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## THE POLITICS OF “HARD” ECONOMIC SECURITY IN EASTERN EUROPE UNDER HYBRID AND MILITARY THREATS

**Purpose.** This study substantiates the shift toward “hard” economic security in Eastern Europe under sustained military and hybrid threats (2014–2025) and develops a composite Hard Economic Security Index (HESI) for cross-country comparison.

**Methodology.** The research combines institutional-structural, comparative, and risk-oriented approaches. Quantitative procedures include indicator selection and operationalization, min–max normalization, composite index construction, and the Analytic Hierarchy Process (AHP) for domain weighting. The framework integrates multidimensional assessment across energy security, defence-industrial capacity, hybrid and cyber resilience, technological autonomy, and institutional stability. Visualization is used to present cross-country differences.

**Findings.** The article assesses how five author-selected factors contribute to the dynamics of the resilience indicator in the context of war-related disruption, energy coercion, technological constraints, and hybrid pressure. It proposes and empirically tests HESI, enabling the ranking of selected Eastern European countries by their capacity to sustain core economic functions under military and hybrid escalation. The results indicate differentiation across cases and suggest that resilience depends on the configuration and balance of capabilities rather than on any single variable. The analysis highlights a regional transition from “soft” economic security logics toward securitized, risk-control-based policy.

**Originality.** The study demonstrates that the global and regional indices available do not provide an integrated measurement of economic security tailored to military and hybrid confrontation. HESI offers an original composite tool that consolidates economic, security, technological, cyber, and institutional dimensions into a unified analytical model suitable for structured comparison under conditions of systemic disruption.

**Practical value.** The proposed framework provides a practical toolkit for policymakers and researchers in diagnosing vulnerabilities, prioritizing resilience investments, and designing coherent hard economic security strategies. HESI can be applied to strategic planning, monitoring of adaptation policies, and refinement of national and EU-level economic security measures for states exposed to persistent military and hybrid risks.

**Keywords:** *finance, security, hybrid threats, cyber threats, resilience, energy, determinants, risks*

**Introduction.** Russia’s full-scale aggression against Ukraine and the escalation of hybrid influence during 2022–2026 have exposed systemic limitations of economic security models in Eastern European countries that were built on the liberal paradigm of interdependence. Coordinated attacks on energy infrastructure, disruptions of transit routes, cyber operations targeting governmental and communication systems, pressure on defence-industrial capacities, and the conflict-driven use of regulatory and financial instruments have demonstrated that predominantly “soft” economic security tools are insufficient to ensure resilience under conditions of sustained military and hybrid escalation.

In response, countries across the region have increasingly incorporated elements of a “hard” economic security policy, including the active use of sanctions regimes, diversification of energy supply and critical imports, technology and export controls, investment screening and control mechanisms, expansion of defence-industrial capacities, reinforcement of infrastruc-

ture resilience, and financial stabilization instruments. Unlike the “soft” model, which prioritizes market facilitation and openness, the “hard” approach treats economic policy as a mechanism of deterrence, shock prevention, and continuity of critical state functions, with security considerations embedded into trade, investment, industrial, and fiscal decision-making.

Ukraine illustrates the most far-reaching wartime transformation of its economic architecture, combining rapid restructuring of the energy sector, logistics corridors, and parts of the industrial base with large-scale financial and military assistance from the EU and international partners. Poland, Lithuania, Latvia, Estonia, Romania, and Moldova pursue differentiated adaptation trajectories that combine enhanced defence readiness, energy de-risking, stronger regulatory filtering of external vulnerabilities, and adjusted participation in European security and economic regimes. Across these cases, the re-prioritization of resilience over short-term efficiency is increasingly reflected in policies targeting critical infrastructure protection, supply-chain reconfiguration, and institutional coordination for crisis response.

**Literature review** demonstrates a clear shift from “soft” interpretations focused on macroeconomic stability toward the concept of “hard” economic security, where resilience is defined as the capacity to function, adapt, and recover under coercion, disruption, and conflict-driven shocks. This shift is grounded in the financial security perspective, which interprets economic and financial vulnerabilities as systemic risks that directly affect enterprise stability, liquidity, and long-term strategic resilience [1, 2]. In parallel, contemporary research emphasizes that states increasingly complement traditional power instruments with reputational, communicative, and value-based strategies, particularly under conditions of geopolitical instability and hybrid confrontation [3].

A foundational empirical and theoretical contribution is the “weaponized interdependence” framework, which explains how asymmetric positions in global networks enable coercion and create dependencies that can be exploited during confrontation [4]. In this perspective, vulnerabilities are not limited to energy imports; they also emerge through financial infrastructures, digital platforms, and supply-chain chokepoints that shape the feasibility of sanctions, the credibility of deterrence, and the resilience of critical services. These arguments underpin the analytical need to quantify economic security as a multidimensional construct rather than as a single macroeconomic outcome.

