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Measuring Illicit Financial Flows: A Conceptual Review of Methodological Approaches and Their Limitations

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Abstract: *Illicit financial flows (IFFs) represent a critical impediment to sustainable development, draining an estimated USD 88.6 billion annually from developing economies through trade-related channels alone. Despite growing international policy commitment to reducing IFFs, as reflected in Sustainable Development Goal (SDG) Target 16.4, the measurement of these flows remains fragmented across disconnected methodological traditions. This paper provides a conceptual review of the principal methodological approaches to estimating IFFs, encompassing capital account-based estimates, trade-based estimates, offshore wealth estimates, corporate tax avoidance estimates, forensic approaches, and emerging computational techniques. Drawing on the UNCTAD-UNODC Conceptual Framework for the Statistical Measurement of IFFs endorsed by the United Nations Statistical Commission in 2022, the paper critically evaluates the theoretical assumptions, data requirements, estimation scope, and empirical limitations of each approach. Cross-cutting challenges affecting all measurement traditions are examined, including data quality constraints in developing economies, the double counting problem, the contested boundary between illicit and illegal flows, and the disconnect between estimated flows and their predicate offences. As its principal contribution, the paper proposes a Five-Dimensional Assessment Framework for evaluating IFF measurement methodologies based on definitional coherence, data accessibility, estimation precision, cross-country comparability, and policy actionability. Six testable propositions are advanced from this framework. The paper concludes that no single methodology achieves adequate performance across all five dimensions, and that effective IFF estimation requires complementary deployment of multiple methods calibrated to the institutional and data context of each country.*

Keywords: Illicit Financial Flows, Measurement Methodology, Trade Misinvoicing, Developing Economies, SDG 16.4.1, Conceptual Framework

1. Introduction

Developing countries lose an estimated USD 88.6 billion annually through trade-related illicit financial flows alone (UNCTAD, 2022). Cumulatively, Ndikumana and Boyce (2021) estimate that 30 African countries lost approximately USD 2 trillion in capital flight between 1970 and 2018. These figures, while staggering in their magnitude, are themselves products of measurement methodologies that remain subject to considerable scholarly and institutional

debate regarding their accuracy, scope, and policy relevance. The very tools designed to quantify the problem may, paradoxically, be obscuring its true dimensions.

Illicit financial flows, broadly defined as cross-border movements of money or capital that are illegally earned, transferred, or used, have emerged as a central concern in the international development discourse over the past two decades. The 2030 Agenda for Sustainable Development explicitly identifies IFF reduction as a priority through SDG Target 16.4, which calls on states to significantly reduce illicit financial and arms flows by 2030, strengthen the recovery and return of stolen assets, and combat all forms of organised crime. The Addis Ababa Action Agenda on financing for development similarly calls for redoubled efforts to substantially reduce IFFs. Most recently, the Sevilla Commitment adopted at the 4th International Conference on Financing for Development in July 2025 emphasised the urgent importance of addressing the root causes of IFFs through stronger measures against tax evasion, money laundering, corruption, and trade misinvoicing (UNCTAD, 2025).

Progress towards SDG Target 16.4 is monitored through Indicator 16.4.1, which requires measurement of the total value of inward and outward IFFs. In a landmark development, the UNCTAD-UNODC Task Force on the Statistical Measurement of IFFs developed a Conceptual Framework that was endorsed by the United Nations Statistical Commission (UNSC) in March 2022. This framework provides the first globally agreed statistical definition of IFFs for measurement purposes: financial flows that are illicit in origin, transfer or use, that reflect an exchange of value and that cross country borders (UNCTAD & UNODC, 2020). The endorsement of this framework represents a watershed moment for the field, yet the translation of conceptual clarity into operational measurement remains at an early stage. Pilot testing has been conducted in only 22 countries to date, and the results have revealed significant methodological challenges, particularly in economies with limited statistical infrastructure (UNCTAD, 2023).

The academic literature on IFF measurement has grown substantially. Cobham and Janskỳ (2017) provided the foundational four-category classification of IFF estimation methods, distinguishing between capital account-based estimates, trade-based estimates, offshore wealth estimates, and corporate tax avoidance estimates. Collin (2020), writing in the World Bank Research Observer, offered a comprehensive review of IFF concepts, measurement, and evidence, critiquing three types of studies: methods of measuring IFFs, constructed risk indicators, and forensic studies. More recently, Popik-Mazur (2025) conducted a systematic literature review of 1,249 papers on IFFs and money laundering, finding that 38 per cent of the literature focuses on systematising existing knowledge while 26 per cent employs machine learning techniques for detection and estimation. Netshisaulu et al. (2022) developed and validated a conceptual framework to curb IFFs in financial statements. Carbonnier and Mehrotra (2024) examined new data and methods for measuring IFFs in commodity trade.

Despite these contributions, a significant gap persists in the literature. While individual methodologies have been critiqued in isolation, and while systematic reviews have mapped the bibliometric landscape of IFF research, no existing study provides a unified conceptual assessment framework that evaluates all major methodological traditions against a common set of criteria relevant to developing economies. The question is not merely which methods exist, but how they compare across dimensions that matter for both scholarly rigour and policy application: definitional coherence, data accessibility, estimation precision, cross-country comparability, and policy actionability.

This paper addresses this gap by pursuing three interconnected objectives. First, it provides an updated taxonomy of IFF measurement methodologies, extending the classification by Cobham and Janskỳ (2017) to incorporate the UNCTAD-UNODC Conceptual Framework and recent methodological developments including machine learning approaches. Second, it critically evaluates the theoretical assumptions, data requirements, and empirical limitations of each methodological category, with particular attention to the constraints faced by developing economies. Third, and as its principal contribution, it proposes a Five-Dimensional Assessment Framework for evaluating IFF measurement approaches and derives six testable propositions from this framework. The paper thereby contributes to the ongoing effort to establish a more coherent analytical foundation for IFF measurement, an effort that is both academically necessary and practically urgent as the 2030 deadline for SDG Target 16.4 approaches.

The remainder of the paper is organised as follows. Section 2 examines the definitional landscape of IFFs, tracing the evolution from fragmented institutional definitions to the UNCTAD-UNODC statistical definition and its four-category typology. Section 3 presents the core taxonomic analysis, critically evaluating six categories of IFF measurement methodologies. Section 4 discusses cross-cutting challenges that affect all measurement traditions. Section 5 proposes the Five-Dimensional Assessment Framework and applies it to the methodological categories reviewed. Section 6 sets out a research agenda derived from the identified gaps. Section 7 concludes.

