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Pricing Geopolitical Risk

A Market-Based Framework for Measuring and Hedging a Structural Risk

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Executive Summary

Geopolitical risk — the danger that wars, terrorism, and inter-state tensions disrupt the global economy — is no longer an episodic shock that fades between crises. It has become a permanent, structural feature of the financial environment, and supervisors now require banks to measure it. In December 2025 the European Central Bank announced a 2026 thematic reverse stress test on geopolitical risk covering 110 directly supervised banks, asking each to identify the geopolitical events that would deplete 300 basis points of its core capital. In July 2026 the ECB published the results: the banks produced economically meaningful scenarios, but the exercise delivered narratives, not probabilities. Banks and supervisors face a hard question: how likely is such an event, and what would it cost to insure against it?

This white paper offers an answer. It shows that the same well-established mathematics used to price volatility derivatives such as VIX and VSTOXX futures can be applied directly to a standard, publicly available measure of geopolitical tension — the Caldara–Iacoviello Geopolitical Risk (GPR) index. Because the index behaves like volatility — it spikes on shocks, reverts toward a long-run level, and is more turbulent when elevated — a proven pricing framework carries over with little modification. The result is a way to translate any supervisory trigger into two numbers: the historical probability that it is exceeded, and the market-implied probability that a forward-looking market would price in.

As a concrete illustration — using the ECB exercise here only as a worked example — take a representative bank at its minimum capital level: the historical probability that the index stands above a supervisory trigger after a year is about 12 per cent, the answer a backward-looking stress test produces, while the market-implied probability lies between roughly 30 and 80 per cent depending on the market price of geopolitical risk — about 54 per cent at the midpoint of the empirically plausible range. The gap between the two is the price of bearing geopolitical risk — the geopolitical analogue of the insurance premium embedded in option and inflation-swap markets — and the width of the band is itself the message: no traded instrument yet pins down the premium, and a single observed transaction price would collapse the band to a point. Today supervisors can see only the first number; a tradable market would reveal the second.

Three takeaways for decision-makers

1. Geopolitical risk has become a structural financial risk, not a transient shock — and supervisors now require banks to quantify it.
2. Market-based pricing mechanisms for geopolitical risk are conceptually feasible: a proven derivatives-pricing framework applies directly to a standard, transparent GPR index.
3. Such instruments could materially improve stress testing and risk management — supplying a forward-looking, market-implied probability that today's historical methods cannot produce.

Keywords: geopolitical risk, derivative pricing, mean reversion, square-root process, Grünbichler–Longstaff, inflation swaps, financial stability, ECB stress testing.

JEL classification: G12, G13, G21, F51, E44.

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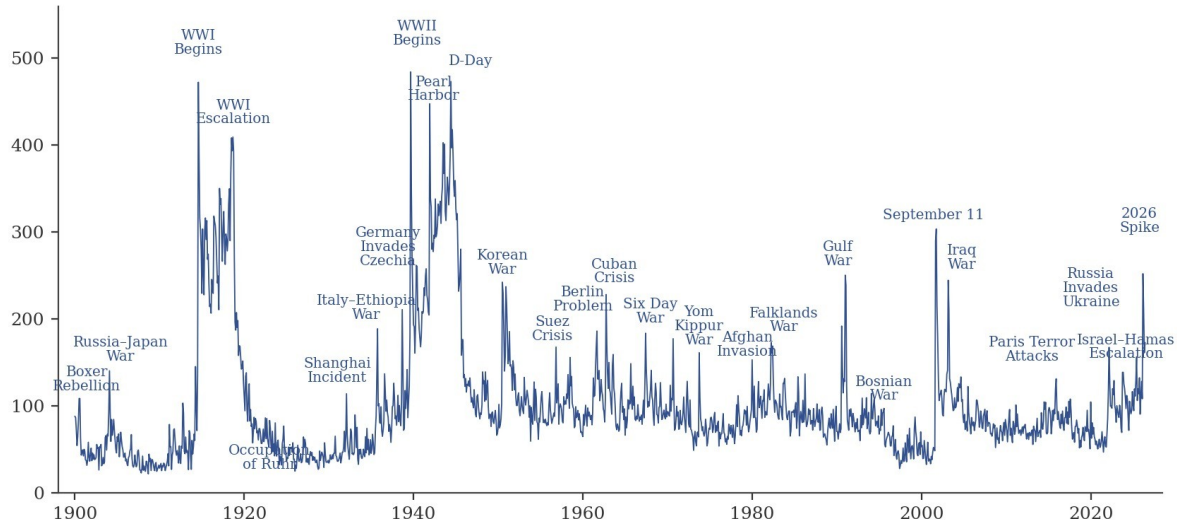
comments on an earlier version, and to **Thomas Ho** for comments that sharpened the treatment of model risk. I thank **Elsa Clara Massoc** (University of St. Gallen) for her careful reading and her guidance on making the contribution accessible to executives, policymakers, and practitioners. All remaining errors are my own.