At the EU level, the recent policy turn explicitly formalizes this logic. The European Economic Security Strategy sets a risk-governance framework built around reducing critical dependencies, protecting sensitive technologies, and strengthening partnerships [5]. The Strategic Compass further integrates economic resilience into the broader security architecture [6]. Analytical commentaries show that EU practice is moving toward a “risk–control–partner” model in which Member States in Eastern Europe occupy a frontline position in de-risking and critical infrastructure reinforcement [7]. In this setting, the objective is not only stability but also the ability to absorb coercive pressure and sustain operational continuity during hybrid confrontation.

Within Central and Eastern Europe, empirical studies converge on three interconnected vulnerability channels: energy dependence and coercion risk, hybrid threats undermining institutional continuity, and fiscal fragility under crisis and defence mobilisation. Energy security research documents persistent heterogeneity among EU Member States in diversification, supply security, and institutional capacity, with import dependence remaining a central constraint on strategic autonomy [8, 9]. Multi-criteria approaches and composite indicators increasingly dominate the methodological toolkit, enabling energy security to be assessed as a multidimensional phenomenon rather than as a single indicator [10]. Recent advances apply clustering and neural network techniques to classify EU Member States by energy-security profiles, revealing that many Eastern European economies accumulate multiple vulnerabilities simultaneously [11, 12]. Additional analyses stress the importance of energy efficiency and environmental security in the post-2022 context, highlighting crisis-driven structural adjustments [13, 14].

A related strand links defence mobilisation to economic resilience through reallocation of fiscal space and

industrial priorities. Empirical assessments based on military expenditure databases and defence spending statistics indicate that higher defence outlays may enhance security capacity, yet the net economic effect depends on institutional quality, innovation intensity, and technological upgrading [15, 16]. Without structural modernization, militarization can increase dependence on external suppliers and constrain value-added growth trajectories [17]. Hybrid threat literature further emphasizes cascading and multiplicative effects: cyberattacks, disinformation, sabotage, and economic coercion interact with energy and trade shocks, amplifying systemic disruption [18, 19]. This supports modelling economic security as the interaction of structural capacity and exogenous pressure rather than as a static snapshot.

Ukrainian scholarship adds crucial wartime evidence on how infrastructure destruction, trade shocks, and institutional stress generate systemic economic insecurity [20]. Studies demonstrate that resilience is shaped not only at the macro level but also through firm-level adaptation, relocation, and logistics reconfiguration that preserve productive capacity under extreme uncertainty [21, 22]. Research on societal resilience and regional vulnerability further reveals pronounced spatial unevenness in shock exposure, energy vulnerability, and institutional effectiveness, reinforcing the need for monitoring tools capable of detecting structural bottlenecks and heterogeneity in resilience [23, 24]. The digital transformation dimension is increasingly framed as a component of national security and institutional continuity under hybrid pressure [25].

Despite these advances, the literature still rarely integrates energy security, defence-related capacity, technological autonomy, institutional quality, and macro-fiscal stability into a single framework suitable for cross-country comparison in a conflict-affected region, particularly for EU-focused panels. This gap motivates the development of a panel-based composite index that captures both structural capacity and the compressing effect of asymmetric exposure to war-related and hybrid risks.

**Research objective, methodology and data.** The objective of this study is to substantiate the shift of Eastern European countries toward “hard” economic security under sustained military and hybrid threats (2014–2025) and to develop a composite Hard Economic Security Index (HESI+) for cross-country comparison, while assessing how five author-selected factors contribute to the dynamics of the resulting resilience measure. To achieve this objective, the research employs an integrated institutional-structural, comparative, and risk-oriented methodology that conceptualizes economic security as an active policy regime encompassing energy de-risking, defence-industrial capacity, technological autonomy, hybrid and cyber resilience, and institutional stability. The empirical analysis constructs HESI+ as a composite indicator aggregating five core domains using min–max normalization and AHP-based weighting and applies a risk adjustment to capture vulnerability effects, operationalized as  $HESI_{adj} = HESI+ \cdot (1 - Risk)$ . The study relies exclusively on internationally comparable, publicly available data from official sources, including Eurostat, the World Bank, NATO, SIPRI, the National Cyber Security Index, the Worldwide Governance Indicators, and EU institutional datasets, covering selected

Eastern European countries over 2014–2025, when military and hybrid threats increasingly shaped economic governance.

**Results and discussion.** The deterioration of the regional security environment since 2022 has fundamentally altered the strategic calculus of Eastern European states. The erosion of predictable economic interdependence, the weaponization of trade and energy flows, and the growing fragmentation of global markets have reduced the effectiveness of development models built primarily on openness and cost-efficiency. In place of linear integration strategies, governments increasingly operate under conditions of uncertainty, where exposure to external shocks is no longer a cyclical risk but a structural constraint.

At the same time, the geopolitical reconfiguration of Europe has intensified coordination between economic and security institutions at both national and supranational levels. EU-level sanctions regimes, energy market interventions, joint procurement mechanisms, and new investment screening frameworks illustrate a broader trend toward embedding security criteria into economic governance. For Eastern European countries, this multilevel transformation intersects with national adaptation strategies, creating hybrid models that combine European regulatory alignment with domestically driven resilience-building policies.

