

## A CONFIGURATIONAL MACRO-FRAMEWORK LINKING CIRCULAR MATERIALIZATION AND INTERNATIONALIZATION OUTCOMES

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***Abstract:** This paper proposes a macro-comparative framework for examining how circular materialization relates to internationalization outcomes under conditions of uneven indicator availability and limited case numbers. To preserve level consistency, internationalization outcomes are approached through international economic positioning, understood as a macro-level expression of a country's external economic profile. The framework distinguishes between an economy's internal structural profile - institutional setting, innovation capacity, and circular materialization - and its external economic profile, captured through international economic positioning. Two conceptual boundaries are clarified: between circularity as a broader systemic horizon and circular materialization as a narrower construct focused on observable aggregate material outcomes, and between firm-level internationalization behaviour and macro-level international economic positioning. Methodologically, the paper introduces a two-tier indicator architecture, combining a parsimonious comparative core with validating indicators for contextual interpretation, supported by transparent procedures for standardization, aggregation, and stability checks. An illustrative application using a reduced indicator set for Germany, Bulgaria, and Romania demonstrates how comparative profiles can reveal patterns of alignment and divergence across countries, even under constrained data conditions. Designed for small-N analysis, the framework functions as a diagnostic comparative template rather than a causal model, while remaining open to later empirical application and theoretical elaboration.*

***Keywords:** circular materialization; international economic positioning; comparative profiling; composite indicators; comparative framework.*

***Classification JEL:** C43; F63; Q56.*

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### 1. Introduction

Circular economy strategies are increasingly discussed not only in environmental terms, but also in relation to competitiveness, resilience, and broader sustainability-oriented transformation. At the macro-comparative level, research faces a persistent gap between conceptual breadth and empirical observability, as internationally comparable indicators capture only selected dimensions of circularity (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Korhonen et al., 2018; Moraga et al., 2019). Cross-country comparability is further constrained by differences in definitions, measurement approaches, and data availability (OECD, 2024; Saidani et al., 2019).

To address this, the paper distinguishes between circularity - the broader systemic horizon of transformation - and circular materialization, which focuses on observable aggregate material outcomes. This distinction allows for tractable comparative analysis under current data constraints.

A parallel challenge arises in assessing countries' outward-oriented economic profiles at the macro level. Firm-level concepts such as learning, commitment, and opportunity-driven expansion (Johanson & Vahlne, 1977, 2009; Oviatt & McDougall, 2005) are primarily designed to explain firm behaviour and therefore do not translate directly to macro-level analysis, where the focus shifts from behavioural processes to structural economic characteristics. Instead, features such as export breadth, export sophistication, value-added

trade participation, and broader forms of international connectedness provide more appropriate proxies for capturing countries' external economic structure.

Taken together, these considerations point to a broader comparative gap: although circular economy research, macro-level internationalization, and composite-indicator methodology offer important insights, they remain insufficiently integrated in frameworks that connect observable material outcomes with outward-oriented economic positioning.

This paper addresses the gap by proposing a comparative profile-analytical framework that connects internal structural conditions - including institutional setting, innovation capacity, and circular materialization - to external economic outcomes. Designed for small-N, data-constrained settings, it combines a parsimonious core of indicators with contextual validation to support structured, level-consistent comparison.

The contribution is both conceptual and methodological. Conceptually, the paper distinguishes circularity from circular materialization and macro-level economic positioning from firm-level internationalization behaviour. Methodologically, it introduces a two-tier indicator architecture with transparent procedures for standardization, aggregation, and stability checks, providing a structured template for analysing alignment and divergence in countries' internal and external economic profiles.

## 2. Literature Review

The literature relevant to this paper is rich but fragmented, offering insights for linking material transformation to outward-oriented economic profiles while leaving significant gaps at the macro level.

Circular economy is widely understood as a systemic alternative to linear “take-make-dispose” models, emphasizing value retention through reuse, repair, remanufacturing, recycling, and broader resource-efficiency strategies. Its diffusion across multiple fields has promoted adoption but generated ambiguity regarding definitions, system boundaries, and units of analysis (Geissdoerfer et al., 2017; Kirchherr et al., 2017). At the macro level, empirical work relies on partial proxies such as resource productivity, waste intensity, and recycling-related recovery, which capture only selected aspects of circular transformation and reflect heterogeneous measurement approaches and system boundaries (Moraga et al., 2019; Saidani et al., 2019). These issues, combined with differences in data availability and statistical frameworks, limit cross-country comparability (OECD, 2024).

