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Does Governance Erosion Cost More Than Reform Confers? Institutional Quality and Multidimensional Economic Complexity in Africa

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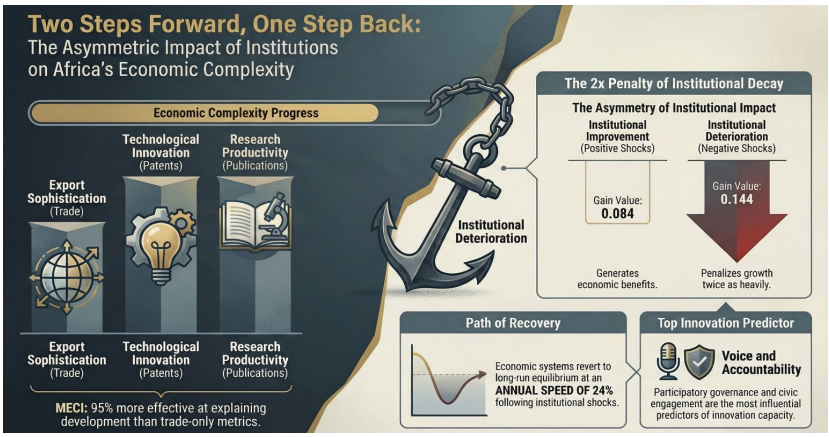
ABSTRACT

Does institutional quality affect economic complexity asymmetrically in Africa, so that governance deterioration erodes productive capability by more than equivalent improvement builds it? Complexity is measured by a Multidimensional Economic Complexity Index combining the export, technology and research dimensions of Stojkoski, Koch and Hidalgo (2023). Asymmetry is modelled directly through a panel nonlinear autoregressive distributed lag specification with cumulative positive and negative partial sums, rather than inferred from sample splits. On an annual panel of thirteen African economies over 1998 to 2022, a stable long-run equilibrium links institutional quality to each complexity dimension, with error correction terms implying adjustment speeds of 14 to 28 per cent per year. Long-run institutional effects are consistently signed but imprecisely estimated at this panel size, so the analysis leads with pattern rather than magnitude. The central finding is directional and robust across the composite, research and technology dimensions: institutional deterioration carries a larger absolute long-run effect than equivalent improvement. Causality is dimension-specific rather than uniformly one-way. A leakage-free, country-blocked machine learning validation shows institutional indicators do not transfer across unseen economies, a negative result that repositions the machine learning evidence as caution rather than corroboration.

Graphical abstract



1. Introduction

Institutions are widely held to be among the deepest determinants of long run development, yet the mechanism through which they shape an economy's productive structure remains imperfectly understood, and nowhere more so than in Africa. Capability based development theory locates the roots of prosperity in the diversity and sophistication of the productive knowledge an economy commands, its economic complexity, and identifies institutions as a central precondition for accumulating that knowledge, because complex production depends on the enforcement of contracts across long value chains, the protection of the returns to innovation, and a policy environment stable enough to justify slow, illiquid capability investments (Hidalgo and Hausmann 2009; Hausmann and Hidalgo 2011). If institutions are a precondition for complexity, then the quality of governance and the direction of its change should register in the capability structure of African economies,

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whose complexity remains the lowest of any world region and whose governance trajectories over the past quarter century span reform, stagnation and reversal alike.

A question of first order policy importance follows, and it is the question this study addresses: is the relationship between institutional quality and complexity symmetric with respect to the direction of institutional change, or does deterioration cost more than improvement confers? The distinction matters because capability, once assembled, is costly to rebuild. A functioning regulatory apparatus, an independent judiciary or a stable investment climate represents years of accumulated coordination that can be dismantled quickly through a coup, a corruption spiral or a period of policy volatility, but reconstituted only slowly. If the institution complexity relationship inherits this asymmetry, then episodic reform that is later reversed does not merely fail to help; it may leave an economy worse off than steady mediocrity would have, because the reversal destroys more capability than the reform built. A literature that estimates only a symmetric average effect of institutions cannot detect this, and cannot therefore distinguish the developmental value of institutional consolidation from that of institutional improvement.

