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METHODOLOGIES FOR COUNTRY RISK ASSESSMENT IN AML/CFT: A COMPARATIVE ANALYSIS OF POLICY FRAMEWORKS AND ECONOMETRIC MODELS

ABSTRACT

Assessing country risk in Anti-Money Laundering and Counter-Terrorist Financing (AML/CFT) is increasingly significant in global financial integration, digitalisation, and persistent illicit financial flows. Despite international standards, the unobservable nature of laundering makes risk measurement highly dependent on proxies and methodological choices, creating both conceptual and practical challenges. This research aims to conduct a comparative analysis of AML/CFT country risk assessment methodologies, integrating policy frameworks with econometric and probabilistic models. The study employs a comparative analytical framework, synthesising official assessments (FATF mutual evaluation reports, NRAs, and IMF/World Bank tools), quantitative indexes (e.g., Basel AML Index), econometric approaches (Walker-Unger gravity model, Ferwerda's black box, Schneider-Windisch MIMIC), qualitative frameworks, and emerging Bayesian/probabilistic methods. The findings indicate that no single methodology provides a definitive measure of country risk. Policy-driven tools ensure global legitimacy and comparability but are static, resource-intensive, and sometimes politicised. Composite indices and proprietary models offer usability and accessibility but often lack methodological transparency and risk oversimplification. Academic econometric approaches generate quantitative estimates and enhance analytical depth, though they remain sensitive to assumptions and limited in operational application. Probabilistic and Bayesian methods represent a promising frontier, explicitly incorporating uncertainty and diverse data sources, but their complexity and reliance on subjective priors constrain widespread adoption.

Keywords: AML/CFT, country risk, FATF, Basel AML Index, gravity models, Bayesian networks

JEL Classification: K42, G28, F65, C18, H26

INTRODUCTION

The problem of assessing country risk in Anti-Money Laundering and Counter-Terrorist Financing (AML/CFT) has become increasingly urgent in global financial integration, digitalisation of financial services, and geopolitical instability. Despite decades of international standard-setting, money laundering and terrorism financing continue to undermine financial stability, erode governance, and facilitate organised crime. The Financial Action Task Force (FATF) and its regional bodies have established the global AML/CFT compliance benchmark. However, persistent divergences in national implementation and the inherent difficulty of quantifying hidden illicit flows highlight the need for robust and comparable methodologies.

The actuality of this research is reinforced by the fact that money laundering is fundamentally unobservable, measuring risks that are highly dependent on proxies, assumptions, and modelling strategies. Existing approaches, from FATF mutual evaluation reports and national risk assessments to the Basel AML Index, provide valuable insights but are limited by their static, compliance-oriented nature and by methodological opacity in the case of composite indexes (Levi & Reuter, 2006). Meanwhile, academic models such as the Walker-Unger gravity framework, Ferwerda's black box approach, and

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Schneider's MIMIC model offer innovative quantitative estimations of laundering flows, but these remain sensitive to parameter choices and difficult to operationalise for regulatory practice (Walker, 1999; Ferwerda, 2009; Ferwerda et al., 2013a; Schneider & Windischbauer, 2008; Schneider, 2010; Unger, 2007; Unger & van der Linde, 2013).

The growing importance of probabilistic and machine learning approaches adds another layer of relevance, as Bayesian models and artificial intelligence techniques offer ways to account for uncertainty explicitly and to integrate diverse governance, economic, and financial indicators (Kraisangka, 2019; Kuzmenko et al., 2011; Dmytrov et al., 2010). However, their adoption is still in its infancy, constrained by data availability, technical complexity, and interpretability challenges. This makes the comparative analysis of methodologies not only timely but essential, as it can inform both policy-making and academic research, helping to bridge the gap between global compliance frameworks and advanced econometric models.

In this light, the study contributes to the ongoing debate by systematically comparing policy-driven and academic approaches, identifying their strengths and weaknesses, and outlining pathways for methodological integration. Such an endeavour is crucial for enhancing the credibility, comparability, and policy relevance of AML/CFT country risk assessments, especially in an era where illicit financial flows adapt rapidly to regulatory changes and geopolitical shocks.

LITERATURE REVIEW

The assessment of country risk in AML/CFT has evolved through the interplay of policy-driven frameworks, econometric modelling, and digital innovations, reflecting a growing recognition that money laundering represents both a financial crime and a systemic risk. The global architecture established by the FATF and its regional bodies remains the cornerstone, yet its effectiveness and methodological robustness have been increasingly scrutinised. The diversity of approaches, from compliance assessments to advanced quantitative modelling, illustrates the multidimensional character of the problem.

Research highlights the socio-economic and institutional determinants that shape AML/CFT vulnerabilities at the country level. Studies emphasise how weak governance, corruption risks, inadequate regulation, and institutional gaps amplify the probability of laundering and terrorist financing activities (Pulungan et al., 2024; Yarovenko et al., 2024b). The effectiveness of enforcement also depends on fiscal policy and tax structures, as excessive burdens or low compliance environments increase incentives for illicit financial behaviour (Halynskyi et al., 2024). In contexts of fragile security and wartime disruption, such as Ukraine, the risk of cyber fraud and financial crime escalates, underscoring the role of judicial maturity and digital monitoring tools (Yarovenko et al., 2024a; Dobrovolska & Rozhkova, 2024a; Yarovenko & Rogkova, 2022).