2. Defining Illicit Financial Flows: Semantic, Conceptual, and Statistical Dimensions

The measurement of any phenomenon presupposes a clear definition of what is being measured. In the case of IFFs, this prerequisite has proven exceptionally difficult to satisfy. The term itself encompasses a broad spectrum of financial activities that differ in their legality, their mechanisms, and their economic consequences. This definitional ambiguity is not merely an academic concern; it has direct and consequential implications for measurement. Different definitions lead to different measurement strategies, which produce different estimates, which in turn shape different policy responses. As Cobham and Janskỳ (2020) observe, definitional ambiguity in IFFs affects the perceived severity of the problem and the urgency of the policy response it warrants.

2.1. The Evolution of IFF Definitions

The concept of IFFs has been defined differently by different institutions and scholars, reflecting their respective disciplinary perspectives, research objectives, and policy concerns. Global Financial Integrity (2023) defines IFFs as illegal movements of money or capital from one country to another, classifying a flow as illicit when funds are illegally earned, transferred, or utilised. The International Monetary Fund (2023) similarly refers to the movement of money across borders that is illegal in its source, its transfer, or its use. The Organisation for Economic Co-operation and Development (2018) provide a more granular definition, categorising IFFs into three components: corruption (proceeds of theft, bribery, graft, and embezzlement), commerce (proceeds of tax evasion, misinvoicing, and money laundering through commercial transactions), and crime (proceeds of drug trafficking, smuggling, counterfeiting, and terrorist financing).

These institutional definitions share a common emphasis on the cross-border nature of IFFs and the illegality or illicitness of their origin, transfer, or use. However, they differ in important ways. Some definitions, such as that of GFI, focus narrowly on illegality, while others, such as the UNCTAD and UNODC (2019) framework, extend the scope to include practices that are

legal but may be considered illicit, such as aggressive tax planning and profit shifting by multinational corporations. This distinction between illegal and illicit is analytically significant. Activities such as transfer mispricing by multinational corporations may be technically legal under domestic tax law yet may be considered illicit because they contravene the spirit of international tax norms and deprive developing economies of legitimate tax revenue (Forstater, 2018). Aziani and Aziani (2018b) propose a three-dimensional legitimacy framework, arguing that an IFF occurs whenever one or more of three aspects is illegitimate: capital generation legitimacy, international transaction legitimacy, and final use legitimacy.

2.2. The UNCTAD-UNODC Statistical Definition and Typology

The endorsement by the UNSC in March 2022 of the UNCTAD-UNODC Conceptual Framework represents the most significant definitional advance in the field. For the first time, a globally agreed statistical definition of IFFs has been established: financial flows that are illicit in origin, transfer or use, that reflect an exchange of value and that cross country borders (UNCTAD & UNODC, 2020). This definition was developed through extensive international consultation, including expert meetings held between 2017 and 2020, and was designed to be operationally compatible with existing statistical systems, including the System of National Accounts (SNA) and the Balance of Payments (BoP) framework.

The Conceptual Framework identifies four main categories of activities that generate IFFs. The first category, illegal tax and commercial IFFs, includes illegal practices by legal entities such as tax evasion, tariff and duty offences, revenue offences, and market manipulation. The second category, illicit tax and commercial IFFs, encompasses practices that are legal but considered illicit, including aggressive tax planning, transfer mispricing, and profit shifting to low-tax jurisdictions. The third category, IFFs from illegal markets, covers the proceeds from the production, trafficking, and sale of illegal goods and services, including drug trafficking, human trafficking, arms trafficking, and wildlife trafficking. The fourth category, IFFs from corruption and exploitation-type activities, includes proceeds from bribery, embezzlement, extortion, and terrorism financing.

This four-category typology carries direct implications for measurement. Each category requires different data sources, different estimation techniques, and different institutional capacities. Trade-related IFFs may be estimated through bilateral trade data comparison, while crime-related IFFs require law enforcement and criminal justice data. Corruption-related IFFs demand governance and transparency indicators, while tax avoidance-related IFFs necessitate access to corporate financial data that is often confidential. The typology thus reveals that IFF measurement is not a single methodological problem but a family of related but distinct estimation challenges.

2.3. Implications of Definitional Fragmentation for Measurement

The persistence of definitional variation has produced three measurable consequences for the IFF estimation literature. First, estimates produced under different definitions are frequently compared in policy discussions as if they were commensurable, even when they measure fundamentally different phenomena. The widely cited GFI estimates, for example, focus primarily on trade misinvoicing, while the World Bank residual method captures a broader range of unrecorded capital movements, including some that may be entirely legal. Comparing these estimates without acknowledging their different definitional bases is analytically misleading. Second, the lack of definitional standardisation impedes cross-country and cross-temporal comparability, as different studies apply different inclusion criteria to the same underlying data. Third, definitional ambiguity creates space for political manipulation, as

actors with different policy agendas can selectively cite estimates that support their preferred narrative regarding the severity or sources of IFFs. On the basis of this analysis, the following proposition is advanced:

Proposition 1 (P1): *The absence of a universally adopted operational definition of IFFs is a primary source of inconsistency in IFF estimates across studies and institutions.*

3. Taxonomy of IFF Measurement Methodologies

This section presents a critical evaluation of the principal methodological approaches to estimating IFFs. The taxonomy builds on the foundational classification by Cobham and Janskỳ (2017) and extends it to incorporate the UNCTAD-UNODC framework and recent methodological developments. Six categories of approaches are examined: capital account-based estimates, trade-based estimates, offshore wealth estimates, corporate tax avoidance estimates, forensic and case-study approaches, and emerging computational approaches. Figure 1 provides a visual overview of this taxonomy, illustrating the six categories and their constituent methods.

3.1. Capital Account-Based Estimates

Capital account-based methods identify IFFs by detecting discrepancies in a country's capital and financial accounts. Two principal techniques fall within this category: the World Bank Residual Method and the Hot Money Narrow Method. The World Bank Residual Method, also known as the residual approach, estimates IFFs by calculating the difference between recorded sources of funds (external debt and net foreign direct investment) and recorded uses of funds (the current account deficit and additions to reserves). The unaccounted residual is assumed to represent illicit capital outflows (Kar, 2011; Kar & Cartwright-Smith, 2009). The Hot Money Narrow Method takes a more targeted approach, examining the net errors and omissions line in a country's balance of payments. Any unexplained leftovers in the BoP are considered to represent short-term illicit capital movements (Brandt, 2023; Fontana, 2010).