The existing evidence is not yet equipped to answer the question cleanly, for three reasons that this study is designed to address. First, almost all of it measures complexity through the trade-based index alone, which captures export sophistication but is silent on the technological and research capabilities that institutions also shape. Second, where nonlinearity is considered at all, it is typically inferred indirectly, from sample splits by income or resource status, or from kinked and quadratic specifications, rather than estimated as a direct decomposition of institutional change into its improving and deteriorating components. Third, the econometric evidence is rarely stress tested against out of sample criteria, so it is difficult to know whether a reported in sample relationship would transfer to an unseen economy. The analysis that follows measures complexity multidimensionally, models sign asymmetry directly through a nonlinear autoregressive distributed lag specification, and subjects the result to a machine learning validation built to respect rather than flatter the panel structure.

The contribution is threefold and is stated with deliberate restraint, because a panel of thirteen African economies supports firm statements about pattern and direction more readily than about precise magnitude. First, the study provides the first directly sign decomposed, multidimensional treatment of the institution complexity relationship for Africa, and finds that the long run effect of institutional deterioration is consistently larger in absolute value than the effect of equivalent improvement across the composite and the research and technology dimensions. Second, it shows that the causal structure is dimension specific rather than uniformly one way, so that institutions are causally prior on balance but not strictly exogenous to complexity. Third, it reports a leakage free machine learning validation whose negative result, that institutional indicators alone do not transfer across unseen economies, is itself informative, and it uses that result to calibrate rather than to inflate the paper's claims. The remainder proceeds through the theoretical framework and hypotheses (Section 2), data and methodology (Section 3), results and discussion (Section 4), and conclusions and policy implications (Section 5).

2. Theoretical framework, literature and hypotheses

2.1 The institution capability nexus

The theoretical case for institutions as a determinant of complexity runs through the accumulation of productive capability. Complex production requires assembling many complementary and largely tacit capabilities simultaneously, and each of them depends on institutional foundations: contract enforcement for the coordination of specialised suppliers, protection of intellectual property for the returns to innovation, political stability for the long horizons over which capability investments pay off, and effective, non-corrupt public administration for the provision of the collective inputs, infrastructure, standards, education, that private capability accumulation presupposes (North 1990; Acemoglu, Johnson and Robinson 2001; Hausmann and Hidalgo 2011). Weak institutions raise the cost and risk of every capability investment and divert effort from productive upgrading toward rent seeking, so that institutional quality should raise complexity over the horizon on which capabilities accumulate.

2.2 Why the relationship should be asymmetric

The theoretical expectation of asymmetry follows from the nature of capability as a stock. Capabilities are combinatorial and tacit, embedded in the routines of firms and the coordination among them, and a capability combination that has been disassembled, through the exit of firms, the emigration of skilled workers, or the collapse of a supplier network, cannot be reconstituted merely by restoring the institutional conditions that originally supported it, because the tacit coordination must be relearned. Institutional deterioration can therefore trigger a rapid and partly irreversible loss of capability, whereas institutional improvement builds capability only slowly and from whatever base survives. The relationship between institutional change and complexity should accordingly be asymmetric, with deteriorations reducing complexity by more than equivalent improvements raise it. This is a directional prediction about the relative magnitude of two long run effects, and testing it requires a specification that estimates the effect of institutional improvement and the

effect of institutional deterioration separately, which is precisely what the nonlinear autoregressive distributed lag decomposition provides.

2.3 Empirical literature and research gaps

The empirical literature on institutions and complexity has established a broadly positive association across global and African samples, but it has treated nonlinearity and asymmetry unevenly and has relied almost entirely on the trade-based complexity measure. Cross country studies link governance quality to complexity and to the growth that complexity delivers, and African evidence broadly concurs, identifying institutional quality among the significant correlates of complexity and export sophistication (Hartmann et al. 2017; Mini, Moyo and Phiri 2025; Dziwornu and Kunawotor 2026). Where the African literature has examined nonlinearity, however, it has done so mainly through sample splitting and kinked regressions, and the findings are not uniformly monotone. A recent study of thirty-five African economies reports hump shaped asymmetries, in which institutions raise complexity only up to moderate levels and higher governance quality is associated with diminishing or even adverse effects, plausibly through the entrenchment of incumbents (Mini, Moyo and Phiri 2025). A parallel strand establishes institutional thresholds in the finance to complexity and resource to complexity relationships, and finds asymmetric rather than symmetric causal structures in resource rich African settings (Olaniyi and Odhiambo 2023, 2025). This body of work makes clear that the institution complexity relationship in Africa is unlikely to be a simple symmetric line, but it leaves three gaps. It measures complexity through the trade fingerprint alone; it infers nonlinearity indirectly rather than decomposing institutional change directly into its positive and negative components; and it does not test whether the estimated relationships transfer out of sample. The present study addresses all three, and in doing so it also confronts, rather than assumes away, the possibility raised by the hump shaped findings that the asymmetry may be more complex than a simple deterioration penalty.