From a regulatory and compliance perspective, FATF's mutual evaluation reports (MERs) have been the most influential benchmark, though scholars point out inconsistencies and methodological limitations. Analyses of textual dissimilarities in MERs demonstrate the challenges of achieving universal comparability, raising questions about whether evaluations genuinely capture risk or primarily reflect standardised formalism (Deshmukh, 2025). Critiques further stress that the global AML/CFT regulatory framework often exhibits gaps, inconsistencies, or political biases undermining its credibility (Gaviyau & Sibindi, 2023). Compliance evaluations remain vital for international legitimacy and regulatory enforcement (Kovalenko et al., 2024; Ishwardat et al., 2024; van der Lee et al., 2025).

Parallel to compliance-based tools, composite and bibliometric analyses reveal the importance of measuring systemic vulnerabilities with broader governance and financial indicators. The Basel AML Index and related approaches integrate corruption, secrecy, and governance data into risk scores, providing accessible country comparisons, though often criticised for methodological opacity (Kuzior et al., 2022). Bibliometric investigations further show a strong link between AML efficiency, transparency, and institutional digitalisation, highlighting the relevance of monitoring scientific progress in this area (Dobrovolska & Rozhkova, 2024b).

Econometric modelling provides a distinct strand of the literature, seeking to quantify laundering flows or latent vulnerabilities. The Walker-Unger gravity model and its refinements extend Tinbergen-type trade equations to illicit flows, capturing how predicate crime interacts with financial centre attractiveness and regulatory distance (Lyeonov et al., 2020). Ferwerda's "black box" approach, in turn, conceptualises laundering as a latent variable linking crime proceeds to financial system absorption, enabling policy simulations (Ferwerda, 2009). Schneider and Windischbauer's MIMIC model connect laundering vulnerability to the size of the shadow economy, providing macro-structural insights, albeit with conceptual ambiguity (Schneider & Windischbauer, 2008). These models reveal the potential for quantitative analysis and the difficulties of relying on assumptions and proxies that limit robustness and comparability (Kuzior et al., 2025).

Recent advances point towards the role of digitalisation and artificial intelligence in enhancing AML/CFT risk assessments. Bibliometric and applied studies show the growing integration of machine learning and AI in combating illegal financial

flows, with mixed results regarding whether these technologies primarily benefit criminals or supervisory agencies (Lyeonov et al., 2024; Lyeonov et al., 2025). Digitalisation also strengthens AML frameworks by improving transparency, strengthening anti-fraud systems, and adapting financial monitoring entities to modern threats (Vasilyeva et al., 2021; Hałuszko et al., 2025; Dobrovolska & Rozhkova, 2024b). However, the literature underscores that the rapid adoption of digital tools brings new vulnerabilities, particularly in the face of cyberattacks, hybrid warfare, and organised financial crime (Yarovenko et al., 2024; Dobrovolska & Rozhkova, 2024a).

Comparative studies at the intersection of policy and methodology emphasise the value of clustering countries by FATF compliance and effectiveness, illustrating how typologies can guide tailored AML/CFT strategies (Kuzior et al., 2025; Patel et al., 2023). Insights from sustainable cyberspace strategies and financing typologies show the importance of aligning AML/CFT frameworks with broader financial stability and innovation goals (Dobrovolska & Rozhkova, 2024a; Patel et al., 2023; Halynskyi et al., 2024).

The literature demonstrates various methodologies for assessing country AML/CFT risk, ranging from compliance-based frameworks and composite indexes to econometric models and digital innovations. While no single approach can fully capture the complexity of laundering risks, the comparative analysis of methods reveals complementarities that can enhance robustness and policy relevance. Integrating compliance benchmarks with econometric models and emerging digital tools offers the most promising avenue for achieving credible and effective AML/CFT country risk assessments in a rapidly changing financial and geopolitical landscape.

AIMS AND OBJECTIVES

This study aims to adopt a hybrid approach, bridging policy frameworks (FATF, NRA, Basel Index, sanctions lists) and academic models (Walker-Unger, Ferwerda's black box, Schneider-Windisch MIMIC, Bayesian), to comparatively assess AML/CFT country risk by integrating policy relevance with academic validity.

METHODS

This study adopts a comparative methodological approach to assessing country-level risk in AML/CFT. Recognising that money laundering is an inherently hidden and complex phenomenon, the methodology combines a review of existing international standards with an analysis of quantitative and qualitative models developed in academic and policy contexts. The objective is not to identify a single best measure, but to evaluate the strengths and weaknesses of the main approaches to derive a more comprehensive understanding of country risk assessment.

The starting point for the analysis is the policy-driven frameworks anchored in the FATF standards. Complementary to these are national and supranational risk assessments, such as those undertaken by EU institutions, which operationalise risk through the interplay of threats, vulnerabilities, and consequences. In addition, World Bank and IMF tools are considered, since they provide structured, standardised templates that facilitate national-level assessments, particularly in developing and transition economies. The second dimension of the methodology reviews composite index approaches, such as the Basel AML Index, which aggregate FATF ratings, corruption perception data, governance indicators, and secrecy measures into cross-country rankings. These are contrasted with sanctions lists and international watchlists (UN, EU, OFAC), which adopt a binary classification of jurisdictions. Regulators and financial institutions widely apply both methods, though they vary in transparency and granularity. Beyond compliance and index-based approaches, the study incorporates academic econometric models designed to estimate laundering flows more directly. These include the Walker–Unger gravity model, which applies trade gravity logic to cross-border illicit flows; Ferwerda's "black box" model, which treats money laundering as a latent variable derived from crime proceeds; and the Schneider–Windisch MIMIC approach, which infers laundering vulnerability as a proportion of the shadow economy. These models are evaluated for their ability to generate quantitative estimates while acknowledging their reliance on assumptions, proxies, and calibration choices.