These developments highlight a deeper conceptual shift: economic resilience is no longer treated as a by-product of growth, but as a strategic objective in its own right. The emphasis is moving from maximizing efficiency toward managing vulnerability, from optimizing trade flows toward securing critical capacities, and from short-term macroeconomic stabilization toward long-term structural robustness. Within this evolving framework, economic policy increasingly functions as a tool of strategic defence rather than solely as a mechanism of market coordination.

The intensification of military and hybrid threats after 2022 has transformed the economic policy of Eastern European countries, shifting it into a mode of strategic mobilisation. While economic security was previously understood mainly as maintaining core macroeconomic indicators and financial stability, economic policy is now increasingly treated as an instrument for countering external aggression, protecting critical infrastructure, achieving energy autonomy, safeguarding technological sovereignty, and ensuring defence-industrial mobility. As a result, a new governance model is emerging in which the central objective is not merely economic performance, but the state's capacity to function, adapt, and recover under conditions of systemic disruption [26].

In this environment, economic decisions cannot be separated from security dynamics. Energy dependence becomes a direct threat to resilience, reliance on imported technologies creates strategic bottlenecks, cyber and information attacks undermine the continuity of both public and private operations; and institutional weakness amplifies vulnerability to destabilization. These pressures accelerate a shift toward a “hard” economic security paradigm, understood as the ability of the national economic system to absorb, reallocate, and offset external shocks while preserving core functions. In practice, this paradigm requires coordinated progress

across energy risk management, defence-related industrial capacity, cyber resilience, technological autonomy, and institutional effectiveness, however, it also demands macro-financial stability as a necessary condition for sustained mobilization and crisis response.

Because these components are strongly interdependent and weaknesses in one area can neutralize advances in others, the analysis requires a formalized framework capable of capturing overall resilience and its dynamics. Therefore, this study applies the extended Hard Economic Security Index (HESI+) as a panel tool for 2014–2025, covering Poland, Lithuania, Romania, Estonia, and Ukraine. Unlike a static single-year ranking, the panel specification allows identification of both cross-country contrasts and trajectory shifts associated with the escalation of threats after 2022. HESI+ integrates ten indicators that jointly reflect security-relevant capacities (energy dependence, defence effort, cyber infrastructure, innovation effort, and institutional quality) and macro-financial resilience (inflation, public debt, current account balance, real growth, and fiscal balance), enabling a more policy-relevant assessment of “hard” economic security under prolonged military and hybrid pressure.

The defence-industrial component of “hard” economic security is reflected, first, in the scale and trajectory of defence effort. Rising military expenditure increases immediate defence capacity and supports sustained demand for domestic production and procurement; however, a one-sided expansion of spending without technological upgrading may lock economies into low value-added segments and preserve critical import dependence. In HESI+, the defence dimension is therefore captured through a comparable quantitative proxy military expenditure as a share of GDP (DC) which allows consistent cross-country and intertemporal assessment of the mobilization effort over 2014–2025.

Resilience to hybrid threats is operationalized through the capacity to maintain continuity under cyber pressure. This includes the development of national cybersecurity systems, incident response mechanisms (CERT/CSIRT), protection regimes for critical infrastructure, and coordination between public authorities and private operators. In the HESI+ framework, this dimension is proxied by the density of secure internet servers (HR), which reflects the maturity of basic digital security infrastructure and, in a panel setting, enables the identification of structural upgrading or stagnation in cyber-related resilience.

Technological autonomy reshapes industrial and innovation priorities under sustained confrontation. Whereas earlier strategies emphasized competitiveness through deep integration into global value chains, the current context increases the value of domestic innovation capacity, the ability to absorb and scale critical technologies, and the reduction of dependence on strategically sensitive imports. In HESI+, this dimension is represented by R&D expenditure as a share of GDP (TA), which serves as a standardized indicator of long-term technological capacity-building and complements security-oriented policy interpretation in the post-2022 environment.

Institutional resilience completes the architecture of “hard” economic security by determining the effective-

ness of resource allocation, policy coordination, accountability, and credibility under stress. Beyond formal regulation, this dimension reflects state capacity to implement reforms, manage external assistance, and sustain investor and public confidence. In HESI+, institutional stability is proxied by the Rule of Law estimate (IS), which captures institutional quality relevant to risk management and policy execution over time.

Policy documents at the EU level increasingly treat the economy as a frontline of hybrid confrontation and emphasize the need for monitoring tools that integrate energy, trade, cyber, and infrastructure signals. Analytical work on hybrid threats to critical infrastructure similarly highlights that cyberattacks, disinformation, sabotage, and economic pressure jointly create new risk profiles for energy, transport, and digital systems, strengthening the case for composite, multidimensional measurement frameworks [27]. For Eastern Europe, the escalation of Russia’s war against Ukraine intensifies the relevance of integrated resilience assessment and supports comparative evaluation of national trajectories rather than static single-year snapshots.