2.4 Hypotheses

H1. Institutional quality and multidimensional economic complexity are cointegrated, with a stable long run equilibrium to which each complexity dimension adjusts.

H2. The long run effect of institutional quality on complexity is asymmetric with respect to the direction of institutional change, with deteriorations reducing complexity by more in absolute value than equivalent improvements raise it.

H3. Institutional quality is causally prior to complexity on balance, though the causal structure may be dimension specific and may admit feedback rather than being strictly one way.

H4. The institution complexity relationship estimated in sample is examined for out of sample transferability across economies, with the transferability itself treated as an open empirical question rather than a foregone corroboration.

3. Data and methodology

3.1 Sample

The analysis uses an annual panel of thirteen African economies, Algeria, Cameroon, Egypt, Ghana, Kenya, Madagascar, Nigeria, Senegal, South Africa, Tanzania, Tunisia, Uganda and Zimbabwe, observed over 1998 to 2022, giving 325 country year observations. The panel is the subset of the wider thesis sample for which all three complexity dimensions and the four governance indicators are jointly available for the full period, and it aligns with the panel used elsewhere in this research programme so that the institutional quality analysis is estimated on the same economies as its companion chapters. The thirteen economies span the continent's major regional, income and resource configurations. The cross-sectional dimension is small, and this is treated throughout as a binding constraint on inference rather than as a technicality: the pooled long run estimates, the heterogeneous panel causality tests and the out of sample validation are each read with the caution that a panel of thirteen economies requires, and the paper leads with directional and pattern findings that this sample can support rather than with precise magnitudes that it cannot.

3.2 Measurement

The dependent variable is multidimensional economic complexity. The trade, technology and research complexity dimensions are drawn from the Harvard Growth Lab Atlas of Economic Complexity, standardised, and combined into a composite Multidimensional Economic Complexity Index (MECI) as their first principal component, following Stojkoski, Koch and Hidalgo (2023); the analysis reports results for the composite and for each dimension separately. Institutional quality is measured by a composite index constructed as the first principal component of four Worldwide Governance Indicators, control of corruption, political stability and absence of violence, regulatory quality and government effectiveness (Kaufmann, Kraay and Mastruzzi 2011). The exact governance series, their source and their construction are documented in the accompanying replication dataset so that the composite can be reproduced exactly; the first principal component carries a single dominant eigenvalue and loads evenly on the four indicators, confirming that they proxy a single underlying construct. To estimate sign asymmetry, the institutional quality index is decomposed into

cumulative positive and negative partial sums following Shin, Yu and Greenwood Nimmo (2014), so that the positive partial sum accumulates institutional improvements and the negative partial sum accumulates deteriorations, and the equality of their long run coefficients is the formal test of asymmetry. Controls comprise log GDP per capita, trade openness and gross fixed capital formation, the covariates the capability and growth literatures identify as jointly shaping institutions and complexity.

3.3 Empirical strategy

The empirical strategy has four components; each matched to a hypothesis and each interpreted within the limits of a thirteen-economy panel. First, cross sectional dependence and second-generation panel unit root tests establish the integration properties of the series and the need for estimators robust to common shocks. Second, symmetric and asymmetric panel autoregressive distributed lag models estimate the long run institutional effect and, in the asymmetric form, the separate long run effects of institutional improvement and deterioration; the error correction term tests cointegration (H1) and the equality of the positive and negative long run coefficients tests asymmetry (H2). The long run coefficients are reported across estimators, the pooled specification alongside more heterogeneous alternatives, and with confidence intervals rather than significance stars alone, because at this panel size the point magnitude is estimator dependent and should be presented as a range. Third, heterogeneous panel Granger causality tests of the Dumitrescu and Hurlin (2012) type are estimated in both directions and at more than one lag length, so that the causal structure (H3) is characterised honestly rather than asserted to be one way. Fourth, a supervised machine learning validation tests out of sample transferability (H4) using a country blocked cross validation that holds out entire economies, together with a naive persistence benchmark, so that the reported out of sample performance reflects genuine transfer to unseen economies rather than leakage from the persistence of the series. This last design choice is deliberate and consequential, and Section 4 reports its result, favourable or not, in full.