Internationalization research faces a related challenge. Traditional theory explains internationalization through firm-level processes such as learning, commitment, and opportunity-driven expansion (Johanson & Vahlne, 1977, 2009; Oviatt & McDougall, 2005). These concepts do not directly translate to macro-level analysis, where the focus shifts to structural patterns such as export breadth, sophistication, value-added trade participation, and broader forms of international connectedness. These can be interpreted as aspects of a country's external economic structure, drawing on measures of economic complexity and comparative advantage (Hausmann et al., 2007; OECD, n.d.). Level-consistent constructs are therefore essential for analysing macro-level internationalization outcomes.

Finally, comparative reasoning and composite-indicator methodology provide useful tools for analysing multidimensional macro-level phenomena. Both material transformation and external economic positioning are shaped by institutional and innovation-related conditions,

which limits the usefulness of single-variable approaches. Composite indicators can organize heterogeneous measures, but only when decisions regarding indicator selection, normalization, weighting, aggregation, and robustness are transparent (Nardo et al., 2005; OECD, 2008). Without such rigor, composite measures risk overstating precision, especially when data coverage is uneven.

Together, these strands highlight a persistent gap in macro-comparative research: the lack of a coherent framework that integrates observable material outcomes of circularity with structural representations of countries' external economic positioning under conditions of uneven data availability.

### 3. Methodology

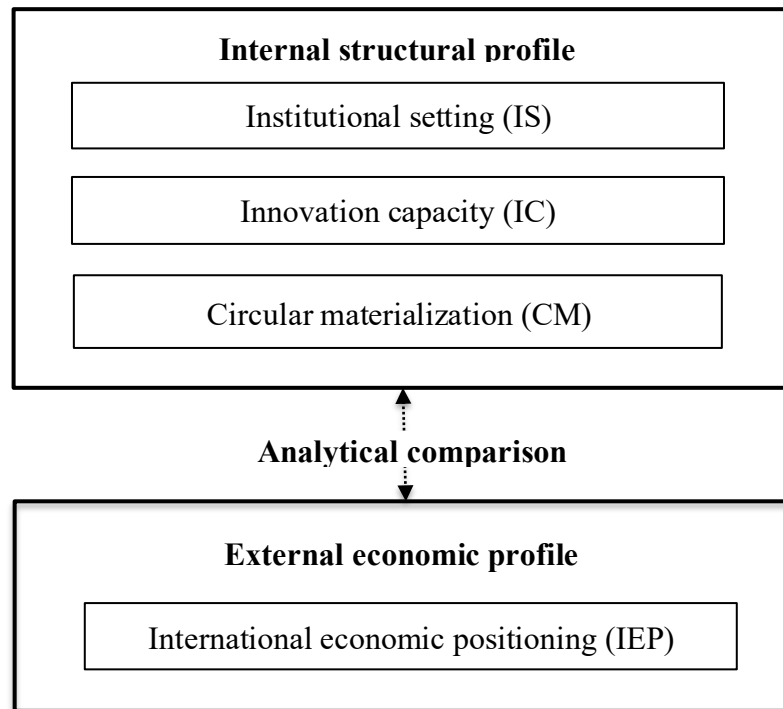
This paper develops a comparative profile-analytical framework for small-N cross-country comparison rather than statistical generalization. Its primary purpose is to examine how circular materialization relates to internationalization outcomes at the macro level under conditions of limited cases and uneven indicator availability. Under these constraints, the analysis does not aim to estimate causal effects or isolate the net impact of individual variables. Instead, it seeks to identify comparative patterns in terms of profile alignment, divergence, and consistency across analytically distinct dimensions. Operationally, this involves constructing and comparing country profiles across institutional, innovation, material, and external economic dimensions. The framework serves as a structured template for small-N comparative application, emphasizing diagnostic interpretation under data constraints. It therefore emphasizes analytical clarity over statistical inference, prioritizing structured interpretation and diagnostic insight.

