

**Agricultural Innovation as Industrial Policy:
Trade Regulation, Value Chains, and Structural Transformation
in Sub-Saharan Africa**

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Industrial Policy for Africa Conference

World Bank, Nairobi

February 16, 2026

Overview

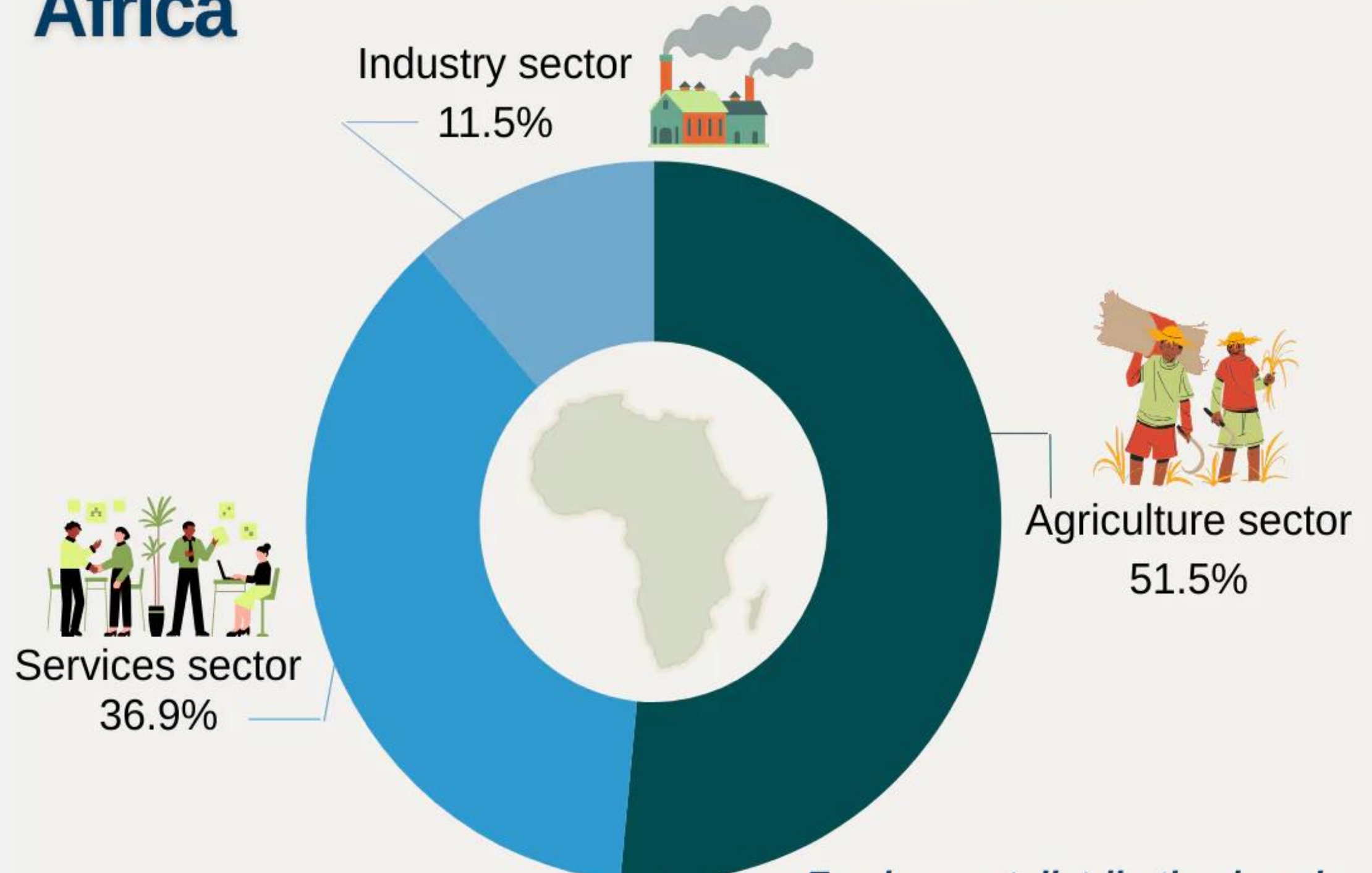
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Introduction

The African Industrial Policy Paradox (Newman et al., 2016; Diao et al., 2021)

Employment in sub-Saharan Africa

The agriculture sector provides the greatest proportion of employment in sub-Saharan Africa



Literature review and contribution

The classical structural transformation framework (Kuznets, 1973; Chenery et al., 1979)

But as McMillan and Zeufack showed in 2022, this simply hasn't happened in Sub-Saharan Africa.