Methodologically, HESI+ builds on established practices in composite index construction, applying min–max normalization and weighted aggregation across the set of indicators. Extending the framework to a 2014–2025 panel and adding macro–financial stability variables (inflation, public debt, current account balance, real GDP growth, and fiscal balance) improves interpretability under prolonged military and hybrid pressure and reduces the risk of over-attributing resilience to any single security-related domain (Table 1).

The indicators were normalized using min–max scaling to the [0.1] interval. This procedure removes differences in units of measurement and ensures cross-country and intertemporal comparability within a single composite framework, preventing distortions arising from heterogeneous indicator scales. In the HESI+ specification, normalization is applied to the full 2014–2025 panel, which allows the index to capture both cross-sectional differences and dynamic changes in resilience under sustained military and hybrid pressures.

For benefit-type indicators (where higher values indicate stronger resilience-DC, HR, TA, IS, CA, GDP,

and FISC), the standard min–max transformation is used

$$Z_{cj} = \frac{X_{cj} - \min(x_j)}{\max(x_j) - \min(x_j)},$$

where  $X_{cj}$  denotes the value of indicator  $j$  for country  $c$ , and  $\min(x_j)$  and  $\max(x_j)$  represent the minimum and maximum values of this indicator across all countries in the sample.

For the cost-type indicator (ES – energy dependence, where higher values imply higher risk), inverse normalization is applied

$$Z_{c,ES} = \frac{\max(ES) - ES_c}{\max(ES) - \min(ES)},$$

where  $ES_c$  denotes the level of energy dependence of country  $c$ .

After normalization, the composite HESI+ score for each country  $ccc$  and year  $ttt$  is computed as a weighted aggregation of the normalized indicators. The weights  $w_j$  reflect the relative importance of each domain (Table 1) and sum to 1. Accordingly, the HESI+ index is defined as

$$HESI_{c,t}^+ = \sum_{j=1}^{10} w_j \cdot Z_{c,t,j},$$

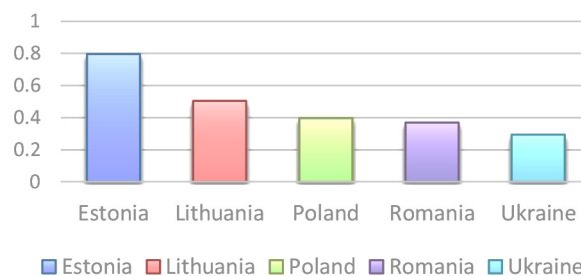
where  $Z_{c,t,j}$  denotes the normalized value of indicator  $j$  for country  $c$  in year  $t$ , and  $w_j$  is the corresponding weight assigned to indicator  $j$ .

As a result of normalization, the indicator scores are expressed on a unified [0.1] scale and presented in Fig. 1 for the latest year of the panel (2025). The figure visualizes the composite HESI+ values derived from the ten normalized indicators for each country, enabling direct cross-country comparison of overall economic resilience under sustained military and hybrid pressures.

The normalization procedure enables cross-country and intertemporal comparisons regardless of the original scale of indicators. In this study, such harmonization is essential because the HESI+ framework combines heterogeneous measures energy imports are reported as percentages, defence effort as a share of GDP, cyber capacity as secure Internet servers per million people, institutional quality as a standardized governance estimate, and macroeconomic stability indicators in different units (inflation rates, fiscal balance, current account balance, and public debt as a share of GDP). Min–max normalization removes scale heterogeneity and ensures mathematically consistent aggregation into a single composite index. At the same time, applying normalization to the full 2014–2025 panel highlights structural

*Table 1*  
Structure of the HESI+ Index (Domains and Weights) [28, 29]

Domain	Description	Weight
ES	Energy imports, net (% of energy use)	0.12
DC	Military expenditure (% of GDP)	0.12
HR	Secure Internet servers per 1 mln people	0.10
TA	R&D expenditure (% of GDP)	0.10
IS	Rule of Law (estimate)	0.10
INF	Inflation, average consumer prices (annual %)	0.10
DEBT	General government gross debt (% of GDP)	0.12
CA	Current account balance (% of GDP)	0.08
GDP	Real GDP growth (annual %)	0.08
FISC	General government net lending/borrowing (% of GDP)	0.08



*Fig. 1. Hard Economic Security Index (HESI+), 2025 (normalized scale 0–1) (Table 1)*

extremes and persistent bottlenecks by identifying countries that systematically approach the maximum or minimum values across key components.

The normalized results indicate pronounced heterogeneity in resilience profiles across countries and over time. Estonia consistently demonstrates a high-performance configuration driven by strong institutional quality, advanced digital capacity, and sustained innovation effort, which together support a coherent “whole-of-system” approach to resilience. Lithuania and Poland exhibit more uneven structures: improvements in defence effort and selected macro-stability parameters are not always matched by comparable progress in other dimensions, which limits the overall balance of their resilience profile. Romania’s pattern is more fragmented, reflecting weaker performance in innovation and institutional capacity alongside a less stable macroeconomic configuration in several years of the panel.