The methodological design follows several guiding principles. First, all constructs are aligned with the macro level, ensuring cross-country comparability while avoiding direct import of firm-level behavioural categories. Second, parsimony is prioritized by focusing on a coherent core set of indicators, which improves interpretability under uneven data availability and reduces noise from less reliable measures. Third, the framework maintains full transparency in indicator selection, directionality, aggregation, and basic stability checks, ensuring that all methodological choices are explicit and reproducible.

The framework distinguishes between the economy's internal structural profile and its external economic profile. The internal profile comprises institutional setting (IS), innovation capacity (IC), and circular materialization (CM), capturing enabling conditions and observable material outcomes. CM is treated as a macro-level proxy for material outcomes rather than a full representation of circularity, reflecting limitations in available indicators. The external economic profile is represented by international economic positioning (IEP), capturing structural characteristics such as export breadth, export sophistication, trade participation, and international connectedness. IEP provides a level-consistent aggregate measure distinct from firm-level internationalization behaviour.

Analytically, the framework compares these internal and external profiles to assess whether different configurations of enabling conditions and material outcomes correspond to particular forms of external economic positioning. This comparison is pattern-oriented and configurational, allowing multiple internal-external combinations without implying deterministic or causal relationships. By systematically contrasting institutional setting,

innovation capacity, and circular materialization with international economic positioning, the framework enables identification of alignment, divergence, or partial correspondence across countries. Figure 1 illustrates this logic, showing how internal structural components are positioned relative to external economic outcomes, providing a visual reference for the subsequent analytical interpretation.



**Figure 1. Analytical comparison between the economy's internal structural profile and external economic profile.**

*Source: Developed by author.*

Empirically, the framework relies on secondary data from internationally comparable sources, including Eurostat, OECD databases, World Bank indicators, and World Integrated Trade Solution trade data, supplemented by national statistical sources where necessary. Case selection is limited to countries with sufficient overlap in core indicators across the analytical period, and indicators are summarized into period-representative statistics (typically means), reducing sensitivity to short-term fluctuations.

To address uneven data availability, the framework adopts a two-tier indicator logic. A parsimonious set of core indicators constructs comparative profiles for IS, IC, CM, and IEP, while a complementary set of validating indicators provides contextual interpretation without altering scores. Missing data are treated conservatively: indicators with limited coverage may be retained as interpretive measures, but no ad hoc imputation is applied.

Indicators are standardized using z-scores with harmonized directionality, while pressure indicators are sign-adjusted for consistency. Composite scores are constructed with equal weighting as a transparent baseline, producing dimension-specific results while leaving broader cross-dimensional interpretation analytical. Basic stability checks, including alternative normalization, modest weighting variations, and selective leave-one-out tests,

assess sensitivity to methodological choices and ensure robustness of comparative patterns (Nardo et al., 2005; OECD, 2008).

## 4. Analytical Outputs and Discussion

Given the conceptual and methodological scope of the paper, this section presents the analytical outputs generated by the proposed comparative profile-analytical framework, rather than finalized empirical findings. Its primary aim is to show how the framework structures cross-country comparison and supports interpretation in small-N settings, particularly where indicator availability is uneven. By integrating internal structural conditions, material outcomes, and external economic positioning into a coherent analytical system, the framework offers a transparent and level-consistent approach to examining circular materialization in relation to macro-level internationalization. The outputs are intended to support diagnostic interpretation by highlighting patterns of alignment and divergence without implying causal relationships.

The section is organized around three interrelated outputs that enable systematic comparison: (1) a comparative analytical model, which structures assessment across internal and external dimensions; (2) a two-tier indicator architecture, which operationalizes the model under conditions of uneven data availability; and (3) a baseline composite-index procedure, which standardizes and aggregates indicators while preserving interpretive clarity. Together, these outputs form a coherent framework for identifying patterns of alignment and divergence between internal structural conditions and external economic outcomes in small-N settings.

The first output, *the comparative analytical model*, establishes the conceptual foundation for cross-country comparison. It distinguishes between the economy's internal structural profile - comprising institutional setting (IS), innovation capacity (IC), and circular materialization (CM) - and its external economic profile, represented by international economic positioning (IEP). IS and IC function as enabling internal dimensions, while CM captures observable material outcomes. These internal dimensions are analytically contrasted with IEP, which reflects outward-oriented structural characteristics such as export breadth, sophistication, trade participation, and broader international connectedness.