1. Why Pricing Geopolitical Risk Matters

1.1 A risk that is both elevated and priced

Geopolitical risk — the risk associated with wars, terrorism, and inter-state tensions disturbing peaceful international relations — has moved from a peripheral concern to a structural feature of the global macro-financial environment. The standard measure of it, the Caldara–Iacoviello GPR index (2022), is now used by the Federal Reserve, the European Central Bank, the IMF, and the BIS, and it has run above its long-run baseline for most of the period since 2017. Figure 1 shows the 125-year record: the rise above the historical baseline since 2017, the peaks during the Russian invasion of Ukraine and the Middle East escalation of 2023–2026, and an early-2026 spike — on the benchmark index, the March 2026 reading of about 331 is the highest since the 2003 Iraq invasion — are all visible at a glance.

That this risk carries a price is well established in economics. Pástor and Veronesi (2013) show that political uncertainty commands a risk premium proportional to the level of uncertainty; Kelly, Pástor and Veronesi (2016) find that one-month at-the-money put options spanning political events are on average about 5 per cent more expensive than comparable non-event options. A growing literature also documents that the underlying level has shifted upward and become more persistent rather than transient (Aiyar et al., 2023; Ahir, Bloom and Furceri, 2022). For banks, supervisors, and investors, the practical consequence is direct: a risk that is both elevated and priced needs to be measured and managed like any other financial risk.



Note: Historical Geopolitical Risk Index from January 1900 through June 2026. Index normalised to 100 throughout the 1900–2019 period. Source: own elaboration based on Caldara and Iacoviello (2022), data: https://www.policyuncertainty.com/gpr.html.

Figure 1. Historical Geopolitical Risk Index (GPRH), January 1900 – June 2026. Source: own elaboration based on Caldara and Iacoviello (2022).

1.2 Why existing stress-testing approaches are insufficient

Banks today assess geopolitical risk mainly through narrative scenarios and historical simulation: they ask how often, in the past, an event of a given size occurred, and what it would have cost. This backward-looking approach has a structural blind spot. It can describe what has happened, but it cannot tell a bank what the market thinks is about to happen — the forward-looking, risk-adjusted probability that participants would actually pay to hedge against. When the world's risk environment

shifts (as the literature in Section 1.1 argues it has), the historical record systematically understates the danger.

The gap became operationally tangible on 12 December 2025, when the ECB announced a 2026 thematic reverse stress test on geopolitical risk, covering 110 directly supervised banks and prescribing a CET1 depletion threshold of 300 basis points. The results, published on 31 July 2026, confirmed the point: the banks produced economically meaningful scenarios, but the exercise delivered narratives, not probabilities. Without a market-implied price of geopolitical risk, no quantitative, forward-looking answer to the question “how likely is this?” has so far been possible.

1.3 How a market-based measure would improve decision-making

A traded instrument whose payoff depends on the GPR index would change this. The price of such an instrument is, by construction, the market's forward-looking, probability-weighted view of geopolitical risk — exactly the number that historical simulation cannot deliver. It would give banks a hedging tool and a capital-efficient way to meet the supervisory requirement; it would give supervisors a market-implied probability to set against their historical one; and it would give the financial system, for the first time, a continuously updated price for a risk that everyone agrees matters but no one currently prices directly. The remainder of this paper shows that such an instrument can be priced with established, closed-form mathematics, and works through what it would mean in the European supervisory context.