These cross-domain differences also reflect divergent national response trajectories to escalating military and hybrid threats after 2014 and, especially, after 2022. In the panel perspective, resilience is highest where security-oriented spending is complemented by institutional capacity, digital robustness, and macroeconomic buffers, whereas one-sided emphasis on individual domains produces only partial gains in the composite HESI+ score. The inclusion of Ukraine in the panel further strengthens this interpretation by illustrating how acute security shocks translate into macro-financial stress and institutional strain, thereby affecting the overall resilience trajectory even when selected security-related indicators improve.

Significant cross-country differences in the HESI+ components reflect divergent response trajectories to military and hybrid threats over 2014–2025. In the panel perspective, higher resilience is observed where defence effort is complemented by institutional capacity, digital robustness, innovation inputs, and macroeconomic buffers. Estonia represents the most coherent configuration, combining strong institutions and digital capacity with stable innovation effort and relatively favourable macro-fiscal conditions, which jointly support a balanced resilience profile. Poland and Lithuania display more uneven patterns: despite strengthening security-related effort over time, structural constraints in selected components (most notably institutional capacity and external/macro vulnerabilities in particular years) limit the overall balance of resilience. Romania’s trajectory remains comparatively constrained, reflecting weaker performance in innovation and governance indicators alongside less stable macroeconomic conditions across the panel.

The HESI+ framework also allows identification of the most persistent bottlenecks that systematically depress the composite score even when progress is achieved elsewhere. In practice, these bottlenecks are not interpreted as “single domains” but as recurring constraints across the ten-indicator set (energy vulnerability, institutional capacity, innovation inputs, and macro-fiscal stability). Such structural chokepoints reduce resilience because they directly affect the system’s ability to sustain critical functions under shock and to mobilize resources for adaptation.

Accordingly, the normalized indicator set constitutes the empirical basis for computing the composite HESI+

index. Normalized values are combined using the pre-defined weight structure reported in Table 1, which ensures transparent aggregation and facilitates interpretation of cross-country contrasts in both level and dynamics.

After obtaining the normalized values, the integrated HESI+ score is constructed by aggregating the ten indicators using the pre-defined weight structure (Table 1). This approach ensures transparent and comparable measurement of resilience across countries and years, while preventing any single indicator from dominating the composite score purely due to scale differences. The resulting index captures the joint effect of security-related capacity (energy exposure, defence effort, digital robustness, innovation inputs, and institutional quality) and macroeconomic buffers (inflation, debt burden, external balance, growth dynamics, and fiscal stance). Importantly, progress in one component is not sufficient on its own: higher defence effort, for example, does not translate into higher overall resilience without institutional effectiveness, technological capacity, and macro-fiscal space. At the same time, compensability across indicators is limited, because systemic vulnerabilities especially energy exposure and macro-fiscal stress can constrain resilience even when other components improve. It should also be noted that HESI measures relative, not absolute, resilience within the region. The index identifies comparative strengths and weaknesses and assesses alignment with the realities of military and hybrid threats. Importantly, it indicates whether resilience is systemic or concentrated in a single domain, which may create latent vulnerability [21].

The panel-based HESI+ results for 2014–2025 reveal that “hard” economic security in Eastern Europe is shaped less by a single policy lever and more by the consistency of a country’s resilience architecture across security, governance, digital capacity, and macroeconomic buffers. The 2014–2025 trajectory indicates that resilience profiles are path-dependent: countries that invested earlier in institutional quality, digital governance, and innovation capacity entered the post-2022 shock period with higher adaptive capacity, while economies with persistent macro-fiscal constraints or weaker institutions exhibit limited ability to convert security spending into system-wide resilience gains.

The latest-year snapshot (2025) reported in Fig. 1 demonstrates a clear differentiation of resilience models. Estonia occupies the leading position due to a comparatively balanced configuration: strong institutional quality and digital capacity coincide with sustained innovation effort and supportive macro-fiscal conditions. This suggests that, under hybrid threat exposure, small open economies can achieve high resilience when defence and cyber priorities are embedded in a wider governance-and-technology framework rather than treated as isolated sectors. Lithuania and Poland form an intermediate group both demonstrate meaningful security-related capacity, but their aggregate performance is constrained by structural bottlenecks that persist across the panel, which limits the overall balance of the resilience profile. Romania ranks below Poland and Lithuania, reflecting a less coherent combination of governance, innovation inputs, and macroeconomic buffers, which together reduce the system’s ability to absorb shocks and sustain mobilization under prolonged stress. Ukraine

records the lowest 2025 value in the sample, which is consistent with the scale of wartime macro-financial pressure and institutional strain: even when certain security-related components improve, the overall index is strongly affected by macro-fiscal stress and the limited policy space typical for an economy operating under full-scale aggression.

Importantly, HESI+ should not be interpreted as a “policy quality score” but as a structured resilience diagnostic. The empirical pattern across 2014–2025 indicates that one-sided strategies are systematically weaker: improvements in defence effort or digital readiness do not translate into high composite resilience unless supported by institutional capacity and macroeconomic buffers that ensure continuity of critical functions. This is particularly visible after 2022, when inflationary pressure, fiscal stress, and external imbalances became binding constraints for several countries, reinforcing the core logic of HESI+ resilience under military and hybrid threats is a joint product of security capacity and economic governability.