By clarifying these boundaries, the model preserves consistency across macro-level comparisons. CM is treated as a bounded proxy for material outcomes rather than a full representation of circularity, while IEP reflects aggregate rather than firm-level outcomes, maintaining interpretability despite uneven data availability.

The model accommodates multiple configurations without implying a single causal pathway. Countries with similar external profiles may exhibit different internal patterns, while comparable internal conditions may correspond to different external outcomes. This flexibility enables the identification of alignment, divergence, and partial correspondence across cases, supporting nuanced comparative analysis rather than simplistic ranking.

Operationalizing the analytical model, the framework employs *a two-tier indicator architecture* designed for small-N, data-constrained settings. A core set of indicators constructs the main comparative profiles for IS, IC, CM, and IEP, while a complementary set of validating indicators provides contextual interpretation. These validating indicators do not affect core scores but help refine interpretation where data are available.

This architecture balances methodological rigor and interpretive clarity, enabling analytical comparability even when some indicators are partially available. It addresses a common challenge in macro-comparative research on circular economy and internationalization. By prioritizing a limited core set of indicators, the framework reduces noise associated with uneven data availability, while additional validating indicators provide contextual support for interpretation.

Table 1 summarizes the full two-tier indicator structure, distinguishing between core and validating measures and showing how each dimension is operationalized under uneven data conditions.

**Table 1. Framework components and indicator architecture**

Component	Core indicators	Validating indicators	Interpretation
IS	Rule of law; integrity; enforcement predictability	Regulatory quality; government effectiveness; business environment	Institutional conditions
IC	R&D intensity; innovation networks; collaboration	Patents; publications; high-tech employment	Innovation capacity
CM	Resource productivity; material/waste intensity; recycling	Circular material use; secondary materials; repair and environmental investment	Material outcomes
IEP	Export sophistication; diversification; capital connectedness	Economic complexity; GVC participation; domestic value added	External economic profile

*Source: Developed by the author.*

Following Table 1, core indicators define the comparative positioning of countries along each dimension, while validating indicators provide supplementary context. This structure ensures that cross-country comparisons remain consistent, transparent, and analytically meaningful, despite variation in data availability.

Building on the two-tier architecture, the framework defines *a baseline composite-index procedure* to summarize and compare indicators. Each indicator is aggregated into period-representative statistics, typically using means over the selected analytical window. Indicators are standardized using z-scores and harmonized in directionality, with pressure indicators sign-adjusted as needed. Composite scores are computed with equal weighting, producing dimension-specific results that preserve interpretive clarity without imposing artificial precision to support robustness, basic stability checks are included, such as alternative normalization methods, modest variations in weighting, and selective leave-one-out tests for multi-indicator dimensions. These checks assess sensitivity to methodological choices. (Nardo et al., 2005; OECD, 2008).

To demonstrate how the framework can be applied under constrained data conditions, Table 2 presents illustrative comparative profiles based on simple period averages (2021-2022) using a minimal set of core indicators. The results are intended for comparative illustration and are not fully standardized.

**Table 2. Illustrative comparative profiles (selected indicators, 2021-2022 averages)**

Country	Rule of Law (WGI)	R&D (% GDP)	Resource productivity (EUR/kg)	High-tech exports (% of manufactured goods)
Germany	84.64	3.13	2.7851	16.44
Bulgaria	55.79	0.76	0.343	10.65
Romania	64.69	0.465	0.364	11.68

*Source:* Developed by the author based on publicly available data from the World Bank and Eurostat databases.

Building on Table 1, Table 2 illustrates how core indicators can be summarized into dimension-specific scores, facilitating direct cross-country comparison even under limited data conditions. Germany exhibits consistently strong performance across all dimensions: high institutional quality, substantial R&D intensity, strong resource productivity, and a large share of high-tech exports. Bulgaria shows moderate institutional conditions and material outcomes but lower innovation capacity and external positioning, suggesting partial misalignment. Romania displays a mixed profile, with moderate institutional conditions and material outcomes, weaker innovation capacity, and intermediate external positioning.