This white paper is part of the CGCS White Paper Series, whose aim is to bring transdisciplinary academic rigour to bear on practical geopolitical challenges for executives, policymakers, and practitioners. Within the Series’ framework — which structures its work along the linkages between geopolitical factors, geographies, and industries — this paper occupies a single, sharp intersection: the geopolitical-risk factor, the European geography, and the banking industry. In pairing a closed-form pricing model with a concrete supervisory application, it embodies the Series’ aim of bridging theory and practice.

2. The Core Idea: A Market Price for Geopolitical Risk

The core insight of this paper is simple to state. The mathematics used for two decades to price volatility derivatives — instruments such as VIX and VSTOXX futures and options — applies, almost without modification, to geopolitical risk. The reason is that the GPR index behaves like volatility: it jumps on shocks, gradually reverts toward a normal level, stays strictly positive, and is far more turbulent when it is already high. These are precisely the properties that the square-root, mean-reverting pricing model of Grünbichler and Longstaff (1996) was built to capture. Figure 2 sketches how the pieces fit together.

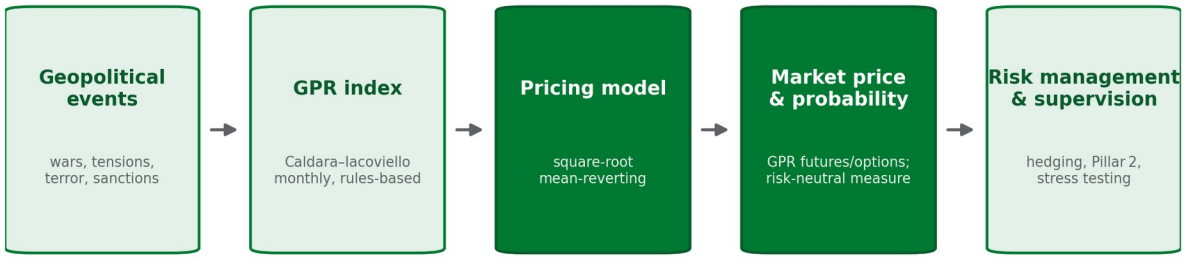


Figure 2. From geopolitical events to a market price of risk. This paper supplies the third and fourth links — a pricing model and a market-implied probability for any supervisory trigger.

2.1 A familiar index with the right behaviour

The state variable is the Caldara–Iacoviello GPR index. It is built transparently by counting, each month, how often a fixed set of leading international newspapers carry articles using a defined dictionary of geopolitical terms, scaled so that it averages 100 over the 1985–2019 period. It is observable in real time (the monthly reading is published by the authors at the beginning of each month), replicable by third parties, and methodologically stable. These features — the same ones that make the VIX a viable underlying for listed contracts — make the GPR index a credible basis for a traded instrument. Figure 3 plots the index since 1985: every major crisis produces a spike that then decays back toward a long-run level of roughly 104, with the rebound taking about two months on average.