These methods rest on the theoretical assumption that all unrecorded capital movements are illicit in nature and that Balance of Payments data is sufficiently accurate to serve as a reliable baseline. Neither assumption holds consistently, particularly in developing economies. The residual method may substantially overestimate IFFs by capturing inaccurately recorded legal capital flows alongside genuinely illicit movements. Statistical discrepancies in the BoP may arise from recording errors, timing differences, classification inconsistencies, or capacity limitations in national statistical offices rather than from illicit activity. Moreover, neither method can distinguish between capital flight driven by rational portfolio diversification, which constitutes a legal and economically efficient response to domestic risk, and capital flight driven by illicit motives such as corruption or tax evasion (Collin, 2020). The Hot Money method further suffers from a temporal bias: it captures only sudden or large-scale flows, missing gradual or systematic outflows that may represent the most damaging form of IFFs over time (Brandt, 2023).

Despite these limitations, capital account-based estimates remain widely used because they can be calculated from readily available macroeconomic data published by the IMF and central banks, they provide a broad macroeconomic perspective on the scale of unrecorded capital movements, and they require relatively limited statistical capacity to implement. Their principal value lies in their ability to provide an upper-bound estimate of potential IFFs, even if the precision of that estimate is limited. The following proposition is therefore advanced:

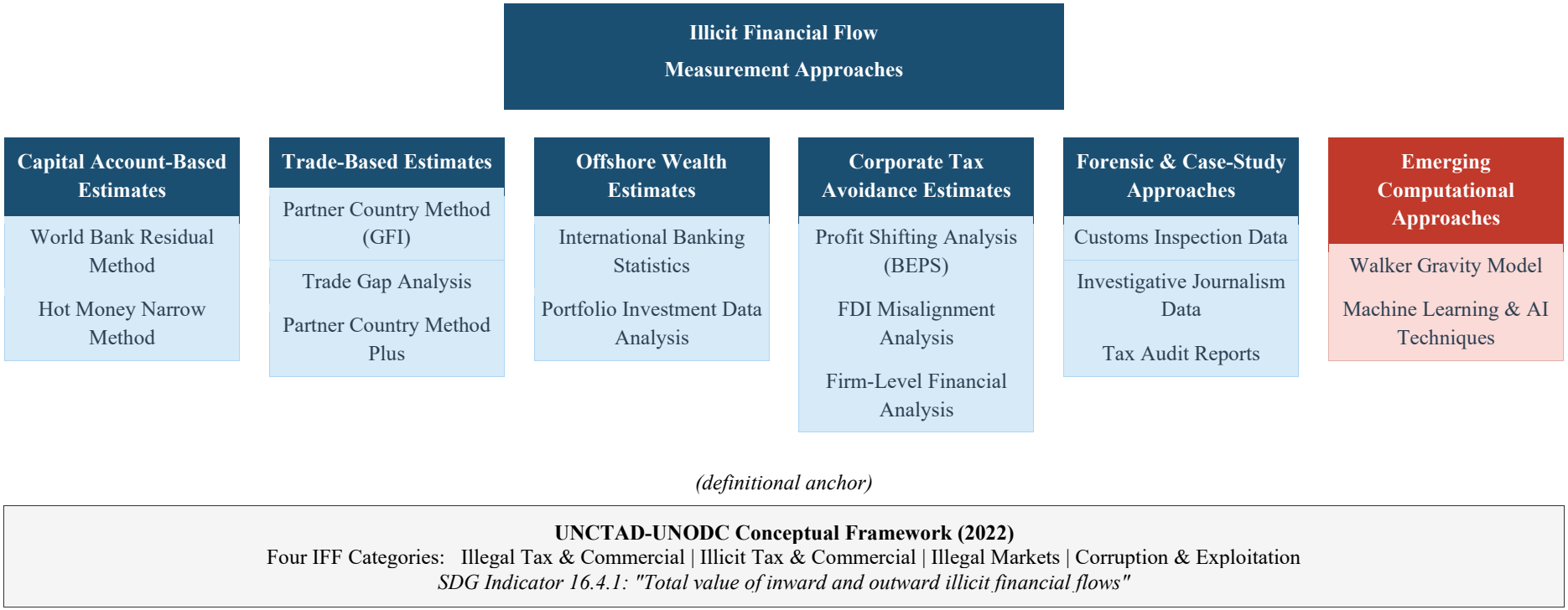

Figure 1: Taxonomy of IFF Measurement Methodologies

Source: Author's elaboration, extending Cobham and Janskỳ (2017).
Note: Emerging computational approaches (shown in red) represent methods at an early stage of integration into macro-level IFF estimation.

Proposition 2 (P2): *Capital account-based estimates systematically overestimate IFFs in developing economies due to the conflation of statistical discrepancies with illicit capital movements.*

3.2. Trade-Based Estimates

Trade-based methods represent the most widely used and most extensively debated category of IFF estimation. The core technique is the Partner Country Method, which compares reported bilateral trade data between trading partners to identify discrepancies, known as value gaps. When Country A reports exporting goods worth USD 100 million to Country B, but Country B reports importing goods worth USD 150 million from Country A, the discrepancy of USD 50 million, after adjusting for freight and insurance differentials, may indicate trade misinvoicing. Systematic over-invoicing of imports or under-invoicing of exports by one or both trading partners constitutes a mechanism through which capital can be illicitly transferred across borders (Global Financial Integrity, 2021). Trade Gap Analysis takes a similar approach at a more aggregate level, comparing total reported trade flows between countries to identify systematic mismatches (Collin, 2020).

Trade misinvoicing has been identified as the largest component of measurable IFFs. GFI estimates suggest that it accounts for approximately 80 per cent of all measurable illicit outflows from developing countries. The method's principal strengths are its transparency, its replicability, and its ability to identify specific sectors, commodities, and trading relationships that are vulnerable to misinvoicing. Recent pilot testing by UNCTAD in several African countries has demonstrated that trade-related IFFs could reach between 5 and 30 per cent of official goods trade, with particularly high risks identified in the trade of raw minerals such as gold, manganese, copper, uranium, and crude oil (UNCTAD, 2025).

However, trade-based estimates face several significant limitations. First, they cannot capture non-trade IFFs, including flows arising from corruption, bribery, embezzlement, criminal enterprises, or financial market manipulation. As such, they provide a measure of only one dimension of IFFs while omitting others that may be equally or more significant. Second, trade discrepancies may arise from entirely legitimate causes. Differences in valuation conventions between cost-insurance-freight (CIF) and free-on-board (FOB) reporting, classification differences across national tariff schedules, transit trade through intermediary jurisdictions, and timing differences in the recording of shipments can all produce bilateral trade asymmetries that are unrelated to illicit activity (Cobham & Janskỳ, 2020). Third, data quality varies significantly across developing economies. UNCTAD pilot testing has revealed that unreliable quantity information in trade statistics made the proposed reliability weighting procedure for the Partner Country Method Plus unattainable in some participating countries, necessitating methodological modifications and alternative estimation approaches (UNCTAD, 2023). Carbonnier and Mehrotra (2024) have responded to this challenge by proposing new data sources, including commodity-specific price benchmarks and shipping data, to improve the reliability of trade misinvoicing estimates.