While these patterns are illustrative rather than conclusive, they demonstrate the framework's utility in identifying alignment and divergence between internal structural profiles and external economic outcomes. The approach supports small-N comparative analysis by enabling structured, transparent, and level-consistent interpretation, even when data availability is uneven. Furthermore, the profiles highlight the potential for nuanced diagnostic insights: strong material outcomes without corresponding innovation capacity may indicate structural or policy gaps, while robust internal conditions with weaker external positioning could reflect barriers to translating domestic capacities into international economic advantages.

## 5. Conclusions

Building on the analytical outputs, this paper has proposed a comparative profile-analytical framework for examining the relationship between circular materialization and international economic positioning under conditions of uneven data availability and limited case numbers. The framework contributes a structured approach for organizing macro-level comparison through a parsimonious and transparent indicator logic.

The illustrative application demonstrates the framework's diagnostic value. Germany exhibits consistently strong internal and external alignment, Bulgaria shows partial correspondence between structural conditions and external positioning, while Romania presents a more mixed profile. These results are intended as illustrative rather than definitive, highlighting the framework's capacity to reveal comparative patterns under data constraints.

Overall, the study contributes a structured and extensible approach to macro-level comparative analysis of sustainability-related material outcomes and external economic structures. Future research may extend this framework through richer indicator sets, sectoral disaggregation, and integration with firm-level evidence to further explore multi-level dynamics.

## 6. References

- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy: A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768. <https://doi.org/10.1016/j.jclepro.2016.12.048>.
- Hausmann, R., Hwang, J., & Rodrik, D. (2007). What you export matters. *Journal of Economic Growth*, 12(1), 1–25. <https://doi.org/10.1007/s10887-006-9009-4>.
- Johanson, J., & Vahlne, J.-E. (1977). The internationalization process of the firm: A model of knowledge development and increasing foreign market commitments. *Journal of International Business Studies*, 8(1), 23–32. <https://doi.org/10.1057/palgrave.jibs.8490676>.
- Johanson, J., & Vahlne, J.-E. (2009). The Uppsala internationalization process model revisited: From liability of foreignness to liability of outsidership. *Journal of International Business Studies*, 40(9), 1411–1431. <https://doi.org/10.1057/jibs.2009.24>.
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, 127, 221–232. <https://doi.org/10.1016/j.resconrec.2017.09.005>.
- Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. *Ecological Economics*, 143, 37–46. <https://doi.org/10.1016/j.ecolecon.2017.06.041>.
- Moraga, G., Huysveld, S., Mathieux, F., Blengini, G. A., Alaerts, L., Van Acker, K., De Meester, S., & Dewulf, J. (2019). Circular economy indicators: What do they measure? *Resources, Conservation and Recycling*, 146, 452–461. <https://doi.org/10.1016/j.resconrec.2019.03.045>.
- Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A., & Giovannini, E. (2005). *Handbook on constructing composite indicators: Methodology and user guide*. OECD.
- OECD. (2008). *Handbook on constructing composite indicators: Methodology and user guide*. OECD Publishing.
- OECD. (2024). *Circular economy indicators*. OECD Publishing.
- OECD. (n.d.). *Trade in value added (TiVA) database*. <https://www.oecd.org/en/topics/sub-issues/trade-in-value-added.html>.
- Oviatt, B. M., & McDougall, P. P. (2005). *Defining international entrepreneurship and modeling the speed of internationalization*. *Entrepreneurship Theory and Practice*, 29(5), 537–553. <https://doi.org/10.1111/j.1540-6520.2005.00097.x>.
- Saidani, M., Yannou, B., Leroy, Y., Cluzel, F., & Kendall, A. (2019). *A taxonomy of circular economy indicators*. *Journal of Cleaner Production*, 207, 542–559. <https://doi.org/10.1016/j.jclepro.2018.10.014>.
- World Bank. (n.d.). *Worldwide Governance Indicators (WGI)*. <https://www.worldbank.org/en/publication/worldwide-governance-indicators/interactive-data-access>.
- World Bank. (n.d.). *World Development Indicators (WDI)*. <https://databank.worldbank.org/source/world-development-indicators>.
- Eurostat. (n.d.). *Circular economy indicators database*. <https://ec.europa.eu/eurostat/web/circular-economy/information-data>.
- World Integrated Trade Solution. (n.d.). *Trade data*. <https://wits.worldbank.org/>.