Additional analytical value is generated by cross-country domain-level comparison, which reveals internal imbalances and structural distortions within each economic security model. For instance, the Baltic states demonstrate strong digital capacity but differing levels of energy vulnerability, which significantly affect their overall HESI outcomes. Poland, in contrast, displays a strong defence component alongside weaker institutional and innovation indicators. Such comparisons help identify the most critical drivers of resilience at the regional level.

Beyond cross-country contrasts, the domain-level structure of HESI+ also reveals the degree of internal coherence within national security models. Countries exhibiting balanced development across energy security, defence capacity, institutional stability, technological autonomy, and macroeconomic resilience tend to demonstrate greater robustness to external shocks than those relying on a single dominant component. Conversely, concentration of performance in one or two domains such as defence spending without parallel institutional strengthening or innovation investment creates structural asymmetries that may limit the overall effectiveness of economic security policy. This multidimensional perspective underscores that sustainable resilience in Eastern Europe depends not only on the scale of policy intervention, but on the systemic alignment of its components.

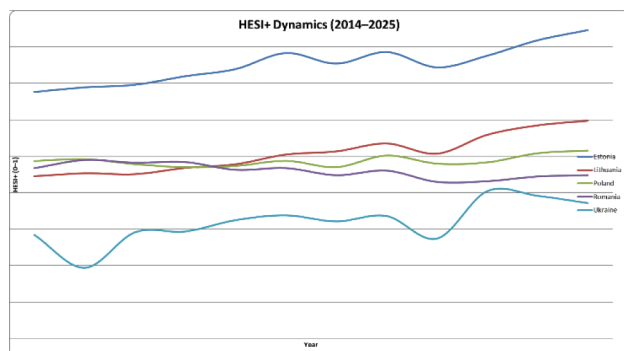


Fig. 2. Dynamics of the HESI+ composite index in Eastern European countries (2014–2025) [30]

Fig. 2 illustrates the dynamics of the HESI+ composite index for Poland, Lithuania, Romania, Estonia, and Ukraine over the period 2014–2025. The figure demonstrates both cross-country heterogeneity and structural breaks after 2022 associated with the escalation of military and hybrid threats. Estonia and Poland display relatively stable upward trajectories, while Ukraine exhibits a pronounced structural shock in 2022 followed by partial recovery. Lithuania and Romania show moderate but uneven dynamics reflecting asymmetric structural adjustments.

The panel-based visualization presented in Fig. 2 illustrates the trajectory of the composite HESI+ index for Poland, Lithuania, Romania, Estonia, and Ukraine over the period 2014–2025. Unlike a static cross-sectional comparison, the dynamic representation allows identification of structural breaks, resilience acceleration phases, and post-2022 adjustment patterns.

While the HESI+ index captures structural economic security capacity across energy, defence, institutional, technological, and macroeconomic dimensions, it does not directly reflect asymmetric geopolitical exposure following the escalation of military aggression after 2022. To account for exogenous vulnerability, a composite Risk coefficient is introduced and multiplicatively integrated into the baseline index.

In the Eastern European security environment, part of the observed cross-country variation in resilience is driven not only by domestic policy capacity, but also by the intensity of external pressure. Geographic proximity to Russia/Belarus, dependence on vulnerable energy channels, exposure to hybrid operations (cyberattacks, disinformation, sabotage), and sensitivity to trade and fiscal shocks may significantly compress “effective” security outcomes even when structural indicators improve.

Accordingly, a compact risk block is specified to operationalize this exogenous component in a transparent, reproducible way. The block aggregates five normalized dimensions and yields a single Risk coefficient (0–1), which is then used to adjust HESI+ multiplicatively. This approach preserves the interpretation of HESI+ as structural capacity, while explicitly quantifying the vulnerability discount applied to that capacity under heightened geopolitical stress.

Five external risk dimensions are considered:

- GR – Geopolitical proximity risk;
- ER – Energy coercion risk;
- HR – Hybrid and cyber threat intensity;
- TR – Trade concentration risk;
- FR – Fiscal vulnerability under war shock conditions.

All the risk indicators are normalized on a [0;1] scale, where higher values indicate higher vulnerability.

Table 2

Normalized Risk Indicators and Composite Risk Coefficient (2025)

Country	GR	ER	HR	TR	FR	Risk
Poland	0.60	0.35	0.55	0.40	0.50	0.48
Lithuania	0.70	0.40	0.60	0.45	0.45	0.52
Romania	0.50	0.30	0.45	0.35	0.40	0.40
Estonia	0.65	0.25	0.65	0.38	0.35	0.46
Ukraine	1.00	0.80	0.90	0.70	0.95	0.87

Conceptually, the Risk block captures exogenous vulnerability, the intensity of external pressure that can compress effective economic security outcomes regardless of domestic reform effort. In Eastern Europe, this vulnerability is shaped by proximity to adversarial actors, exposure to coercive energy channels, the intensity of hybrid operations, sensitivity to trade disruptions, and war-related fiscal stress.