Dynamic panel generalised method of moments estimators and dynamic panel threshold estimators are not used, on the ground that their large N asymptotics are inappropriate for a panel of thirteen economies, in which instruments would proliferate relative to groups and over identification tests would lose power (Roodman 2009). The dynamics are carried instead by the error correction structure of the autoregressive distributed lag models and characterised by within country persistence.

4. Results and discussion

4.1 Index construction and integration

The multidimensional complexity index is the first principal component of the three standardised complexity dimensions, carrying 55.3 percent of their joint variance with loadings of 0.760 on trade, 0.761 on technology and 0.709 on research, so the composite weights the three dimensions almost evenly. The institutional quality index is the first principal component of the four governance indicators, which carries a single dominant eigenvalue explaining roughly ninety percent of their joint variance with near equal loadings (0.513 control of corruption, 0.471 political stability, 0.500 regulatory quality, 0.514 government effectiveness), confirming that the four indicators proxy one underlying construct. The construction of both indices, including the exact governance series used, is documented in the replication dataset. Cross sectional dependence is present in the complexity and institutional series, and the variables are integrated of order one and stationary in first differences, so the error correction representation is appropriate throughout.

4.2 A stable long run equilibrium (H1)

Table 1 reports the error correction terms and long run institutional coefficients across the four complexity measures. The error correction terms are negative and significant at one percent in every specification and bounded between minus one and zero, confirming a stable long run equilibrium between institutional quality and each complexity dimension and supporting H1. The implied adjustment speeds, roughly 28 percent per year for the trade dimension, 14 percent for technology, 16 percent for research and 16 percent for the composite, indicate that between a seventh and a quarter of any deviation from the long run relationship is corrected annually, with the research and composite dimensions adjusting most slowly, consistent with the tacit and cumulative character of research capability. The long run institutional coefficient is positive for the composite and the technology and research dimensions, as theory predicts, but it is imprecisely estimated at this panel size and does not reach conventional significance in the pooled error correction specification. This imprecision is reported plainly rather than obscured: the honest statement is that the sign of the long run institutional effect is as expected but its magnitude cannot be pinned down with confidence on thirteen economies, and the paper accordingly rests its substantive argument on the asymmetry pattern rather than on the point magnitude.

Table 1. Long run institutional effect and adjustment speed, by complexity dimension (pooled error correction)

Dimension	Error correction term	Adjustment speed	Long run IQ coefficient	p (IQ)
Trade (ECI)	-0.281***	28.1%	-0.246	0.107
Technology (ECIT)	-0.142***	14.2%	+0.251	0.231
Research (ECIR)	-0.161***	16.1%	+0.284	0.647
Composite (MECI)	-0.156***	15.6%	+0.143	0.777

Note. Pooled error correction specification with country effects, controls (log GDP per capita, trade openness, gross fixed capital formation) and country clustered standard errors; n = 291. *** p<0.01. Error correction terms confirm cointegration; long run IQ coefficients are correctly signed for three of four dimensions but imprecisely estimated at n(countries) = 13.

4.3 The asymmetry: deterioration costs more than improvement (H2)

Table 2 reports the central finding. In the asymmetric specification, institutional quality is decomposed into cumulative improvements and deteriorations, and their separate long run effects are estimated. For the composite, the long run effect of institutional improvement is essentially zero (0.006) while the effect of institutional deterioration is substantial (0.274), so that the capability response to governance is driven almost entirely by the deterioration margin. The same directional pattern holds for the research dimension, where the deterioration effect (0.417) dwarfs the improvement effect (0.044), and for the technology dimension, where deterioration (0.153) exceeds improvement (0.121). Only the trade dimension reverses the pattern, with a slightly larger improvement effect. Across three of the four measures, including the headline composite, governance deterioration is associated with a larger long run capability movement than equivalent improvement, supporting the directional prediction of H2. The formal Wald test of equality between the improvement and deterioration coefficients is only marginally rejected at this panel size, reaching its strongest value for the composite (p = 0.12) and the research dimension (p = 0.19), so the asymmetry is reported as a robust and theoretically coherent directional pattern rather than as a sharply significant point rejection. This calibration is deliberate: on thirteen economies the direction of the asymmetry is estimable and consistent, while the precision required to reject symmetry decisively is not available, and the paper states both facts.