The methodological evolution within trade-based estimation deserves further examination. The original Partner Country Method, as employed by GFI, compares aggregate bilateral trade statistics reported by each partner to international databases such as the United Nations Commodity Trade Statistics Database (UN Comtrade) and the IMF Direction of Trade Statistics (DOTS). The Partner Country Method Plus, developed under the UNCTAD methodological guidelines, refines this approach by introducing commodity-level analysis and reliability weighting procedures designed to account for known sources of legitimate trade

asymmetries. However, as noted above, pilot testing has demonstrated that the data prerequisites for these refinements are not consistently met in developing economies, highlighting a tension between methodological sophistication and practical applicability.

Moreover, the increasing prevalence of free trade zones, special economic zones, and entrepot trade arrangements in developing economies introduces additional complications for trade-based IFF estimation. Goods that are transshipped through intermediary jurisdictions such as Singapore, the United Arab Emirates, or the Netherlands may appear as discrepancies in bilateral trade data even when no misinvoicing has occurred. The treatment of services trade, which is growing rapidly in many developing economies but is inherently more difficult to value than goods trade, represents a further frontier for trade-based IFF estimation that remains largely unexplored.

Proposition 3 (P3): *Trade-based estimates provide the most widely used but narrowest measurement of IFFs, capturing only the commercial dimension while omitting crime-related and corruption-related flows.*

3.3. Offshore Wealth Estimates

Offshore wealth estimation methods seek to quantify the unrecorded wealth held by residents of a country in foreign jurisdictions. The pioneering work of Zucman (2013) utilised discrepancies in international banking statistics and portfolio investment data to estimate that approximately 8 per cent of the world's financial wealth is held in tax havens. These approaches capture a dimension of IFFs that other methods miss entirely: the accumulated stock of illicitly held wealth abroad, rather than the annual flow of capital leaving a country. This distinction between stocks and flows is analytically important. While flow-based measures indicate the rate of capital hemorrhage, stock-based measures reveal its cumulative developmental cost.

The limitations of offshore wealth estimates are significant. Data availability is severely constrained because offshore wealth is, by definition, designed to be hidden from the scrutiny of domestic authorities. The estimates are highly sensitive to the assumptions made about the proportion of offshore wealth that is illicit, as opposed to legally held abroad for legitimate portfolio diversification purposes. In developing economy contexts, where domestic financial markets are often shallow and currency risk is elevated, the incentive to hold wealth offshore for legitimate reasons may be substantial. The analytical challenge of separating illicit offshore wealth from legitimate offshore holdings remains largely unresolved, limiting the policy utility of these estimates.

3.4. Corporate Tax Avoidance Estimates

Corporate tax avoidance estimation methods assess the revenue losses sustained by countries due to aggressive tax planning strategies employed by multinational corporations (MNCs). These strategies include profit shifting to low-tax jurisdictions through transfer mispricing, the use of intellectual property licensing arrangements to erode the tax base, and the exploitation of mismatches between national tax systems to achieve double non-taxation. The European Commission (2024) estimates that approximately 65 per cent of IFFs are tax-motivated or linked to commercial activities, underscoring the quantitative significance of this category.

Estimation approaches in this category range from macro-level analysis of misalignment between foreign direct investment (FDI) patterns and real economic activity, to micro-level analysis of firm-level financial statements and intra-group transactions. The OECD Base Erosion and Profit Shifting (BEPS) framework has provided an important institutional anchor

for this work, establishing standards for country-by-country reporting by MNCs and multilateral information exchange mechanisms. However, several challenges limit the precision and applicability of these estimates. The boundary between legal tax avoidance and illegal tax evasion is contested and jurisdiction-dependent, making it difficult to determine which corporate tax practices should be classified as illicit. Data on intra-firm transfer pricing is commercially confidential, restricting access for independent researchers. And varying methodological approaches across studies introduce significant uncertainty, with estimates of the same country's revenue losses varying by orders of magnitude depending on the assumptions employed (Cobham & Janskỳ, 2017).

3.5. Forensic and Case-Study Approaches

Forensic approaches employ detailed analysis of individual transactions, financial landscapes, or institutional arrangements within a particular country or sector to detect and estimate IFFs. These include customs inspection data analysis, tax audit reports, financial intelligence unit disclosures, and investigative journalism datasets. The Panama Papers leak of 2016, comprising 11.5 million files from the offshore law firm Mossack Fonseca, and the subsequent Paradise Papers and Pandora Papers, exemplify the power of forensic approaches to reveal specific mechanisms, actors, and jurisdictions involved in facilitating IFFs (Trautman, 2016).

Forensic methods offer the highest level of granularity and contextual specificity among all IFF estimation approaches. They can identify particular schemes, quantify specific transactions, and establish direct links between illicit flows and their predicate offences. These characteristics make forensic estimates highly actionable from a policy and law enforcement perspective. However, forensic approaches are inherently limited in their generalisability. They are time-consuming, dependent on investigative access and political will, and produce findings that cannot be extrapolated to other countries or time periods. They are complementary to, rather than substitutes for, systematic estimation methods (Aziani & Aziani, 2018a; Brandt, 2023).

3.6. Emerging Computational Approaches

The most significant recent development in IFF estimation methodology is the application of machine learning (ML) and artificial intelligence (AI) techniques to IFF detection and estimation. Popik-Mazur (2025), in a systematic review of 1,249 papers, identifies that 26 per cent of recent IFF and money laundering literature employs machine learning techniques, making it the second most prevalent methodological approach after knowledge systematisation. Modified gravity-based models, while representing only 3.33 per cent of the literature, offer a further emerging avenue that combines economic theory with computational estimation.

The Walker Gravity Model, developed by Walker and Unger (2013), represents an important bridge between traditional estimation and computational approaches. This model estimates IFFs by predicting proceeds from crimes at the national level, estimating the likelihood of international laundering, and mapping illicit capital flows between countries based on gravity model variables such as economic size, geographic distance, and financial secrecy indicators (Aziani & Aziani, 2018a). The model is distinctive in its focus on the proceeds of crime rather than on balance of payments or trade data, offering a perspective on IFFs that is complementary to capital account and trade-based methods. However, it relies on national crime statistics that are themselves subject to significant reliability concerns, particularly in developing economies, and it focuses primarily on money laundering while overlooking tax-related IFFs.