New Paradigm Needed (Andreoni & Chang, 2019; Oqubay & Lin, 2020):

- ✓ Industrial policy = fostering learning & capability accumulation, not just sectors
- ✓ Agriculture can be a foundation for transformation (Gollin, 2023; McMillan & Zeufack, 2022)

Literature review and contribution

Theoretical Foundations:

1. Why Trade Regulation as Industrial Policy?(Stiglitz & Lin, 2013; Cherif et al., 2022; Rodrik, 2024; Cadot & Gourdon, 2016; Ghodsi, 2022)
2. Innovation in African Agriculture (Jensen et al., 2007; Lundvall, 2016; Klerkx et al., 2019)
3. GVCs as Upgrading Channel (Swinnen et al., 2015; Gereffi, 2019; Barrett et al., 2022)
4. Institutional Complementarity (North, 1990; Acemoglu & Robinson, 2012, 2019)

Literature review and contribution

Research Gap and Paper's Contributions:

Theoretical:

- . Regulation-led transformation framework for agricultural economies
- . Integrates New Institutional Economics + Innovation Systems + GVC literature

Empirical:

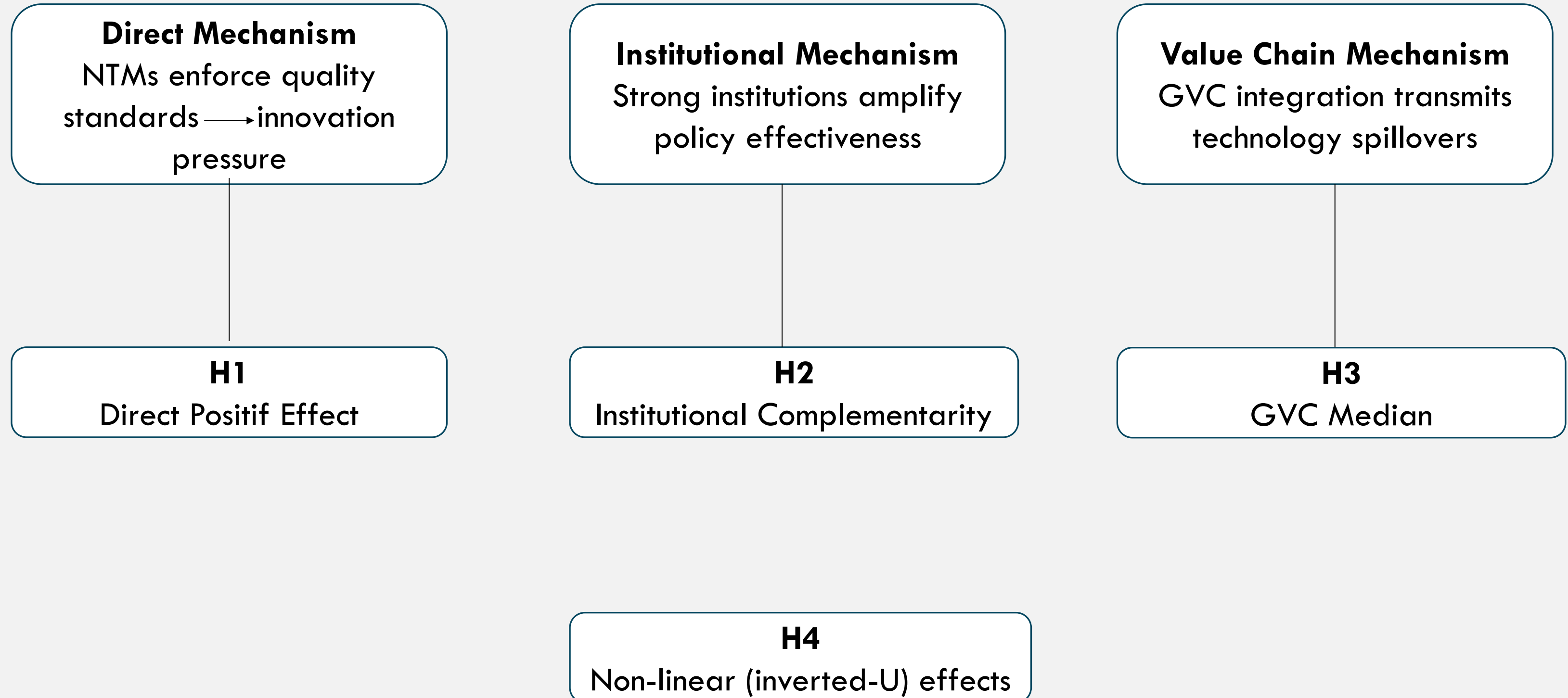
- . First comprehensive panel evidence: 48 countries, 2000-2022
- . Methodological triangulation: FE + GMM + PLS-SEM (mediation)
- . Regional heterogeneity analysis

Policy:

- . Actionable framework for fiscally constrained contexts
- . Demonstrates regulatory reform can activate innovation systems
- . Context-specific strategies vs. universal prescriptions