Methodologically, each risk dimension is operationalized as a quantitative proxy and normalized to a [0; 1] scale (higher values indicate higher vulnerability). Normalization follows the same min–max logic used for HESI+ indicators, ensuring comparability across countries and preventing the composite from being driven by heterogeneous units.

The composite Risk coefficient is then calculated as the arithmetic mean of the five normalized risk dimensions (Table 3). This aggregation preserves transparency and interpretability and allows a straightforward sensitivity check (e.g., alternative weights or exclusion of a component).

Finally, to translate the risk environment into an adjustment of structural capacity, the Risk coefficient is integrated into HESI+ via a multiplicative correction. This specification interprets Risk as a proportional “discount” applied to structural capacity under heightened geopolitical stress.

To incorporate geopolitical pressure into the structural index, the adjusted specification is defined as

$$HESI_{adj} = HESI+ \cdot (1 - Risk).$$

This multiplicative form reflects proportional erosion of structural resilience under external vulnerability.

The comparison between HESI+ and HESI<sub>adj</sub> reported in Table 3 demonstrates that structural economic capacity does not automatically translate into effective resilience under conditions of heightened geopolitical exposure. While HESI+ reflects accumulated domestic capacity across energy, defence, institutional, technological, and macroeconomic dimensions, the Risk-adjusted index captures the extent to which this capacity is compressed by external vulnerability factors. The magnitude of divergence between the two indices therefore provides a measurable estimate of the “exposure discount” applied to structural security under current threat conditions (2025).

Fig. 3 visualizes the interaction between structural economic capacity (HESI+) and exogenous vulnerability pressure (Risk-adjusted HESI). While HESI+ reflects accumulated institutional, technological, fiscal, and defence capacity over the 2014–2025 panel, the adjusted index incorporates the compressing effect of geopolitical exposure observed in 2025.

Table 3

HESI+, Risk Exposure, and Adjusted Resilience Scores in Eastern European States (Table 2)

Country	HESI+	Risk	HESI <sub>adj</sub>
Poland	0.67	0.48	0.35
Lithuania	0.63	0.52	0.30
Romania	0.55	0.40	0.33
Estonia	0.72	0.46	0.39
Ukraine	0.41	0.87	0.05

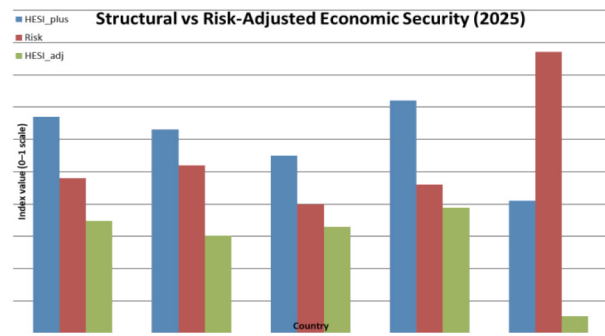


Fig. 3. Structural and Risk-Adjusted Economic Security (2025) (Table 3)

The gap between HESI+ and HESI<sub>adj</sub> represents the measurable vulnerability discount generated by external risk factors. Countries with moderate structural capacity but lower geopolitical exposure experience a limited contraction effect, whereas highly exposed states demonstrate substantial erosion of effective resilience despite internal reform efforts.

This comparison allows a refined interpretation of regional security dynamics. Structural modernization alone does not guarantee effective resilience if exposure to war-related fiscal stress, hybrid operations, and geopolitical proximity remains high. Consequently, sustainable economic security requires both strengthening domestic capacity and actively reducing structural exposure to external pressure.

The graphical representation clearly demonstrates divergence between structural capacity and effective resilience under geopolitical stress. Estonia and Poland retain the highest adjusted values, indicating relatively balanced security models. Lithuania and Romania exhibit moderate compression effects. Ukraine demonstrates the strongest contraction due to extreme exposure across fiscal, hybrid, and geopolitical dimensions.

The results confirm that economic security in conflict-affected regions is determined by the interaction between internal structural capacity and exogenous vulnerability pressure. Incorporating a multiplicative risk block transforms HESI+ into a conflict-sensitive analytical instrument suitable for policy assessment under sustained hybrid confrontation.

**Conclusion.** This study confirms that after 2022 economic security in Eastern Europe should be conceptualized not as a narrow set of macroeconomic “stability” indicators, but as an integrated resilience capacity that determines whether the state and the economy can function, adapt, and recover under sustained military and hybrid disruption. In this context, policy choices in energy, defence-industrial development, technology, cyber security, and governance become structurally interdependent, meaning that progress in one sphere can be neutralized by persistent weaknesses in another.

To operationalize this shift, the paper develops and applies HESI+, a panel-based composite index covering 2014–2025 and integrating ten indicators that jointly capture energy exposure, defence effort, cyber/digital readiness, technological capability, institutional quality, and macroeconomic sustainability. Extending the assessment beyond a single-year cross-section improves interpretability by allowing the index to reflect medium-

term trajectories and structural adjustments rather than point-in-time fluctuations. Importantly, the inclusion of Ukraine strengthens the regional relevance of the analysis by anchoring the index in the most extreme contemporary case of security-driven economic transformation.