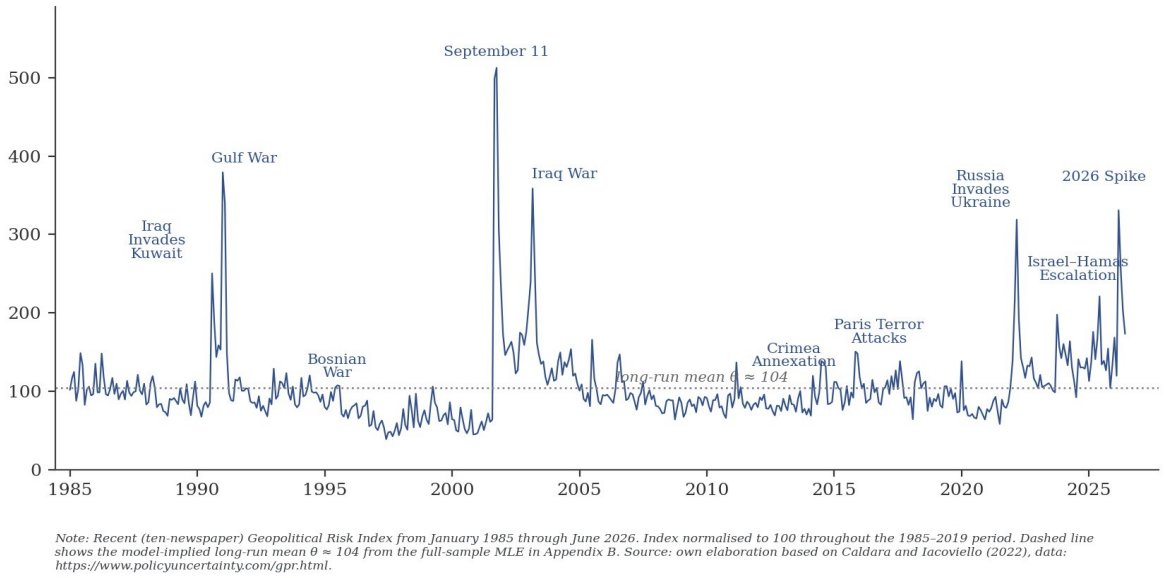


Figure 3. Recent Geopolitical Risk Index, January 1985 – June 2026. The dashed line marks the estimated long-run mean of about 104. Source: own elaboration based on Caldara and Iacoviello (2022).

Why the global index, and not a euro-area one?

A euro-area supervisory exercise might seem to call for a euro-area risk measure. A new index built from European newspapers (Bondarenko et al., 2026) shows that euro-area geopolitical shocks carry distinct macroeconomic effects and fade more slowly — which, through the lens of this framework, would imply fatter and longer-lived tails for euro-area risk. As the underlying for a traded contract, however, that series is not yet suitable: its level wanders across regimes and fails standard stationarity tests, while the global Caldara–Iacoviello index passes them in every specification. Closed-form pricing rests on a stable, mean-reverting process, so the global index is the appropriate underlying today; a euro-area contract is the natural second step once that series accumulates history under a settled regime.

2.2 Two probabilities for the same event

Once an instrument on the GPR index can be priced, any supervisory trigger can be expressed in two distinct ways. The first is the historical (or "physical") probability: how often, given the past behaviour of the index, the trigger would have been reached. The second is the market-implied (or "risk-neutral") probability: the probability embedded in the price a forward-looking market would charge to insure against the same event. The two differ because investors demand compensation for bearing risk — so the market-implied probability is systematically higher. The gap between them is the geopolitical risk premium.

Key concept — the wedge between the two probabilities

The gap between the market-implied and the historical probability is not a modelling artefact; it is a price. It is the geopolitical analogue of two well-documented premia: the **variance risk premium** — the gap between option-implied and realised equity volatility — and the **inflation risk premium** — the gap between swap-implied and realised inflation (Fleckenstein, Longstaff and Lustig, 2017). In each case a market exists that reveals the premium. For geopolitical risk, no such market yet exists; this paper shows what it would reveal once it does.

This distinction is the practical heart of the contribution. A historical stress test gives the supervisor only the first number. A traded GPR instrument would reveal the second. The formal pricing model that produces both is summarised in the next section and set out in full in the journal article; the worked European example is developed in Section 4.

3. How the Model Works

This section explains the idea behind the pricing model in plain language. Readers who want the equations, the maximum-likelihood estimation, and the robustness checks will find them in Appendices A and B.

The analogy. The GPR index behaves like market volatility: it jumps when a shock hits, then drifts back toward a normal level, never falls below zero, and moves more violently when it is already high. These are exactly the features that the square-root, mean-reverting model of Grünbichler and Longstaff (1996) — the same mathematics Cox, Ingersoll and Ross (1985) used for interest rates — was built to capture. The index is pulled toward a long-run average at a steady speed, while its short-

term swings grow with its level. Because the index itself cannot be bought or sold, one extra ingredient — the market price of risk — links its historical behaviour to the prices a market would set. This is the standard device used for interest-rate, volatility, weather, and inflation derivatives, and it keeps the pricing of futures and options exact and formula-based.