Machine learning approaches hold particular promise for transaction-level anomaly detection in customs data, financial transaction records, and corporate reporting. Supervised learning algorithms can be trained on known instances of trade misinvoicing or money laundering to identify patterns indicative of illicit activity in large datasets. Unsupervised learning techniques can detect unusual patterns without prior knowledge of what constitutes illicit behaviour. However, the integration of transaction-level ML detection into macro-level national IFF estimation frameworks remains underdeveloped. The interpretability of ML models, specifically the ability to explain why a particular transaction is flagged as suspicious, presents an additional challenge for their adoption in regulatory and judicial contexts where evidentiary standards must be met.

Proposition 4 (P4): *Emerging computational approaches, including machine learning, offer the potential to improve IFF detection at the transaction level, but their integration into macro-level IFF estimation frameworks remains underdeveloped.*

4. Cross-Cutting Challenges in IFF Measurement

Beyond the specific limitations of individual methodological categories discussed in the preceding section, several systemic challenges affect all approaches to IFF measurement. These cross-cutting issues constrain the overall reliability of IFF estimates and warrant explicit recognition in any assessment of measurement adequacy.

4.1. Data Quality and Availability in Developing Economies

A fundamental paradox characterises IFF measurement: the countries most severely affected by IFFs are typically the least equipped to measure them. Developing economies, which bear the greatest developmental burden of illicit capital outflows, often have the weakest statistical infrastructure. Balance of Payments data compiled by central banks may be incomplete, inconsistent, or subject to extended reporting lags. Customs records, which form the basis for trade misinvoicing analysis, may suffer from under-staffing, under-digitisation, and susceptibility to corruption at border points. Tax administration data, essential for corporate tax avoidance estimation, may be fragmented across multiple government agencies with limited inter-agency data-sharing protocols (Khan & Andreoni, 2018).

The UNCTAD pilot-testing programme has provided empirical evidence of these constraints. Inter-agency collaboration has been identified as a critical success factor in IFF measurement, yet institutionalising platforms such as national coordination mechanisms, technical working groups, or dedicated IFF units requires sustained political commitment and resource allocation. The experience of pilot countries in Africa, including Ghana, Namibia, and Zambia, demonstrates that persistent challenges such as the lack of data-sharing agreements and confidentiality constraints can impede even well-designed measurement initiatives (UNCTAD, 2025). These findings underscore that IFF measurement is not purely a technical exercise; it is embedded within institutional and governance contexts that shape both the feasibility and the credibility of the resulting estimates.

4.2. The Double Counting Problem

Different methodological approaches may capture overlapping components of the same underlying flow. A single act of trade misinvoicing, for example, may generate both a trade-based estimate through bilateral trade data comparison and a capital account residual estimate through the resulting discrepancy in the balance of payments. If estimates from different methods are aggregated without adjustment, the total may substantially overstate the actual

volume of IFFs. The UNCTAD-UNODC framework explicitly acknowledges this problem and calls for the development of methods to aggregate estimates of different types of IFFs into a single SDG indicator while adjusting for double counting. However, practical solutions remain at an early stage of development, and the technical challenge of identifying which components of different estimates overlap requires granular data that is often unavailable (UNCTAD & UNODC, 2020).

4.3. The Illicit Versus Illegal Distinction

The boundary between activities that are illegal and those that are illicit but legal represents one of the most analytically challenging aspects of IFF measurement. The UNCTAD-UNODC framework distinguishes between illegal tax and commercial IFFs, which include practices such as tax evasion, tariff offences, and market manipulation, and illicit tax and commercial IFFs, which include practices that are legal but considered contrary to the spirit of the law, such as aggressive tax planning and profit shifting. This distinction has direct measurement implications. Illegal activities may, in principle, be estimated through law enforcement data, judicial records, and financial intelligence unit reports. Illicit-but-legal activities, by contrast, require entirely different data sources, including corporate financial statements, country-by-country reports, and FDI analysis, and demand different estimation strategies that must grapple with the inherently contested nature of what constitutes illicit versus merely aggressive but lawful tax behaviour (Forstater, 2018).

4.4. Temporal and Cross-Country Comparability

IFF estimates produced using different methods, different time periods, and different country samples are frequently cited alongside one another in policy debates as if they were directly comparable. The GFI trade misinvoicing estimates for a given country, for instance, may be contrasted with World Bank residual estimates for the same country without acknowledging that the two methods measure different phenomena, apply different inclusion criteria, and use different data sources. Cross-temporal comparisons face additional challenges: methodological refinements over time may produce changes in estimates that reflect improved measurement rather than actual changes in IFF volumes. Without explicit methodological standardisation, such comparisons risk generating misleading policy conclusions and undermining confidence in IFF research as a whole.

4.5. The Disconnect Between Estimates and Predicate Offences

Most IFF estimation methods produce aggregate figures that indicate the total estimated volume of illicit outflows without specifying the underlying activities that generated those flows. Capital account-based methods cannot distinguish whether the estimated outflow originated from corruption, tax evasion, drug trafficking, or any other predicate offence. Even trade-based methods, while capable of identifying which commodities or trading partners are involved in misinvoicing, cannot determine whether the misinvoicing serves the purpose of tax evasion, capital flight, or the laundering of criminal proceeds. This disconnect between estimated volumes and predicate offences significantly limits the policy utility of IFF estimates. Policymakers seeking to design targeted interventions need to know not only how much capital is leaving the country illicitly, but through which channels, driven by which underlying activities, and involving which actors. The UNCTAD-UNODC framework's four-category typology represents a step towards this granularity, but the translation of the typology into disaggregated estimation remains a work in progress.

Proposition 5 (P5): *The policy utility of IFF estimates is constrained by the inability of most measurement approaches to link estimated flows to specific predicate offences or sectors of origin.*

5. Proposed Conceptual Assessment Framework

The preceding analysis has demonstrated that IFF measurement methodologies differ not only in their technical mechanics but in their underlying theoretical assumptions, their data requirements, their estimation scope, and their policy applicability. Yet the literature lacks a systematic framework for comparing these methodologies across dimensions that matter for both scholarly evaluation and policy decision-making. This section addresses this gap by proposing a Five-Dimensional Assessment Framework and applying it to the six methodological categories reviewed in Section 3.