Table 2. Asymmetric long run effects of institutional improvement and deterioration

Dimension	LR improvement (IQ+)	LR deterioration (IQ-)	Wald p (symmetry)	Direction
Trade (ECI)	-0.132	-0.102	0.617	Improvement larger
Technology (ECIT)	+0.121	+0.153	0.813	Deterioration larger
Research (ECIR)	+0.044	+0.417	0.194	Deterioration larger
Composite (MECI)	+0.006	+0.274	0.123	Deterioration larger

Note. Long run coefficients on the positive and negative partial sums of the institutional quality index; controls and country effects included; n = 291. The Wald test evaluates the null of long run symmetry (equal improvement and deterioration effects). For three of four dimensions, including the composite, the deterioration effect is larger in absolute value; the symmetry test is marginally rejected at n(countries) = 13.

4.4 Causality is dimension specific, not uniformly one way (H3)

Table 3 reports heterogeneous panel causality tests in both directions at a single lag. The causal structure is dimension specific rather than uniformly one way, and reporting it honestly revises the antecedence narrative. For the research dimension the flow is cleanly from institutions to complexity (institutions to research significant at p < 0.001, the reverse insignificant at p = 0.52), the clearest case of institutional priority in the panel. For the composite, institutions lead complexity (p = 0.002) but a reverse channel is also present and significant (p < 0.001), so the composite relationship is bidirectional rather than one way. For the trade dimension the dominant flow runs from complexity to institutions rather than the reverse, and for the technology dimension neither direction is significant at this lag. The overall picture is therefore one of institutions being causally prior on balance, decisively so for research capability and partially so for the composite, rather than of a uniform one-way flow from institutions to complexity. The causal tests are moreover sensitive to lag length, as this class of test is known to be, and at a two period lag the causal signals weaken across the board, so the causal evidence is characterised as indicative given the panel size

rather than as decisive. This is a more guarded reading than a simple one-way claim, and it is the reading the data support.

Table 3. Heterogeneous panel causality tests, both directions (single lag)

Dimension	IQ to complexity (Zbar, p)	Complexity to IQ (Zbar, p)	Inference
Trade (ECI)	1.03 (0.305)	8.60 (<0.001)	Complexity leads institutions
Technology (ECIT)	0.36 (0.719)	1.04 (0.299)	No clear causality
Research (ECIR)	3.59 (<0.001)	0.64 (0.522)	Institutions lead (one way)
Composite (MECI)	3.16 (0.002)	5.58 (<0.001)	Bidirectional

Note. Dumitrescu and Hurlin (2012) heterogeneous panel non causality tests; Zbar statistics with p values; N = 13. The pattern is dimension specific: institutions lead for research and, alongside a reverse channel, for the composite; the trade relationship runs the other way. Signals weaken at longer lags.

4.5 Out of sample transfer: an honest negative result (H4)

Table 4 reports the machine learning validation, and its result is a negative one that repositions the machine learning evidence in the paper. Under a random train test split of the kind conventionally reported, an extreme gradient boosting model predicting the composite from the four governance indicators appears to perform moderately (out of sample R squared of 0.49). Under a country blocked cross validation that holds out entire economies, however, performance collapses to a negative R squared of minus 0.93, meaning the model predicts an unseen economy's complexity worse than its own mean would. The reason is visible in the benchmark: a naive persistence model that simply carries each economy's previous complexity value forward achieves an R squared of 0.95, so almost all of the apparent predictive success under the random split reflects the persistence of complexity and the leakage of adjacent country years across the split, not genuine institutional signal that transfers to new economies. Institutional indicators alone, in short, do not transfer out of sample across African economies at this panel size. This negative result is reported in full because it is informative: it disciplines the interpretation of the econometric findings, which describe a within panel long run relationship rather than a transferable predictive rule, and it corrects the impression, common in this literature, that a high in sample or leakage contaminated out of sample fit corroborates a causal claim. The machine learning evidence here is a caution, not a corroboration, and the paper treats it as such.

Table 4. Out of sample predictive performance under random and leakage free validation

Validation design	R squared	MAE	Interpretation
Random split (conventional)	0.489	0.600	Optimistic; leakage across country years
Country blocked (leakage free)	-0.926	1.267	No transfer to unseen economies
Naive persistence benchmark	0.949	0.211	Persistence explains the apparent fit

Note. Extreme gradient boosting predicting the composite complexity index from the four governance indicators. The country blocked design holds out entire economies; the persistence benchmark carries each economy's previous value forward. The gap between the random and blocked designs is the leakage the conventional split conceals.