The numbers. Fitted to the monthly Caldara–Iacoviello series from 1985 to June 2026 (498 observations), the model yields three intuitive numbers, reported in Table 1. The index reverts toward its long-run average with a half-life of about two months; that average sits close to the normalisation level of 100; and the swings stay comfortably within the bounds (the Feller condition) that keep the index positive and the pricing formulas valid. Re-estimating over different periods leaves the speed of reversion essentially unchanged, but shows the long-run average drifting upward after 2017 — the structural shift described in Section 1.

Parameter	Estimate (1985 – Jun 2026)	Plain-language meaning
Reversion speed κ	0.348 per month	Spikes decay with a half-life of about 2 months.
Long-run mean θ	104.5	The level the index reverts toward — near the historical baseline of 100.
Diffusion σ	3.02	Volatility of monthly moves; larger when the index is high.
Feller slack $2\kappa\theta - \sigma^2$	63.6 ($\gg 0$)	Comfortable margin keeping the index positive and the formulas valid.

Table 1. Headline parameter estimates. Full sub-sample results and standard errors are reported in the journal article.

What the model produces. With these estimates, the framework delivers two things: closed-form prices for GPR futures and options (derived in the journal article), and — the part that matters most for supervisors — a formula that turns any trigger level into a probability, computed either from history or as a market would price it. Section 4 puts this to work on a concrete supervisory example.

4. From Any Threshold to a Market-Implied Probability

The European Union is a jurisdiction with acute — and unusually well measured — geopolitical-risk exposure in the global financial system — through energy dependence, Eastern European banking subsidiaries, and sovereign-spread sensitivity to defence commitments. It is also the jurisdiction that has made the supervisory question binding. The worked example below shows how the framework turns the ECB's qualitative trigger into a quantitative, forward-looking probability.

4.1 The supervisory trigger as a probability

The ECB's 2026 reverse stress test prescribes a CET1 depletion threshold of 300 basis points and asks which geopolitical events would breach it. Translating capital depletion into a level of the GPR index requires a loss function — a link between the index and a bank's capital. In the spirit of the sensitivities documented by the ECB itself (Dieckelmann et al., 2024), a transparent, stylised calibration for a representative bank at its minimum capital level puts the trigger at a GPR level of approximately 149. The framework then answers the supervisor's question directly: what is the probability that the index stands above 149 twelve months ahead? The one-year window is illustrative, since the ECB exercise itself assesses the maximum capital depletion over a three-year horizon.

The answer depends on which measure is used, and that is the whole point. Under the historical measure the probability is approximately 12 per cent (95 per cent confidence band: 7–18 per cent,

reflecting parameter uncertainty) — the answer a backward-looking historical-simulation stress test would produce. Under the market-implied measure it lies between approximately 29 and 79 per cent across the range of the market price of risk consistent with the inflation-swap literature — approximately 54 per cent at the midpoint. Figure 4 contrasts the historical probability with the midpoint of the market-implied band.