5.1 The Five Dimensions

The proposed framework evaluates IFF measurement methodologies along five dimensions, each addressing a distinct aspect of measurement quality and applicability. The selection of these five dimensions is grounded in three complementary sources. First, the SDG 16.4.1 reporting requirements established by the UNCTAD-UNODC framework necessitate that any measurement approach be definitionally coherent with the agreed statistical definition and produce estimates that are comparable across countries for global monitoring purposes (UNCTAD & UNODC, 2020). These requirements anchor Dimensions 1 and 4. Second, the statistical measurement literature, particularly the work of the IMF on data quality assessment frameworks, identifies accuracy, reliability, and accessibility as core properties of any statistical indicator (International Monetary Fund, 2003). These principles underpin Dimensions 2 and 3. Third, the development policy literature on evidence-based governance emphasises that measurement exercises must ultimately be actionable, producing information that can inform targeted interventions rather than merely documenting the scale of a problem (Reuter, 2017). This requirement is captured in Dimension 5. Together, these five dimensions span the full chain from conceptual definition to policy application, providing a comprehensive basis for methodological evaluation:

Dimension 1: Definitional Coherence. This dimension assesses the degree to which a measurement method aligns with a recognised definition of IFFs. A method scores highly on this dimension if it explicitly defines what it is measuring, if that definition is consistent with the UNCTAD-UNODC statistical definition, and if the estimation procedure captures flows that correspond to the defined concept. Methods that conflate illicit flows with legitimate but unrecorded transactions, or that measure a proxy rather than the target concept, score lower on this dimension.

Dimension 2: Data Accessibility. This dimension evaluates whether the data required by a given method are available, accessible, and of sufficient quality in developing economies. Methods that rely on publicly available international datasets, such as IMF BoP statistics or UN Comtrade trade data, score higher than methods requiring confidential corporate data, proprietary databases, or specialised survey instruments that are unavailable in many developing country contexts.

Dimension 3: Estimation Precision. This dimension concerns the reliability and accuracy of the estimates produced. It encompasses the known direction and magnitude of bias in the

estimates, the sensitivity of results to methodological assumptions, and the extent to which estimates have been validated against external benchmarks or alternative data sources.

Dimension 4: Cross-Country Comparability. This dimension assesses whether a method can produce estimates that are meaningfully comparable across different national contexts. Methods that use standardised inputs and procedures, produce estimates that are robust to variations in institutional settings, and generate results that can be aggregated at regional or global levels score highly on this dimension.

Dimension 5: Policy Actionability. This dimension evaluates the extent to which the estimates produced by a method can inform specific, targeted policy interventions. Methods that identify particular sectors, commodities, actors, or channels through which IFFs occur, and that establish links to predicate offences, score highly. Methods that produce only aggregate national figures without sectoral or actor-level disaggregation score lower.

5.2. Application of the Framework

Table 1 presents the application of the Five-Dimensional Assessment Framework to the six methodological categories reviewed in this paper. Each methodology is rated on a three-level qualitative scale: High, Medium, or Low, based on the evidence and arguments presented in Sections 3 and 4. Where a methodology is too early in its development to permit reliable assessment, it is rated as Emerging.

Table 1: Five-Dimensional Assessment of IFF Measurement Methodologies

Method	D1	D2	D3	D4	D5
Capital Account-Based	Low	High	Low	Medium	Low
Trade-Based	Medium	High	Medium	Medium	Medium
Offshore Wealth	Medium	Low	Low	Low	Low
Corporate Tax Avoidance	Medium	Low	Medium	Medium	Medium
Forensic / Case Study	High	Low	High	Low	High
Gravity / ML Models	Medium	Medium	Emerging	Medium	Emerging

Note. D1 = Definitional Coherence; D2 = Data Accessibility; D3 = Estimation Precision; D4 = Cross-Country Comparability; D5 = Policy Actionability. High indicates the method performs well on the dimension with minimal documented limitations; Medium indicates partial performance with documented constraints that reduce but do not eliminate the method's utility; Low indicates significant limitations that substantially reduce the method's utility on the dimension; Emerging indicates insufficient empirical evidence to permit a definitive rating. Ratings are based on the authors' assessment drawing on the evidence reviewed in Sections 3 and 4.

5.3. Interpretation and Implications

Several patterns emerge from the application of the framework. First, no single methodology achieves High ratings across all five dimensions. This finding is not incidental; it reflects the fundamental character of IFFs as a phenomenon that is deliberately hidden, definitionally contested, and manifested through diverse channels. Forensic approaches achieve the highest ratings on definitional coherence and policy actionability because they examine specific transactions in context, but they are constrained by low data accessibility and zero cross-country comparability. Conversely, capital account-based and trade-based methods achieve high data accessibility because they rely on publicly available macroeconomic data, but they sacrifice definitional coherence and estimation precision in the process.

Second, there is a systematic trade-off between data accessibility and estimation precision. Methods that are easy to implement with available data tend to produce less precise estimates, while methods that offer higher precision require data that are difficult to obtain, particularly in developing economies. This trade-off is not unique to IFF measurement; it is a general feature of economic measurement in data-constrained environments. However, its implications for policy are significant. Policymakers must decide whether imprecise but available estimates are preferable to no estimates at all, and must be transparent about the limitations of the evidence on which their decisions are based.

Third, the emerging computational approaches, including gravity models and machine learning techniques, occupy a middle position across most dimensions. They offer medium-level performance on definitional coherence and data accessibility, but their estimation precision and policy actionability remain at an emerging stage. As these techniques mature and as their integration with macro-level estimation frameworks develops, they may offer the most promising pathway towards improved IFF measurement.

Fourth, the framework reveals an important asymmetry between the needs of researchers and policymakers. Academic researchers may prioritise estimation precision and cross-country comparability, as these properties enable rigorous empirical analysis. Policymakers, by contrast, may prioritise policy actionability and data accessibility, as these properties determine whether estimates can inform practical interventions within existing institutional constraints. The Five-Dimensional Assessment Framework makes these differing priorities explicit, enabling stakeholders to select methodological approaches that align with their specific objectives rather than defaulting to whichever method has the highest visibility in the literature.

Fifth, the assessment reveals that the UNCTAD-UNODC four-category typology of IFF-generating activities does not map neatly onto the six methodological categories evaluated here. Capital account-based and trade-based methods potentially capture flows from multiple typological categories but cannot disaggregate their estimates accordingly. Forensic approaches can achieve typological specificity but only for individual cases. This misalignment between the conceptual typology and the measurement toolkit represents a structural weakness in the current IFF estimation infrastructure that warrants attention in future methodological development.