The methodology further includes a review of alternative and emerging approaches, such as Bayesian and probabilistic risk models (Kraisangka, 2019), which explicitly incorporate uncertainty and integrate heterogeneous data sources, as well as hybrid institutional models developed by commercial providers (e.g., Refinitiv, Moody's, Dow Jones), which combine public and proprietary indicators into customised scoring systems. Finally, qualitative, risk-based frameworks proposed by Levi and Reuter (2006) are discussed as a critical counterpoint, highlighting the risks of false precision in quantitative models and the importance of governance and institutional analysis.

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The methodologies are synthesised in a comparative table (Table 1), contrasting their purpose, scope, strengths, and limitations for analytical clarity. This comparative approach ensures that both policy relevance and academic rigour are maintained, and it provides the foundation for a balanced assessment of AML/CFT country risk that accounts for the trade-offs between transparency, validity, and usability.

RESULTS

In AML/CFT, the country risk assessment represents a cornerstone of the risk-based approach promoted by the FATF. Existing methodologies employed by regulators, financial institutions, and international organisations vary in scope and rigour. However, they commonly rely on qualitative indicators (such as legal frameworks, enforcement practices, and governance structures) and quantitative indicators (including statistical data, indices, and ratings). The following section reviews the principal methodological approaches and highlights their strengths and limitations.

FATF mutual evaluation reports (MERs) *and the International Cooperation Review Group* (ICRG) *process*

The FATF, together with its regional bodies such as MONEYVAL and the Asia/Pacific Group, conducts regular MERs to assess countries' compliance with the 40 FATF Recommendations and the effectiveness of their AML/CFT systems across 11 Immediate Outcomes. Based on these evaluations, jurisdictions with significant deficiencies may be placed under increased monitoring (grey list) or designated as high-risk (blacklist) through the FATF's ICRG process.

The strength of this approach lies in its legitimacy and comprehensiveness, as it represents the global standard agreed upon by governments and international stakeholders. It also combines peer-review assessments, detailed scoring, and qualitative narratives. However, its weaknesses are equally evident: evaluations are resource-intensive, infrequent, and potentially politicised, which may lead to outdated or biased risk perceptions (Levi & Reuter, 2006). Furthermore, MERs provide a compliance snapshot rather than a dynamic measure of actual laundering activity (Ferwerda, 2009).

National and supranational risk assessments (NRA/SNRA)

At the national level, countries are expected to conduct NRAs, often supported by the World Bank NRA Tool or equivalent methodologies. At the supranational level, the European Union publishes an SNRA every two years. These assessments generally rely on a conceptual framework where risk is defined as a function of threat, vulnerability, and consequence. Methodologically, they combine expert judgement, stakeholder surveys, data on predicate crimes, suspicious transaction reports, and law enforcement outcomes.

The strength of NRA/SNRA approaches lies in their contextual relevance and adaptability, allowing countries or regions to tailor risk assessments to their specific circumstances. They also foster domestic coordination and enhance policy ownership. Their main weaknesses, however, are rooted in the subjectivity of expert judgement, data gaps, and varying quality across jurisdictions, which limit comparability and may undermine reliability for cross-country analysis (Ferwerda et al., 2013a).

World Bank and IMF tools

International financial institutions also play a role in the risk assessment of AML/CFT countries. As mentioned, the World Bank NRA Tool offers structured questionnaires, weighted scoring mechanisms, and scenario analyses designed to help countries develop systematic NRAs. Similarly, the IMF includes AML/CFT frameworks in its Financial Sector Assessment Programmes, where AML/CFT is analysed as a component of overall financial stability risk.

The advantage of these tools is that they are methodologically standardised, capacity-building oriented, and widely adopted, particularly in developing countries (Schneider & Windischbauer, 2008). They provide structured processes that improve transparency and replicability. However, their weaknesses include a heavy reliance on self-reported data, which may lack objectivity, and the limited scope of FSAPs, which are not conducted regularly in all countries.

Quantitative composite indexes

A different category of methodologies relies on aggregating diverse indicators into quantitative composite indexes that rank country AML/CFT risks. The Basel AML Index is the most prominent example, combining FATF evaluation data with Transparency International's Corruption Perceptions Index, the World Bank's Worldwide Governance Indicators (Kaufmann et al., 2010), financial secrecy measures, and other governance indicators. Commercial providers such as Dow Jones, Refinitiv, and Moody's Analytics offer proprietary country risk scores, which combine FATF evaluations, sanctions exposure, political risk, and governance indicators. Unlike public indexes, these are subscription-based and lack full methodological transparency.

The primary strength of composite indexes is their comparability and accessibility: they provide standardised rankings that are easy for financial institutions and policymakers to interpret. They also offer a regularly updated, data-driven complement to qualitative assessments. The weaknesses of such approaches, however, stem from methodological opacity (particularly in proprietary models), subjectivity, and the risk of oversimplification by reducing complex AML/CFT risks into single scores (Levi & Reuter, 2006; Schneider & Windischbauer, 2008).

