a copy of a VOCC notice, a reference to an IMO circular, a publication by an insurance committee, or a report by an authoritative news agency. Objective external corroboration reframes the dialogue from 'you are raising the price' to 'we are jointly responding to altered market conditions'.

3. Calculation breakdown. The new pricing proposal must clearly separate tariff components, as stipulated by the formula in Step 3. The client should see the base rate, fixed surcharges, the magnitude of the risk multiplier (if applied), and the exact sum of direct VOCC surcharges. Such transparency precludes suspicions of hidden markups.

4. Offering alternatives. In any case, all agreements and final tariff amounts are to be confirmed in writing (at least by e-mail) and, if possible, included in an addendum to the contract itself.

5. Written record. All agreements and final tariff changes must be recorded in writing, preferably by email, and, where

necessary, formalized as an addendum to the contract. This ensures legal clarity and prevents future misunderstandings.

Adherence to this protocol converts price changes from a potentially conflictual episode into a component of joint risk governance, strengthening the partnership with the client.

CHAPTER 3. PRACTICAL APPLICATION AND EFFECTIVENESS EVALUATION

The practical value of the proposed methodology is determined not only by its theoretical rigor but also by its capacity to operate efficiently under real market conditions. This chapter examines use cases of the algorithm grounded in recent geopolitical crises, proposes a system of key performance indicators (KPIs) to evaluate its effectiveness, and analyzes typical pricing errors that a systematic approach helps to avoid. It is important to note that the methodology applies not only to the computation of current tariffs but also as an instrument of scenario planning. By varying parameters in the K_{gr} formula, a company can simulate what-if scenarios (for example, how will the tariff change under an escalation of conflict in region X), thereby shifting from reaction to anticipation and securing a strategic advantage.

3.1. Case Study: Detailed Breakdown of Practical Examples

To demonstrate the algorithm's operation, consider an anonymized case based on real geopolitical events.

Consider the initial data. A request is made to calculate the tariff for transporting a 40-foot container along the Shanghai-Rotterdam route in January 2024. During this period, attacks on commercial vessels prompted mass rerouting of traffic around the Cape of Good Hope. Spot rates on this lane rose from approximately 1,500 USD to more than 5,000 USD, transit time increased by 10–14 days, and traffic through the Suez Canal declined by 50%. The VOCC base rate (before surcharges) is 1,800 USD. The

VOCC announced a War Risk Surcharge of 1,200 USD. Consider the application of the algorithm.

Step 1 (Identification). The risk of transiting the Bab-el-Mandeb Strait is assessed in the matrix as Likely (level 4) with Catastrophic impact (level 5).

Step 2 (Quantitative assessment). K_{gr} is calculated.

I_c (Intensity of conflict) = 1.0 (active attacks).

I_s (Sanctions) = 0 (sanctions are not applied to the route).

I_v (Vulnerability) = 1.0 (transit through a critical chokepoint).

I_v (Historical volatility) = 0.8 (based on a sharp surge in indices).

Using the weights from Table 3, it becomes as follows:

$$K_{gr} = (0.4 \times 1.0) + (0.2 \times 0) + (0.1 \times 1.0) + (0.3 \times 0.8) =$$
$$= 0.4 + 0 + 0.1 + 0.24 = 0.74.$$

Step 3 (Tariff adjustment). The final tariff is computed. Fixed surcharges (THC, BAF) are conditionally taken as 700 USD.

Table 4

Application of the algorithm to the Red Sea Crisis case

Step	**Component**	**Calculation**	**Result (USD)**
Input data	Base VOCC rate	-	1,800
Input data	Fixed surcharges	-	700
Input data	Direct VOCC surcharge (War Risk)	-	1,200
Step 2	Calculation of KgrK_{gr} Kgr	(0.4 × 1.0) + (0.2 × 0) + + (0.1 × 1.0) + (0.3 × 0.8)	0.74
Step 3	Calculation of risk multiplier	$1 + K_{gr}$	1.74
Step 3	Calculation of adjusted base	1,800 × 1.74 + 700	3,832
Step 3	Calculation of final tariff	3,832 + 1,200	5,032

$$1800\times(1+0.74)+700+1200=1800\times1.74+1900=$$

$$=3132+1900=5032\ USD.$$

Step 4 (Communication). The client is sent a notice with the calculation, which indicates a direct VOCC surcharge of 1,200 USD (with the VOCC notice attached). In comparison, the increase in the base component by 2,550 USD (from 2,500 to 4,350) is explained by applying the systemic risk coefficient driven by the unprecedented situation in the region. The stepwise application is systematized in Table 4.

The effectiveness of the adaptive pricing methodology should be comprehensively assessed, as it affects not only financial outcomes but also operational stability and client relationships. KPIs are therefore considered.

3.2. Key Performance Indicators (KPIs)

Aggressive tariff increases can protect margin in the short term but lead to client attrition in the long term. A balanced KPI system is therefore proposed, comprising three groups of metrics.

The first group comprises financial KPIs, which include the following metrics.

- TAccuracy of forecasting additional costs. Comparison of the calculated risk-oriented premium (the tariff component obtained via K_{gr}) with actual additional costs not covered by direct VOCC surcharges.
- Margin preservation. Tracking the profitability percentage of shipments affected by geopolitical events and comparing it with plan indicators.
- Freight bill accuracy. The percentage of invoices paid by clients without disputes and adjustments. A high figure indicates transparency and pricing intelligibility.

The second group comprises operational KPIs, which include the following metrics.

- On-Time Delivery (OTD). The percentage of shipments delivered within adjusted timelines (accounting for detour routes). The industry standard is 95% (RXO, n.d.).
- Lead Time. The average actual time from cargo acceptance to delivery to the consignee. Monitoring this indicator helps to assess the real impact of disruptions on the supply chain.