On the basis of this analysis, the following proposition is advanced:

Proposition 6 (P6): *No single measurement approach achieves high ratings across all five assessment dimensions; effective IFF estimation requires a complementary deployment of multiple methods, calibrated to the specific institutional and data context of each country.*

Figure 2 synthesises the overall analytical chain of this paper, illustrating how definitional foundations (Stage 1) shape the selection of measurement methodologies (Stage 2), how cross-cutting challenges (Stage 3) constrain the reliability of resulting estimates, and how the Five-Dimensional Assessment Framework (Stage 4) provides a structured basis for evaluating methodological adequacy. The figure further maps the six propositions to their respective stages and traces the pathway from improved measurement to evidence-based policy action for SDG 16.4 monitoring.

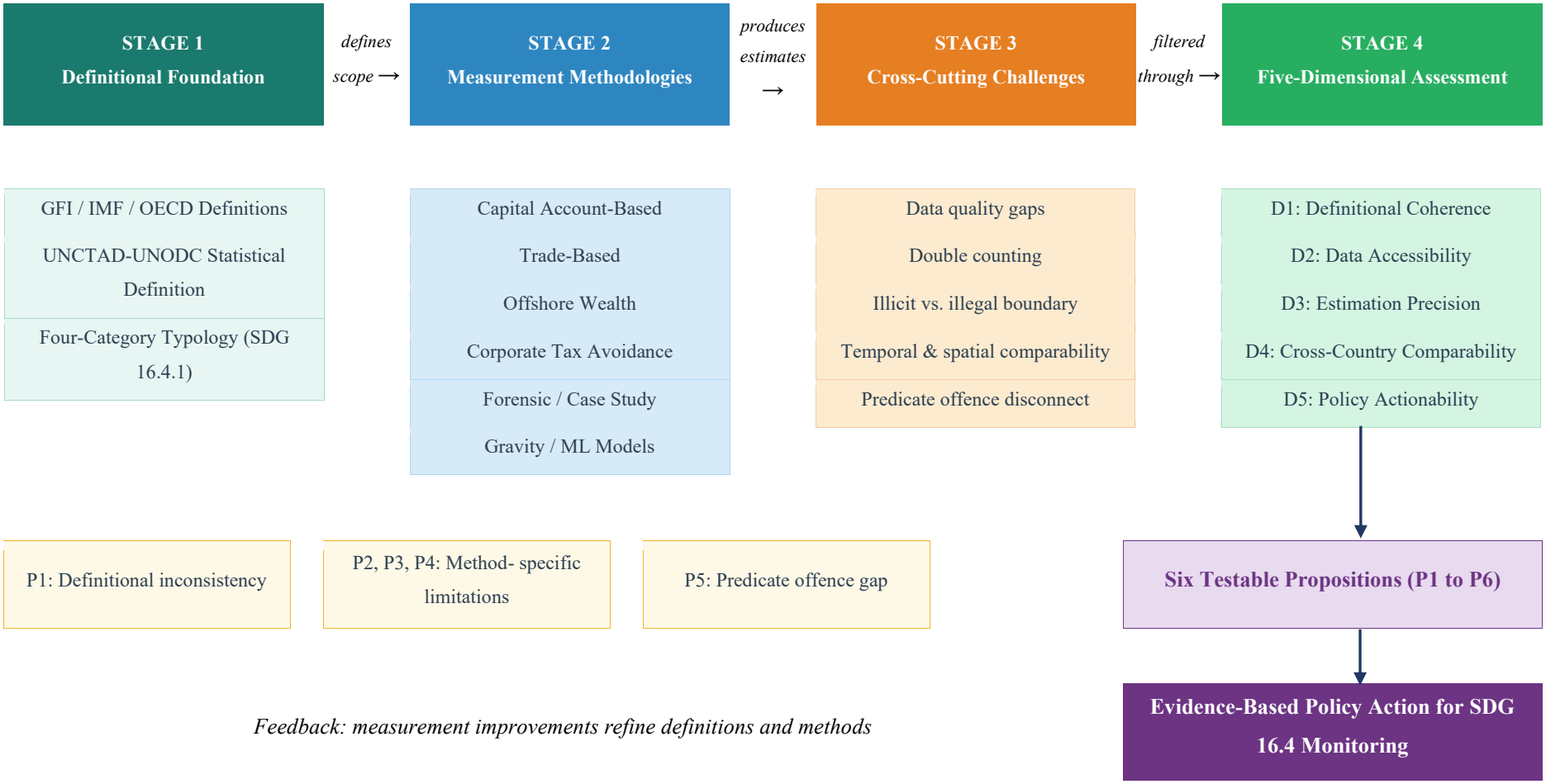

Figure 2: Conceptual flow: From IFF definition to policy action

Source: Author's conceptualisation.

6. Research Agenda and Future Directions

The analysis presented in this paper identifies several areas where further research is needed to advance the measurement of IFFs and improve the analytical foundations for policy action. This section outlines five priority directions for future work.

First, the integration of machine learning with macro-level estimation frameworks. While ML techniques have demonstrated promise in transaction-level anomaly detection, the methodological bridge between flagging individual suspicious transactions and producing reliable national-level IFF estimates has not been constructed. Future research should explore aggregation methodologies that translate ML-detected anomalies into national accounts-compatible IFF estimates. This requires collaboration between computer scientists, statisticians, and economists, reflecting the multidisciplinary character of IFF research identified by Popik-Mazur (2025).

Second, methodological triangulation. The Five-Dimensional Assessment Framework proposed in this paper suggests that no single method is sufficient for comprehensive IFF measurement. This implies a research agenda focused on triangulation: the application of multiple methods to the same country-period, followed by systematic reconciliation of the resulting estimates. Methodological triangulation could provide both a more reliable composite estimate and a means of identifying the specific sources of divergence between methods. To date, no study has rigorously applied and compared multiple IFF estimation methods to the same country and time period.

Third, country-level capacity building and institutional design. The UNCTAD pilot experience demonstrates that IFF measurement is not merely a technical challenge but an institutional one. Building on the experience of Ghana, Namibia, Zambia, and other pilot countries, future research should investigate how statistical offices in developing economies can be equipped to produce IFF estimates as part of their regular national accounts production cycle. This includes examining the institutional prerequisites for effective inter-agency data sharing, the role of national IFF coordination mechanisms, and the optimal sequencing of capacity-building interventions.