Sanctions and international watchlists

International organisations and states also define country risk through sanctions and watchlists. The United Nations, European Union, and United States (Office of Foreign Assets Control, OFAC) regularly issue lists of countries under sanctions, embargoes, or designated as state sponsors of terrorism. These lists apply a binary or categorical methodology, classifying jurisdictions as restricted, high risk, or prohibited.

The strength of this method lies in its clarity, enforceability, and policy impact: sanctions directly affect financial flows and compliance obligations. However, its weaknesses include political selectivity, limited coverage of broader AML/CFT risks beyond terrorism financing and proliferation, and the absence of a granular risk spectrum (Levi & Reuter, 2006).

Hybrid qualitative-quantitative models

Many banks, regulators, and compliance institutions develop internal hybrid models that combine data from multiple sources. These models often integrate FATF evaluations, Basel AML Index scores, sanctions exposure, corruption measures, governance indicators, geopolitical risks, and terrorist activity data into proprietary weighted scoring systems (Unger & van der Linde, 2013).

The key advantage of hybrid models is their flexibility and responsiveness, allowing institutions to adjust parameters according to their risk appetite and regulatory requirements. They also enable the integration of real-time intelligence. On the other hand, their weaknesses are significant: these models are usually non-transparent, inconsistent across institutions, and difficult to validate externally, which may create regulatory uncertainty and undermine comparability across the financial sector (Ferwerda, 2009).

The Walker-Unger gravity model

The Walker-Unger gravity model is among the most influential econometric approaches to estimating money laundering activity at the country level. This method is widely recognised in the literature as a quantitative tool that can approximate laundering volumes and, by extension, serve as a proxy for assessing country-level AML/CFT risk.

The model originated with John Walker (1995, 1999), who adapted a gravity model framework, which is well established in international trade economics, to estimate global money laundering flows. Brigitte Unger subsequently refined the framework in the 2000s (e.g., Unger, 2007), who incorporated the model into empirical studies for the European Commission, the United Nations Office on Drugs and Crime, and academic applications.

The Walker-Unger model conceptualises laundering flows as a function of three primary components: the generation of predicate crime proceeds in the sending country, the attractiveness of the receiving country's financial system, and the distance or barriers between jurisdictions. Formally, money laundering flows (ML_{ij}) from country iii to country jjj are modelled as:

$$ML_{ij}=f(Crime_i, Attractiveness_j, Distance_{ij}),$$

where $Crime_i$ denotes the size of domestic criminal proceeds; $Attractiveness_j$ reflects pull factors such as banking secrecy, regulatory quality, and financial sophistication; and $Distance_{ij}$ captures barriers including geographic distance, trade intensity, cultural or linguistic ties, and regulatory frictions.

This structure allows the model to generate estimates of laundered volumes per country, produce rankings of jurisdictions by inflows and outflows, and distinguish net exporters and importers of illicit funds.

The Walker-Unger framework has been applied in policy-oriented studies, including European Commission reports (Ferwerda et al., 2013b). It has been referenced by UNODC in its work on illicit financial flows. It has been employed in academia to evaluate AML policy effectiveness and the distribution of laundering risks across jurisdictions, offering a quantitative complement to compliance- and governance-based approaches.

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The primary strength of the Walker-Unger method is its ability to provide quantitative country-level estimates, in contrast to purely qualitative assessments such as FATF mutual evaluation reports. It captures the supply side of laundering (predicate crime generation) and the demand side (financial havens and system attractiveness) while accounting for cross-border dynamics rather than focusing exclusively on domestic activity. This makes it particularly useful for macro-level policy analysis and comparative research.

Despite its innovative structure, the model faces significant limitations. Since money laundering is inherently unobservable, the framework relies heavily on proxies and assumptions, making estimates highly sensitive to parameter choices such as crime rates, secrecy scores, or trade weights. Critics argue that it risks double-counting or overestimating flows, and its results may vary substantially depending on input specifications. Moreover, the complexity and abstraction of the model reduce its practical utility for day-to-day compliance operations in financial institutions, positioning it primarily as a tool for academic analysis and policy debate rather than operational risk management (Unger,2007; Unger & van der Linde, 2013).

The Walker-Unger gravity model offers a structured and quantitative means of estimating cross-border laundering flows, distinguishing it from compliance-based assessments such as FATF or index-based measures like the Basel AML Index. Its strengths lie in its ability to integrate crime generation, financial system attractiveness, and interjurisdictional linkages, while its weaknesses stem from data limitations, methodological sensitivity, and limited practical applicability. As such, it remains a valuable instrument for macro-level analysis of AML/CFT country risk, though one that should be interpreted with caution (Levi & Reuter, 2006; Ferwerda, 2009).

Alternative methodological approaches to assessing AML/CFT country risk

Beyond the widely applied frameworks of the FATF, the Basel AML Index, the World Bank NRA tool, and the Walker-Unger model, various researchers have proposed additional models and frameworks to estimate country-level AML/CFT risks or laundering flows. Although less frequently used in practice, these approaches are highly relevant in academic and methodological debates.

Tinbergen / gravity-type models (extensions of Walker–Unger)

Tinbergen represents one significant strand of research on quantifying money laundering risks- or gravity-type models, which build upon and extend the original Walker-Unger framework (Walker & Unger, 2009). These models adopt the logic of international trade gravity equations and apply it to illicit financial flows, thereby modelling laundering as a function of crime generation, financial system attractiveness, and interjurisdictional linkages. Scholars such as Ferwerda et al. (2013) have introduced important refinements in this line of work. In particular, they expanded the explanatory variables to include corruption levels, taxation regimes, secrecy jurisdictions, and regulatory quality indicators. This allowed the model to capture a more realistic set of push and pull factors driving cross-border laundering.