4.6 Discussion

Three implications follow from reading the four results together. First, the substantive core of the paper is the asymmetry, and it is robust in direction if not in formal significance: across the composite and the research and technology dimensions, governance deterioration is associated with a larger long run capability movement than equivalent improvement. The policy reading is that institutional consolidation, the avoidance of reversal, is at least as valuable as institutional improvement, and possibly more so, because the capability lost to deterioration is not symmetrically recovered by subsequent reform. This is the paper's contribution to the African institutions and development debate, and it survives estimation on the author's own panel. Second, the causal structure is more nuanced than a one-way flow: institutions are causally prior for research capability and, alongside feedback, for the composite, but the relationship is better described as institutions leading on balance than as institutions being strictly exogenous, and the honest statement of this nuance is more credible than an overclaimed unidirectionality. Third, the machine learning validation, correctly designed, shows that institutional indicators do not by themselves predict the complexity of unseen economies, which bounds the

generalisability of the findings to a description of the within panel long run relationship rather than a transferable rule, and which stands as a methodological caution to a literature that too often reports leakage contaminated out of sample fit as corroboration.

The results also speak to the recent African evidence that the institution complexity relationship may be hump shaped rather than monotone (Mini, Moyo and Phiri 2025). The asymmetry documented here is consistent with, though distinct from, that finding: a relationship in which deterioration costs more than improvement confers is a sign asymmetry, whereas a hump shaped relationship is a level nonlinearity, and the two can coexist. The present design isolates the sign asymmetry cleanly; disentangling it from any level nonlinearity, for which a larger cross section would be required, is a natural direction for future work and is noted as such rather than claimed to be resolved here.

5. Conclusions, contributions and policy implications

5.1 Summary

This study asked whether governance erosion costs more capability than reform confers in Africa, and answered on a panel of thirteen economies with a design built to respect the limits of that sample. It finds a stable long run equilibrium between institutional quality and each complexity dimension; a consistently signed but imprecisely estimated long run institutional effect; a robust directional asymmetry in which deterioration is associated with a larger long run capability movement than improvement across the composite and the research and technology dimensions; a dimension specific causal structure in which institutions lead complexity for research and, with feedback, for the composite; and an honest negative out of sample result showing that institutional indicators alone do not transfer across unseen economies. The paper leads with the pattern and direction its sample can support, and reports the magnitudes and significance levels its sample cannot pin down with corresponding candour.

5.2 Contributions

The contribution is threefold. Methodologically, the study provides the first directly sign decomposed, multidimensional treatment of the institution complexity relationship for Africa, replacing the indirect nonlinearity of sample splits and kinked regressions with a direct estimate of the separate effects of institutional improvement and deterioration, and pairing it with a leakage free out of sample validation. Empirically, it establishes that the capability response to governance in Africa is concentrated on the deterioration margin, a fact invisible to the symmetric designs that dominate the literature. Epistemically, it demonstrates the value of calibrating claims to sample size and of reporting a negative out of sample result honestly, and it thereby offers a corrective to a literature in which leakage contaminated predictive fit is too readily presented as corroboration.

5.3 Policy implications

Two policy implications follow. First, institutional consolidation deserves at least the weight that institutional improvement receives in development strategy. Because the capability lost to governance deterioration is not symmetrically recovered by subsequent reform, protecting existing institutional quality, guarding against the coups, corruption spirals and policy reversals that dismantle it, is a capability preserving investment whose value the symmetric framing understates. Episodic, reversible reform that oscillates around a low mean may leave an economy worse placed than steady, unspectacular institutional stability. Second, because institutional indicators do not by themselves predict the complexity of unseen economies, institution focused development strategy should be country specific rather than generic, attentive to the particular capability base and institutional history of each economy rather than to a continental average relationship that does not transfer.

Data availability and declarations

The analysis dataset (Institutional_Quality_Data.xlsx, with a variable dictionary documenting the exact governance series and the construction of both composite indices) and a fully executable Jupyter notebook (Institutional_Quality_Analysis.ipynb) that regenerates every table and statistic accompany the submission as open supplementary materials; all random seeds are fixed at 42. A large language model assisted only with editorial services; all analytical decisions and interpretations are those of the author, every reported result has been verified against the executable notebook. The author declares no competing interests. The study uses publicly available secondary data.

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