Fourth, sector-specific measurement frameworks. The UNCTAD pilot findings indicate that IFF measurement is more feasible and more policy-relevant when focused on specific commodity sectors rather than aggregate national estimates. The high IFF risks identified in the trade of raw minerals such as gold, copper, cobalt, and crude oil suggest that sector-specific measurement frameworks, incorporating commodity price benchmarks, physical production data, and shipping records, could significantly improve estimation precision. Future research should develop and validate such frameworks for the commodities most vulnerable to IFF exploitation in developing economies.

Fifth, linking IFF estimates to developmental outcomes. The accuracy and reliability of IFF estimates directly affect the validity of empirical studies that examine the effects of IFFs on economic growth, human development, institutional quality, and subjective well-being. The measurement challenges documented in this paper imply that existing empirical studies of IFF impacts may be based on estimates that are subject to significant measurement error. Future research should explicitly address the sensitivity of IFF-impact findings to the choice of measurement methodology and should develop estimation strategies that account for the

known biases in IFF data. This is particularly important for developing economies, where the developmental stakes of IFF measurement are highest.

Beyond these five priority areas, two further directions merit attention. The rapid evolution of digital finance, including cryptocurrencies, decentralised finance platforms, and mobile money systems, is creating new channels for illicit cross-border transfers that existing measurement methods are not designed to capture (Tropina, 2016). The pseudo-anonymous nature of blockchain-based transactions, the speed of cross-border cryptocurrency transfers, and the jurisdictional fragmentation of digital asset regulation pose fundamental challenges for IFF measurement frameworks that were developed for a world of bank-intermediated and goods-based financial flows. Research on the measurement of digitally facilitated IFFs is urgently needed, and must engage with the technical properties of these new financial instruments as well as with the regulatory and institutional contexts in which they operate.

Additionally, the development of satellite and geospatial data sources, combined with advances in remote sensing technology, may offer novel approaches to estimating IFFs from extractive industries. Discrepancies between physical production volumes observed through satellite imagery and reported export values could indicate illicit outflows that are invisible to traditional measurement methods. Such approaches have already been explored in the context of deforestation monitoring and illegal mining detection, and their extension to IFF estimation represents a promising but unexplored frontier. The convergence of satellite data, customs records, and commodity price benchmarks could enable a new generation of triangulated IFF estimates with higher precision than any single data source can achieve.

Finally, the role of professional intermediaries in facilitating IFFs, such as accountants, lawyers, corporate service providers, and financial advisors, remains insufficiently addressed in the measurement literature. While forensic investigations such as the Panama Papers have revealed the centrality of professional enablers in IFF schemes, existing macro-level estimation methods do not systematically incorporate data on intermediary activity. Research that links regulatory data on professional intermediaries to IFF estimation could improve both the precision and the policy actionability of the resulting estimates, directly informing anti-money laundering supervision and professional regulation.

7. Conclusion

This paper has provided a conceptual review of the principal methodological approaches to measuring illicit financial flows, evaluated their theoretical assumptions and empirical limitations, and proposed a Five-Dimensional Assessment Framework for systematically comparing these approaches. The six propositions advanced throughout the paper are consolidated in Table 2.

Table 2: Consolidated Set of Propositions

ID	Proposition
P1	The absence of a universally adopted operational definition of IFFs is a primary source of inconsistency in IFF estimates across studies and institutions.
P2	Capital account-based estimates systematically overestimate IFFs in developing economies due to the conflation of statistical discrepancies with illicit capital movements.
P3	Trade-based estimates provide the most widely used but narrowest measurement of IFFs, capturing only the commercial dimension while omitting crime-related and corruption-related flows.

P4	Emerging computational approaches, including machine learning, offer the potential to improve IFF detection at the transaction level, but their integration into macro-level IFF estimation frameworks remains underdeveloped.
P5	The policy utility of IFF estimates is constrained by the inability of most measurement approaches to link estimated flows to specific predicate offences or sectors of origin.
P6	No single measurement approach achieves high ratings across all five assessment dimensions; effective IFF estimation requires a complementary deployment of multiple methods, calibrated to the specific institutional and data context of each country.

The analysis presented in this paper yields three principal contributions to the literature.

First, the paper presents an updated taxonomy of IFF measurement methodologies that extends the foundational classification by Cobham and Janskỳ (2017) to incorporate the UNCTAD-UNODC Conceptual Framework endorsed by the United Nations Statistical Commission in 2022, the results of pilot testing in 22 countries, and emerging computational approaches including machine learning. This updated taxonomy provides a structured analytical map of the methodological landscape that reflects its current state of development.

Second, the critical evaluation of each methodological category reveals that existing approaches are characterised by significant trade-offs between accessibility and precision, between breadth and granularity, and between feasibility and validity. Capital account-based methods offer broad coverage but low precision. Trade-based methods provide transparency and replicability but capture only one dimension of IFFs. Offshore wealth and corporate tax avoidance estimates address important but data-constrained dimensions of the phenomenon. Forensic approaches deliver high granularity but low generalisability. Emerging computational approaches hold promise but remain at an early stage of integration into macro-level estimation frameworks.

Third, and as the paper's principal original contribution, the Five-Dimensional Assessment Framework provides a structured basis for evaluating and comparing IFF measurement methodologies. The framework's five dimensions, namely definitional coherence, data accessibility, estimation precision, cross-country comparability, and policy actionability, address the criteria that matter most for both scholarly evaluation and policy application. The application of this framework demonstrates that no single methodology achieves adequate performance across all five dimensions, confirming that effective IFF measurement requires the complementary deployment of multiple methods calibrated to specific country contexts.

Six testable propositions have been advanced from this analysis, spanning definitional fragmentation (P1), overestimation bias in capital account methods (P2), the narrow scope of trade-based estimates (P3), the emerging potential of computational approaches (P4), the disconnect between estimates and predicate offences (P5), and the necessity of methodological complementarity (P6). These propositions provide a foundation for future empirical investigation and methodological development.

The policy implications of this analysis are direct. As the 2030 deadline for SDG Target 16.4 approaches, the international community's ability to assess progress depends on the reliability of IFF estimates. The UNCTAD-UNODC Conceptual Framework provides the definitional foundation; what remains is the construction of robust, accessible, and policy-actionable measurement systems, particularly in the developing economies where the developmental costs of IFFs are greatest. This paper has argued that achieving this objective requires not the selection of a single best method, but the strategic deployment of complementary approaches,

supported by institutional capacity building, inter-agency coordination, and continued methodological innovation. The measurement of IFFs is not merely a technical exercise; it is a precondition for the effective governance of an interconnected global financial system.

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Conflict of Interest Statement
The author declares that this study was conducted solely for academic purposes and that there is no conflict of interest regarding the conduct, analysis, or publication of this research.

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