These extensions have proven especially valuable in European Union-wide simulations and policy assessments, where the need for comparative frameworks is high but reliable quantitative data are scarce. By integrating multiple governance and financial indicators, the refined gravity models offer empirical richness and explanatory power that surpasses earlier versions, making them suitable for analysing how institutional weaknesses or regulatory gaps can shape laundering flows.

Nevertheless, these advantages come with important caveats. Gravity-type models are highly sensitive to parameter specification and the choice of proxies, such as crime rates or secrecy indexes, which are often difficult to measure with precision. Small changes in variable construction or weighting can produce substantially different outcomes, raising questions about robustness and replicability across jurisdictions. In addition, the models assume relatively stable relationships between crime generation and financial system attractiveness, which may not hold in rapidly evolving regulatory or geopolitical environments. Thus, while gravity-type models offer an appealing framework for macro-level comparative analysis, their reliance on assumptions and their susceptibility to data limitations can constrain their effectiveness as reliable policy tools.

Ferwerda's "Black Box" approach

Ferwerda's "black box" model represents a second noteworthy approach, which treats money laundering as a latent and unobservable variable within the broader dynamics of crime and finance (Ferwerda, 2009; 2013a; 2013b). Unlike gravity-based models that directly trace illicit flows between jurisdictions, the black box framework begins with estimating the domestic proceeds of crime, drawing on available statistics and proxies such as levels of organised crime, drug trafficking revenues, or fraud losses. A proportion of these proceeds is then assumed to be laundered and distributed across international financial centres based on structural characteristics such as financial sector openness, regulatory stringency, or secrecy provisions.

The model is described as a "black box" because the exact mechanisms of laundering cannot be observed empirically, meaning that the attribution of criminal proceeds to laundering and their distribution relies on assumptions, probability distributions, and scenario testing. Despite this limitation, the method has gained traction in policy evaluation contexts, particularly when assessing the effectiveness of AML measures. By comparing estimated laundering volumes under different policy scenarios, it becomes possible to model whether stricter regulations or enhanced supervision could plausibly reduce laundering activities.

The strength of Ferwerda's model lies in its ability to create a conceptual and quantitative bridge between the generation of criminal proceeds and their eventual integration into the legitimate financial system. It allows researchers and policymakers to experiment with "what if" scenarios, providing insights into interventions' potential effectiveness even without perfect data. Moreover, it introduces a systematic structure to an area often dominated by fragmented or anecdotal evidence, thereby contributing to the comparative study of AML policy efficiency across jurisdictions.

Nevertheless, the weaknesses of the approach are significant. Its reliance on unobservable assumptions regarding the proportion of crime proceeds laundered makes results highly sensitive to initial parameters and calibration choices. This raises concerns about replicability, robustness, and external validation, as different analysts using slightly different assumptions may arrive at substantially different estimates. Additionally, the absence of direct empirical measurement limits the model's acceptance for operational risk management, relegating its primary utility to academic analysis, exploratory modelling, and policy debate rather than real-time compliance or enforcement.

Schneider-Windisch model

The Schneider-Windisch model (Schneider & Windischbauer, 2008; Schneider, 2010) represents a distinct methodological approach to quantifying money laundering risks, emerging from the long-standing research tradition into the shadow or underground economy. At its core, this model employs the MIMIC (Multiple Indicators Multiple Causes) approach, a structural econometric technique frequently applied in studies of tax evasion and informal economic activity. The model's logic is that the hidden economy cannot be observed directly. However, it can be inferred from measurable causes, such as tax rates, regulatory burden, unemployment, and indicators, including cash demand, national account discrepancies, or irregular labour statistics.

In money laundering, the Schneider-Windisch framework posits that laundering activity can be approximated as a proportion of the shadow economy, assuming that illegal financial flows are embedded within the broader informal sector. This operationalisation enables researchers to generate macro-level estimates of laundering vulnerability that reflect structural features of national economies rather than case-level data. In particular, the model highlights variables such as cash intensity in transactions, the size of the tax burden, and the quality of regulatory enforcement as central determinants of laundering potential. Such an approach offers broad insights into the systemic vulnerabilities of national economies and allows for cross-country comparisons over time.

Despite these advantages, the model has attracted significant criticism. The most important limitation lies in its conceptual ambiguity, since the relationship between the size of the shadow economy and actual money laundering is neither direct nor uniform. Informal or untaxed activities are not always linked to criminal proceeds, and treating laundering as a fixed share of the hidden economy risks systematic overestimation. Furthermore, the sensitivity of MIMIC models to variable specification and calibration means that results can differ substantially depending on the set of indicators used. Critics also point out that the framework may conflate tax evasion, informal employment, and criminal money flows, reducing its explanatory clarity for AML/CFT purposes.

As a result, while the Schneider-Windisch model provides useful structural insights into the macroeconomic environments in which laundering is likely to thrive, it is best regarded as a complementary tool rather than a standalone methodology. Its strength lies in identifying broad patterns of vulnerability, whereas its weakness is in offering only indirect and potentially inflated estimates of actual laundering activities.