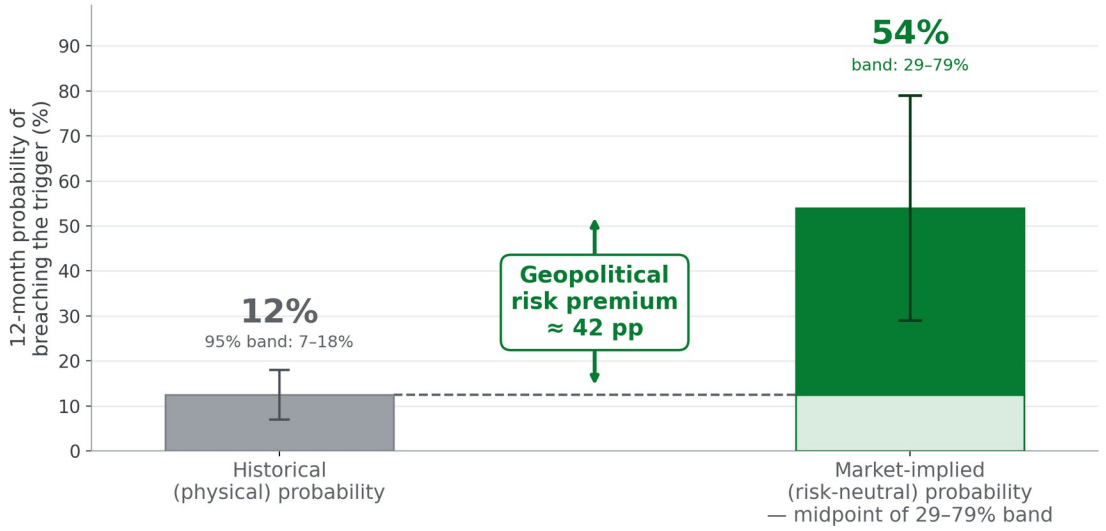


Figure 4. The same trigger event, valued two ways. The historical probability (with its 95 per cent confidence band) is what a backward-looking stress test produces; the market-implied probability is shown at the midpoint of the 29–79 per cent band spanned by the plausible range of the market price of risk. The gap is the geopolitical risk premium.

Intuitively, the 12 per cent reflects the strong mean reversion of the index. Although the index stood at about 174 in June 2026 — above the trigger of 149 — the two-month half-life means the starting level is almost fully dissipated over a twelve-month horizon: the probability is driven by the long-run mean near 104 and the size of typical monthly swings, not by the spot reading. Moving the starting level between 116 and 254 moves the historical probability only between 12.0 and 13.3 per cent, so the supervisory anchor does not swing with the month's headlines. The 54 per cent at the midpoint reflects the market price of risk: a forward-looking market reverts more slowly and to a higher level, so under its measure the trigger sits essentially at the long-run mean rather than well above it — which is what pushes the probability from low double digits toward roughly even odds. This market-implied reading complements the credit-portfolio reverse-stress-testing approach of Hurlin, Lajaunie and Pull (2026), which instead asks which scenario would breach the threshold; the two can be used side by side within a single submission.

5. What This Means for Banks and Regulators

The framework is not only a pricing result; it has direct consequences for how banks manage geopolitical exposure, how supervisors design and read stress tests, and how the financial system might treat geopolitical risk as an asset class. This section draws out those implications.

5.1 What this means for banks

For a bank, the framework converts a qualitative geopolitical-risk assessment into a defensible, model-based, regularly updated number. Three uses follow. First, measurement: the bank can express its exposure to the ECB trigger as a probability rather than a narrative, satisfying the supervisory

requirement in a transparent and auditable way. Second, hedging: a cash-settled GPR contract is the most capital-efficient instrument for offsetting geopolitical exposure, just as VIX contracts hedge volatility exposure. Third, pricing: the geopolitical component of credit and counterparty risk can be priced explicitly rather than buried in a general buffer, reducing the systematic under-pricing of exposed borrowers and over-pricing of unexposed ones.

5.2 How supervisors could use such tools

For supervisors, the framework supplies the missing forward-looking complement to historical stress testing. Reading the historical and market-implied probabilities side by side tells the supervisor two different and equally relevant things: how often the trigger would have been reached under recent dynamics, and what the market would charge to insure against reaching it. A widening wedge between the two is itself an early-warning signal that risk is being repriced. And if supervisors were to recognise GPR contract exposures as eligible for Pillar 2 capital relief, the market-implied number would translate directly into a capital requirement — closing the loop from the supervisory threshold to a market price.