The empirical results show persistent cross-country heterogeneity in both aggregate scores and domain-level profiles. Estonia and Poland tend to exhibit comparatively higher structural capacity, although with different internal configurations; Lithuania and Romania display more pronounced asymmetries, where strengths in selected domains are offset by bottlenecks in others. Domain-level inspection indicates that “one-sided” resilience strategies such as emphasizing defence spending without parallel improvements in institutional performance, innovation capacity, or macro-fiscal buffers produce structurally fragile security models. Thus, the index supports the core conclusion that resilience in Eastern Europe is primarily determined by coherence across domains rather than by the maximization of any single component.

A key added contribution of the study is the introduction of a composite Risk coefficient capturing exogenous geopolitical exposure, integrated through a transparent multiplicative correction:  $HESI_{adj} = HESI+ \cdot (1 - Risk)$ . This adjustment demonstrates that structural capacity and effective resilience under exposure may diverge substantially when countries operate under different levels of external pressure. The observed gap between HESI+ and  $HESI_{adj}$  provides a quantifiable estimate of the “exposure discount”, i.e., the proportion of domestic capacity that cannot be fully translated into effective security outcomes under intensified hybrid and war-related stress.

Against this background, the composite HESI framework enables a more structured reading of resilience under conditions where military pressure, energy coercion, and hybrid operations operate simultaneously. By combining capability-oriented dimensions with an explicit risk adjustment, the approach captures not only the presence of protective capacities but also the extent to which external exposure can erode their effectiveness. This makes it possible to interpret cross-country differences in terms of both mobilization potential and vulnerability management, rather than relying on isolated indicators or single-domain rankings.

Overall, the findings substantiate that economic security in conflict-affected regions is shaped by the interaction between endogenous modernization capacity and exogenous vulnerability dynamics. Methodologically, HESI+ (and its risk-adjusted extension) offers a conflict-sensitive analytical instrument suitable for comparative assessment and monitoring, with potential applicability to other regions exposed to persistent hybrid threats. Substantively, the results imply that sustainable resilience requires a dual logic – systematic strengthening of institutional, technological, and macroeconomic foundations, and targeted reduction of exposure channels that transmit external coercion and disruption into the national economy.

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## Політика «жорсткої» економічної безпеки у Східній Європі в умовах гібридних і воєнних загроз

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**Мета.** Обґрунтувати перехід до політики «жорсткої» економічної безпеки у країнах Східної Європи в умовах тривалих військових і гібридних загроз (2014–2025) й розробити інтегральний індекс жорсткої економічної безпеки (HESI) для міждержавного порівняння.

**Методика.** Дослідження поєднує інституційно-структурний, порівняльний і ризик-орієнтований підходи. Кількісні процедури включають відбір та

операціоналізацію індикаторів, min–max нормалізацію, побудову композитного індексу й застосування методу аналізу ієрархій (АНР) для визначення ваг доменів. Емпірична рамка інтегрує багатовимірну оцінку у сферах енергетичної безпеки, оборонно-промислової спроможності, гібридної й кіберстійкості, технологічної автономії та інституційної стабільності. Візуалізація використовується для представлення міждержавних відмінностей.

**Результати.** Встановлено внесок п'яти відібраних авторами факторів у зміну показника економічної стійкості за умов воєнних руйнувань, енергетичного примусу, технологічних обмежень і гібридного тиску. Запропоновано й емпірично апробовано індекс HESI, що дозволяє ранжувати країни Східної Європи за здатністю підтримувати функціонування ключових економічних систем в умовах військової та гібридної ескалації. Отримані результати свідчать про диференціацію між країнами й підтверджують, що стійкість визначається не окремим чинником, а збалансованою конфігурацією енергетичної автономії, кіберготовності, технологічної спроможності та інституційної якості. Виявлено стратегічний перехід від «м'яких» моделей економічної безпеки до сек'юритизованої, ризик-контрольованої політики.

**Наукова новизна.** Доведено, що наявні глобальні й регіональні індекси не забезпечують інтегровано-го вимірювання економічної безпеки в умовах військової та гібридної конфронтації. Запропонований HESI поєднує економічні, безпекові, технологічні, кібернетичні й інституційні виміри в єдину аналітичну модель, придатну для структурованого порівняння в умовах системних потрясінь.

**Практична значимість.** Результати дослідження формують прикладний інструментарій для політиків і дослідників щодо діагностики структурних вразливостей, визначення пріоритетних напрямів втручання й розроблення узгоджених стратегій жорсткої економічної безпеки. Рамка HESI може бути використана для стратегічного планування, моніторингу політик підвищення стійкості й адаптації національних і європейських заходів економічної безпеки в регіонах, що зазнають тривалих військових і гібридних ризиків.

**Ключові слова:** фінанси, безпека, гібридні загрози, кіберзагрози, стійкість, енергетика, детермінанти, ризики

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