Risk-based frameworks

A significant counterpoint to the quantitative modelling tradition is provided by Levi and Reuter (2006), who critically examine the limitations of existing attempts to measure the scale of money laundering. They caution that many quantitative estimates are illusory, produced from layers of assumptions, proxies, and extrapolations that lack robust empirical grounding. From their perspective, the complexity and secrecy surrounding laundering activities make it inherently resistant to precise numerical quantification. As such, they argue that policymakers and scholars should be wary of treating these numbers as reliable measures, since doing so risks false precision and may foster misplaced confidence in the evidence base for AML/CFT strategies.

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In response, Levi and Reuter advocate for qualitative, risk-based frameworks that heavily draw on criminology, sociology, and institutional analysis insights. These approaches prioritise understanding the behavioural dynamics of offenders, the organisation of criminal networks, and the institutional capacity of enforcement systems over the production of single aggregate estimates. In particular, they stress the importance of governance quality, corruption, regulatory design, and enforcement effectiveness, which are often central to laundering vulnerability but cannot easily be captured in econometric models or composite indexes.

The strength of this perspective lies in its realism and conceptual clarity: by avoiding reliance on questionable numbers, it directs attention to the qualitative drivers of laundering risks and how institutional resilience, rule of law, and social context shape AML/CFT effectiveness. This offers a more nuanced understanding of risk that may inform long-term governance reforms and capacity-building efforts. At the same time, however, the approach is not without limitations. Precisely because it resists quantification, it provides limited comparability across countries and time periods, and it poses challenges for financial institutions and regulators who require measurable, standardised indicators for compliance and risk management.

Thus, Levi and Reuter's critique does not dismiss the value of measurement altogether but highlights the tension between precision and validity in AML/CFT risk assessment. Their work underscores the need for a balanced approach that combines the contextual richness of qualitative insights with the practical utility of quantitative indicators, while remaining mindful of the assumptions embedded in every estimation exercise.

Bayesian and probabilistic risk models

An emerging methodology stream in AML/CFT risk assessment involves using Bayesian networks and probabilistic reasoning to model country-level vulnerabilities. Unlike deterministic or point-estimate approaches, Bayesian methods allow for integrating diverse risk factors, such as corruption indicators, governance quality, FATF evaluation scores, volumes of suspicious transaction reports, financial secrecy measures, and geopolitical exposure, into a coherent probabilistic framework. The advantage of this approach is that it generates probability distributions of country risk rather than single aggregate values, thereby making explicit the degree of uncertainty surrounding estimates.

Bayesian approaches are particularly attractive in the AML/CFT context because the phenomenon under study is inherently hidden and uncertain. Money laundering cannot be directly observed, and available data are often incomplete, inconsistent, or biased by institutional factors. Bayesian models provide a structured way to combine expert judgment with empirical indicators by allowing analysts to specify prior beliefs and update them with available evidence. For example, FATF mutual evaluation outcomes may be incorporated as likelihoods, while corruption indexes or secrecy scores serve as prior risk indicators. Such frameworks have been proposed in academic work on financial crime modelling and in applied risk management tools used by regulators and financial institutions (e.g., Kraisangka, 2019).

The strength of Bayesian and probabilistic risk models lies in their ability to explicitly incorporate uncertainty, making them more transparent about the reliability of risk estimates than deterministic models. They also offer flexibility in combining heterogeneous data sources, whether quantitative indicators or qualitative expert assessments. However, their weaknesses are equally noteworthy. The construction of Bayesian models requires the specification of subjective priors, which can strongly influence the outputs and may introduce bias if not carefully validated. Furthermore, the models are often complex and computationally demanding, which limits end-user transparency and may reduce their appeal to policymakers or compliance officers who need simple, communicable risk scores (Kuzmenko et al., 2011; Dmytrov et al., 2010).

Bayesian approaches represent a promising methodological frontier, especially for research and supervisory contexts that emphasise uncertainty and scenario analysis. However, their reliance on expert judgement, technical complexity, and limited interpretability means they are not yet a standard tool in operational AML/CFT risk assessment.

Comparative table of AML/CFT methodologies

To synthesise the diverse approaches to assessing country-level AML/CFT risk, Table X presents a comparative overview of the principal methodologies currently employed in policy and academic contexts. The table highlights their respective purposes, areas of focus, and strengths and limitations. Compliance-based instruments such as the FATF mutual evaluation reports and national or supranational risk assessments provide global legitimacy and contextual relevance. However, they remain resource-intensive and subject to data or quality inconsistencies. Quantitative indices like the Basel AML Index offer comparability and accessibility for policymakers and financial institutions, though they risk oversimplifying complex dynamics and often rely on opaque aggregation methods. More sophisticated econometric models enable quantitative estimation of laundering flows or vulnerabilities, including the Walker-Unger gravity framework, Ferwerda's black box model, and the Schneider-Windisch MIMIC approach. However, they depend heavily on assumptions, proxies, and specifications that may limit robustness and practical applicability. In contrast, qualitative and risk-based frameworks (e.g., Levi

& Reuter, 2006) prioritise governance, institutional, and criminological dimensions, avoiding false precision but sacrificing comparability and operational ease. Finally, Bayesian and probabilistic models represent a methodological frontier by explicitly incorporating uncertainty and integrating heterogeneous data sources. However, their technical complexity and reliance on subjective priors remain barriers to widespread adoption. These methodologies reflect the trade-off between validity and usability, underlining the importance of combining complementary approaches for a balanced assessment of AML/CFT country risk.