5.3 Strategic implications if geopolitical risk became tradeable

If a GPR market developed, geopolitical risk would join volatility and inflation as a directly traded macro risk factor. That would have system-level consequences. Price discovery would produce a continuously updated, transparent gauge of geopolitical risk that policymakers, firms, and investors could all observe — a public good distinct from any single institution's internal models. Geopolitical exposure would become a portfolio-construction factor with an identifiable price, and a tactical signal: a market reverting from a spike behaves predictably, which the model makes explicit. Safe-haven assets such as gold and certain currencies, which already move inversely to geopolitical stress, would gain an explicit benchmark against which to measure their hedging value.

5.4 Opportunities and challenges for financial institutions

The opportunities are first-mover advantages in a new product line, a capital-efficient hedging channel, and a credible answer to an emerging supervisory demand. The challenges are equally concrete and should not be understated. Liquidity must be built before the market-implied price is reliable — the inflation-swap market took years to reach depth. Basis risk remains between a bank's specific exposure and a broad index, though country-level GPR indices mitigate it. Model risk attends any pricing framework, and the market price of risk is the key uncertain input until a market reveals it. And the entire institutional case depends on the supervisory regime remaining binding and on recognition of GPR contracts as eligible capital relief. The economic case is at least as strong as the case for the inflation derivatives that did develop; the institutional path to liquidity remains to be walked.

Summary — who gains what

- **Banks:** an auditable measure, a capital-efficient hedge, and explicit pricing of geopolitical exposure.
- **Supervisors:** a forward-looking complement to historical stress tests and an early-warning signal in the wedge between the two probabilities.
- **The system:** a transparent, continuously updated price for a risk everyone agrees matters but no one yet prices directly.

6. Limitations

Three limitations deserve emphasis. First, the GPR index is built from textual analysis and is subject to measurement error and possible structural breaks in news-coverage technology — the rise of social media and the post-2022 expansion of geopolitical reporting may have shifted how the index is generated. A regime-switching or jump-augmented extension would address this, at some cost to the closed-form tractability that makes the framework usable. The technical paper quantifies what is at stake: formal specification tests detect jump-like moves that no pure diffusion captures, yet against the best-fitting alternative the historical trigger probability shifts by only about 0.4 percentage points — the modelling choice that matters is mean reversion itself, which the data support strongly.

Second, the assumption that the market price of risk is constant (or scales with the level of the index) is unlikely to hold in every regime; during acute crises the sensitivity of asset prices to geopolitical risk appears to rise non-linearly. Allowing it to follow a slow-moving process — as risk premia smooth across the (re)insurance underwriting cycle — would extend the framework without sacrificing tractability, and is left for future work.

Third, the inflation-derivative precedent is encouraging but not deterministic. The inflation-swap market developed because hedgers had standing needs and the legal infrastructure was in place. The corresponding hedger for GPR — the directly supervised bank — is contingent on the regulatory regime remaining binding and on supervisory recognition of GPR contracts as eligible capital relief. The economic case is strong; the institutional path remains to be built.

7. Conclusion

Geopolitical risk has become a structural financial risk, and supervisors now require banks to measure it — yet the tools in common use are backward-looking and cannot deliver a forward-looking, market-implied probability. This white paper shows that they can. By applying the established square-root, mean-reverting pricing framework of Grünbichler and Longstaff (1996) directly to the standard Caldara–Iacoviello GPR index, it becomes possible to price futures and options on geopolitical risk in closed form, and to translate any supervisory trigger into two probabilities: the historical one a stress test produces, and the market-implied one a forward-looking market would set.

Applied to the ECB's 2026 reverse stress test, the framework turns a 300-basis-point capital threshold into concrete numbers — roughly 12 per cent under the historical measure and, across the empirically plausible range of the risk premium, roughly 30 to 80 per cent under the market-implied measure (about 54 per cent at the midpoint) — whose difference is the price of bearing geopolitical risk; a single observed transaction price on a GPR contract would collapse the band to a point. Market-based pricing mechanisms for geopolitical risk are therefore conceptually feasible, and such instruments could materially improve stress testing and risk management. What remains is institutional: a path to liquidity along the lines that the volatility and inflation markets have already walked. The originality of the idea is matched by the concreteness of the supervisory need it would serve.

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