The third group comprises client KPIs, which include the following metrics.

- Client Retention Rate (CRR). A key indicator reflecting client loyalty after the application of pricing adjustments.
- Net Promoter Score (NPS). An assessment of clients' willingness to recommend the company, measured via surveys. It reflects overall satisfaction and the level of trust in the company as a partner.

The KPI matrix for assessing the effectiveness of the methodology is presented in Table 5.

These KPIs provide a clear, measurable framework for continuous, data-driven monitoring and improvement across financial, operational, and customer dimensions to ensure achievement of strategic objectives.

Table 5

KPI matrix for assessing the effectiveness of the methodology

KPI Category	KPI Name	Data Source	Target Value
Financial	Margin preservation	Financial system (ERP)	> 90% of plan
Financial	Freight invoice accuracy	CRM / ERP	> 98%
Operational	On-time delivery (OTD)	TMS / Operational reports	> 95% (against adjusted schedule)
Customer	Customer retention rate (CRR)	CRM system	> 85%
Customer	Net Promoter Score (NPS)	Customer surveys	> 40

3.3. Analysis of Typical Pricing Mistakes under Instability

The application of the proposed algorithm helps avoid several common mistakes made by logistics companies operating in unstable environments.

Mistake 1: Reactive pricing. The most frequent mistake is waiting for an official VOCC notice announcing a surcharge. In the period between a geopolitical event and the announcement of a surcharge, the company continues to quote rates at old prices, effectively operating at a loss or at zero profitability. The proposed algorithm, owing to proactive K_{gr} computation based on risk monitoring, enables immediate tariff correction, protecting margin even before official instructions are received from the line.

Mistake 2: Non-transparent price increases. In an attempt to compensate for risks, some companies simply raise the aggregate rate without clear justification, which provokes dissatisfaction and erodes client trust. The algorithm resolves this problem through Step 4 (Communication Protocol), which mandates documentary substantiation and a detailed tariff breakdown, rendering the pricing process transparent and intelligible for the client.

Mistake 3: Margin erosion due to goodwill. In an effort to retain clients, managers may choose to absorb small but numerous risks and indirect costs at the expense of their own profit. This leads to a gradual decline in overall profitability. The tariff formula with the $\left(1+K_{gr}\right)$ multiplier addresses this problem systematically, introducing a standardized premium for uncertainty that is justifiably embedded in the service price rather than borne by the operator.

Thus, the proposed methodology is not merely a computation tool but also instills a pricing discipline grounded in data, transparency, and a proactive stance.

CONCLUSION

The conducted research confirms that escalating geopolitical tensions have transformed the global logistics environment, making volatility and unpredictability its inalienable characteristics. Under these conditions, traditional pricing approaches premised on static costs and reactive surcharge accounting become ineffective, leading to financial losses and diminished client trust.

The adaptive pricing methodology proposed in this work addresses this challenge. The key findings of the study are as follows.

A systematic, data-driven understanding of external geopolitical risks is a prerequisite for any sustainable business. Better risk classification and understanding of the channels through which these risks materialize into additional costs are the basis for moving beyond vague gut-feel assumptions.

Expressing this as an algorithm to set a price provides reproducibility, transparency, and controllability. The authorial model for calculating the Geopolitical Risk Coefficient enables the digitization of qualitative threats and their proactive integration into the tariff, creating the buffer required to protect margins from indirect costs and uncertainty.

Effective pricing under contemporary conditions is not only a financial task but also a communication task. A standardized client notification protocol, grounded in transparency and the provision of objective evidence, transforms tariff adjustments from a conflict-prone episode into an element of joint risk management, thereby fostering long-term partnership relations.

Evaluation of the methodology's success requires a comprehensive approach based on a balanced KPI system that includes financial, operational, and client metrics. This enables avoiding one-sided optimization and achieving a strategic balance among profitability, reliability, and loyalty.

Taken together, these findings demonstrate that the proposed methodology enables logistics operators, particularly NVOCCs, to transition from a passive reaction to external shocks to proactive management of pricing risks, thereby constituting a material competitive advantage in the new geopolitical reality.

The practical significance of the work lies in offering an implementation-ready managerial tool for a broad range of professionals in international logistics: pricing analysts, logistics managers, heads of commercial departments, and company directors. The methodology provides not only formulas and algorithms but also a methodological foundation and a language for justifying pricing decisions both within the company (to the finance department and management) and in negotiations with clients and partners.

By applying this algorithm, logistics companies can increase the accuracy and legitimacy of their tariffs against uncertainty, protect their businesses from such geopolitical costs, create a fair and transparent relationship with customers to increase customer loyalty and retention potential, and use the pricing of logistics as a planned tool for scenario planning and obtaining a competitive advantage in an uncertain environment.

As such, it's not only an academic exercise, but also a guideline for the financial and market power of the logistics industry.

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SCIENTIFIC EDITIONS

METHODOLOGY OF ADAPTIVE PRICING IN INTERNATIONAL LOGISTICS:
An Algorithm for Incorporating Geopolitical Risks and Adjusting Tariffs

By Yevhenii Shymchenko

Computer typesetting — *Yevhen Tkachenko*

Format 60×84/16.
Offset printing. Offset paper.
Headset NewCenturySchoolbook.

Internauka Publishing House LLC
Ukraine, Kyiv, street Pavlovskaya, 22, office. 12
Contact phone: +38 (067) 401-8435
E-mail: editor@inter-nauka.com
www.inter-nauka.com
Certificate of inclusion in the State Register of Publishers
№ 6275 від 02.07.2018 р.