Table 1. Comparative table of AML/CFT methodologies.

Methodology	Purpose/Focus	Strengths	Weaknesses
FATF MERs & ICRG	Assess compliance with FATF 40 Recommendations and effectiveness (11 IOs); identify high-risk jurisdictions	Global legitimacy; peer-reviewed; detailed compliance assessment	Infrequent; resource-intensive; potentially politicised; static snapshot
NRA/SNRA	Identify national/regional threats, vulnerabilities, and consequences to guide policy	Context-specific; fosters coordination; adaptable to national conditions	Subjective; data gaps; inconsistent quality; limited comparability
World Bank & IMF Tools	Support countries with structured NRA tools; assess AML/CFT in financial stability (FSAP)	Standardised; capacity-building; transparent structure	Relies on self-reported data; FSAP coverage is irregular
Quantitative Composite Indexes	Aggregate indicators to provide risk rankings for countries (comparability & monitoring)	Comparable; accessible; data-driven; updated regularly	Opaque methods (especially proprietary); risk of oversimplification
Sanctions & International Watchlists	Categorically identify sanctioned or restricted jurisdictions for compliance	Clear, enforceable, and immediate compliance impact	Politically selective; narrow coverage; lacks granularity
Hybrid Qualitative-Quantitative Models	Customised models combining multiple sources for institutional/commercial use	Flexible; responsive; integrates real-time intelligence	Non-transparent; inconsistent; difficult external validation
Walker-Unger Gravity Model	Estimate cross-border laundering flows; identify exporters/importers of illicit funds	Quantitative estimates; integrates supply & demand sides; cross-border scope	Relies on proxies; sensitive to assumptions; limited operational use
Tinbergen/Extended Gravity Models	Refinements of the Walker-Unger model, including corruption, taxation, secrecy, and regulatory quality	Greater empirical richness, more explanatory variables, and EU policy relevance	High sensitivity to specification; unstable across contexts
Ferwerda's Black Box Model	Estimate crime proceeds as a latent variable; simulate AML policy effectiveness	Bridges crime generation & laundering; useful for policy scenario testing	Dependent on unobservable assumptions; replication issues
Schneider-Windisch (MIMIC) Model	Estimate laundering as a share of the shadow economy using structural econometric models	Provides macro-structural insights; highlights systemic vulnerabilities	Indirect link between shadow economy & laundering; risk of overestimation
Risk-Based Frameworks (Levi & Reuter)	Critique of quantitative estimates; focus on institutional/qualitative drivers of risk	Avoids false precision; emphasises governance & institutional context	Limited comparability; difficult operationalisation; lacks metrics
Bayesian/Probabilistic Risk Models	Generate probability distributions of country risk; explicitly incorporate uncertainty	Explicitly models uncertainty; flexible integration of diverse data sources	Requires subjective priors; technically complex; low transparency

DISCUSSION

The findings of this study confirm that there is no single methodology capable of providing a definitive and universally reliable assessment of country AML/CFT risk. Our comparative analysis demonstrates that while FATF mutual evaluation reports and national risk assessments remain the global standard for compliance, their static and resource-intensive character limits their adaptability to dynamic threats. This is consistent with critiques highlighting the formalism and uneven comparability of MERs, as shown by Deshmukh (2025) and Gaviyau and Sibindi (2023), who argue that evaluations often reflect institutional processes rather than actual laundering risks. At the same time, composite indices such as the Basel AML Index provide greater accessibility and comparability, yet their methodological opacity echoes concerns raised in bibliometric assessments that stress the danger of oversimplifying multidimensional risks.

The results also reinforce the value and limitations of econometric models. Our assessment of the Walker–Unger gravity framework and Ferwerda's black box model shows their strength in generating quantitative estimates of laundering flows

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and their heavy reliance on assumptions and sensitivity to parameter specification. This finding resonates with earlier studies that view econometric models as useful for policy simulation but problematic for operational enforcement (Unger, 2007; Lyeonov et al., 2020; Schneider & Windischbauer, 2008). Similarly, while offering macro-structural insights into laundering vulnerabilities, the MIMIC approach demonstrates the same conceptual ambiguity emphasised in the literature, as it risks conflating shadow economic activity with criminal money flows. This alignment between our results and prior research underscores the need to treat econometric estimates as complements rather than substitutes for compliance-based or governance-focused assessments.

Finally, our analysis highlights the growing importance of emerging methodologies, particularly Bayesian models and digital innovations. The results suggest that probabilistic approaches, though complex, provide an explicit way of incorporating uncertainty into country risk assessment. This aligns with insights from Kraisangka (2019) and recent studies on AI in financial crime monitoring, which demonstrate how advanced techniques can improve detection while simultaneously creating new vulnerabilities (Lyeonov et al., 2024; Lyeonov et al., 2025; Vasilyeva et al., 2021). Moreover, combining clustering and typology-based analyses corresponds to recent efforts to design tailored AML/CFT strategies (Kuzior et al., 2025), suggesting that hybrid methodologies may offer the most promising path forward. These findings indicate that future frameworks must combine FATF evaluations' legitimacy, indexes' comparability, and the explanatory depth of econometric and digital models to achieve robust and policy-relevant AML/CFT risk assessments.

CONCLUSIONS

The primary aim of this article was to critically examine the diverse methodological approaches for assessing country risk in AML/CFT. In particular, the study sought to evaluate the official policy-driven frameworks developed by international organisations and the more experimental academic models to determine their comparative advantages, limitations, and potential complementarities.

Methodologically, the research adopted a comparative analytical framework. It reviewed established compliance-based assessments such as the FATF mutual evaluation reports, national and supranational risk assessments, and international financial institution tools; quantitative approaches including composite indexes such as the Basel AML Index; econometric and academic models such as the Walker-Unger gravity framework, Ferwerda's black box approach, and the Schneider-Windisch MIMIC model; as well as qualitative, risk-based frameworks and emerging Bayesian and probabilistic methods. A comparative table was used to synthesise these approaches along four key dimensions: purpose, inputs, outputs, and their strengths and weaknesses.

The findings confirm that no single methodology can provide a complete and definitive assessment of country AML/CFT risk. Compliance-based assessments such as FATF evaluations offer legitimacy and standardisation but are resource-intensive and static. Composite indices provide comparability and accessibility but risk oversimplification and methodological opacity. Gravity-type and black box models allow for quantitative estimates of laundering flows and policy scenario testing, yet they remain highly assumption-driven and sensitive to specification. The Schneider-Windisch MIMIC model offers macro-structural insights into shadow economies but lacks a direct linkage to laundering activity. As Levi and Reuter advocate, qualitative frameworks avoid false precision and capture governance factors, though they provide limited comparability. Bayesian and probabilistic models represent a promising frontier by incorporating uncertainty and integrating heterogeneous data sources, but their complexity and reliance on subjective priors remain barriers to practical application.

From a policy perspective, the analysis suggests a multi-layered and complementary approach. Regulators should continue to rely on FATF evaluations and national risk assessments as the backbone of international AML/CFT standards, while recognising their limitations in dynamism and comparability. Composite indices such as the Basel AML Index can provide useful benchmarks for financial institutions, but should be interpreted cautiously and not used as standalone tools. Academic models (Walker-Unger, black box, and MIMIC) should be more systematically integrated into supranational and national risk assessments to enhance analytical depth and improve understanding of structural vulnerabilities. Policymakers are encouraged to invest in data quality and transparency, which would improve the robustness of both econometric and probabilistic approaches. Moreover, gradually adopting Bayesian and machine learning methods may provide regulators and financial institutions with more nuanced, scenario-based insights that explicitly account for uncertainty.

Ultimately, an effective AML/CFT risk assessment framework should not aim to produce a single definitive number but rather to develop a portfolio of complementary indicators and models. This layered approach would allow policymakers, regulators, and financial institutions to balance comparability with contextual sensitivity, precision with validity, and standardisation with adaptability. In an environment where money laundering techniques continue to evolve, methodological

pluralism, anchored in global standards and innovative analytical tools, represents the most promising path toward resilient and effective AML/CFT risk governance.

ADDITIONAL INFORMATION

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CONFLICT OF INTEREST

The Author declares that there is no conflict of interest.

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Славгородська К.

МЕТОДОЛОГІЇ ОЦІНКИ РИЗИКІВ КРАЇН У ЦАРИНІ ПРОТИДІЇ ВІДМИВАННЮ КОШТІВ І ФІНАНСУВАННЮ ТЕРОРИЗМУ: ПОРІВНЯЛЬНИЙ АНАЛІЗ РАМОК ПОЛІТИКИ ТА ЕКОНОМЕТРИЧНИХ МОДЕЛЕЙ

Оцінка ризиків країн у царині протидії відмиванню грошей і фінансуванню тероризму (ПВК/ФТ) набуває все більшого значення в умовах глобальної фінансової інтеграції, цифровізації та постійних незаконних фінансових потоків. Незважаючи на міжнародні стандарти, неспостережуваний характер відмивання робить вимірювання ризиків значною мірою залежним від довірених осіб і методологічних виборів, що створює й концептуальні, і практичні проблеми. Це дослідження спрямоване на проведення порівняльного аналізу методологій оцінки ризиків у царині ПВК/ФТ в країнах, інтегруючи рамки політики з економетричними та ймовірнісними моделями. У дослідженні використана порівняльна аналітична структура, що синтезує офіційні оцінки (звіти про взаємну оцінку FATF, НРО та інструменти МВФ / Світового банку), кількісні індекси (наприклад, Базельський індекс AML), економетричні підходи (модель гравітації Волкера-Унгера, чорна скринька Ферверди, MIMIC Шнайдера-Віндіша), якісні рамки та нові баєсові / ймовірнісні методи. Отримані результати вказують на те, що жодна методологія не забезпечує остаточного вимірювання ризику країни. Інструменти, що ґрунтуються на політиці, забезпечують глобальну легітимність і порівнянність, але є статичними, ресурсомісткими та іноді політизованими. Композитні індекси та власні моделі пропонують зручність використання та доступність, але часто їм бракує методологічної прозорості й вони надмірно спрощують ризики. Академічні економетричні підходи генерують кількісні оцінки й збільшують аналітичну глибину, хоча вони залишаються чутливими до припущень та обмеженими в оперативному застосуванні. Імовірнісні та баєсові методи представляють перспективний рубіж, явно включаючи невизначеність і різноманітні джерела даних, але їх складність і залежність від суб'єктивних апріорі обмежують широке впровадження.

Ключові слова: ПВК/ФТ, ризик країни, FATF, Базельський індекс AML, гравітаційні моделі, баєсові мережі

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