Conceptual framework

Regulation-Led Transformation Model



Methodology

Comprehensive Panel Data Analysis

- **Sample:** 48 Sub-Saharan African countries, 2000-2022 (1,104 obs.)
- **Methods:** Random Effects, System GMM, PLS-SEM. *Triangulation ensures robustness*

Key indices constructed:

- NTM Proxy: Combines tariff rates + inverted LPI
- Agricultural Innovation Index: WIPO methodology (07 drivers)
- GVC ratio
- Institutional quality, colonial, and trade openness index

Regional heterogeneity analysis

- West, East, Central, Southern Africa

Methodology

Descriptive overview

Variable	N	Mean	SD	Min	Max
Innovation Index	1,104	3.57	0.46	1.52	4.51
NTM Proxy	708	8.51	2.61	1.03	16.14
GVC Ratio	627	0.50	0.09	0.00	0.69
Institutional Quality	1,047	4.10	0.12	3.94	4.82

Key Insight: Substantial variation across countries and time

Findings and Discussion

Main finding- H1 Direct Effect: Trade Regulation Significantly Enhances Innovation

Model	NTM Proxy β	P-value	Significance
Fixed Effects	0.040*	0.002	✓ Strong
Random Effects	0.045***	0.004	✓ Strong
System GMM	0.057	0.179	Positive (marginally)

Interpretation: 1-unit increase in NTM proxy \rightarrow 4% increase in innovation

- Robust across specifications
- Challenges protectionism myths

Findings and Discussion

**Institutional Quality - The Real Driver- H2: Institutions Work Independently,
Not as Moderator**

Variable	Coefficient	P-value
Institutional Quality	0.807*	0.001
NTM Proxy	0.057	0.179
GVC Ratio	-0.352	0.647

Key Insight:

- ✓ Institutions have STRONGEST effect on innovation
- ✓ BUT: No significant interaction with NTMs
- ✓ Institutions work independently, not as a multiplier

Findings and Discussion

Value Chains - Marginal Role-H3: GVC Participation Shows Weak Effects

- ✓ GVC integration may help innovation via technology spillovers
- ✓ But doesn't significantly amplify NTM effects
- ✓ Weaker than expected mediation pathway

Non-linearity Test - Linear Relationship Holds-H4: No Evidence of Inverted-U

- ✓ No regulatory threshold effects detected
- ✓ More regulation \neq diminishing returns in our sample
- ✓ Linear model preferred over non-linear

Findings and Discussion

REGIONAL HETEROGENEITY - Critical Finding

Region	N	NTM Coefficient	P-value	Key Driver
East Africa	299	0.054*	<0.001	✓ Strongest
West Africa	368	0.089	0.227	Positive
Southern Africa	230	0.029	0.283	Weak
Central Africa	207	0.021	0.379	Weak

Key Insights:

- ✓ East Africa Success Factors: EAC regulatory harmonization, Export-oriented horticulture, Strong trade infrastructure
- ✓ Central/Southern Africa Constraints: Conflict and governance failures, Infrastructure gaps

Policy Implication: One-size-fits-all approaches fail

Findings and Discussion

Robustness

Direct NTM Validation- NTM Observed Subsample (12 countries, 2012-2015)

- ✓ **Very small sample** (N=24 Observations → low statistical power)
- ✓ **Direction consistent** with proxy results (positive tendency)
- ✓ **Validates our NTM Proxy construction** approach

GMM Diagnostics:

- ✓ Hansen J-test: $p = 0.289$ ✓ (valid instruments)
- ✓ AR(2) test: $p = 0.412$ ✓ (no serial correlation)

PLS – SEM Measurement Model Validation:

- ✓ All constructs: $AVE > 0.50$ ✓
- ✓ Cronbach's $\alpha > 0.70$ ✓
- ✓ Discriminant validity: $HTMT < 0.85$ ✓

Findings and Discussion

PLS-SEM - Structural Relationships

PLS – SEM Measurement Model Validation:

- ✓ All constructs: AVE > 0.50 ✓
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- ✓ Discriminant validity: HTMT < 0.85 ✓

Key Finding:

- ✓ Physical infrastructure (loading = 0.919) and digitalization (loading = 0.757) as the core components of agricultural innovation.
- ✓ Institutional quality and colonial legacy are key drivers
- ✓ Trade openness has a small negative direct effect, offset by the indirect institutional channel
- ✓ The model explains ~36% of innovation variance

Findings and Discussion

Policy Implications - Regulation-Centered Model

- ✓ Strategic NTMs that enforce quality standards (not pure barriers)
- ✓ Institutional capacity building (strongest driver)
- ✓ Regional integration deepening (ECOWAS, EAC model)
- ✓ Regulatory reform over fiscal incentives alone

Policy Implications - Context-Specific Strategies

- ✓ **East/West Africa:** Deepen regulatory harmonization; Strengthen export agriculture value chains; Build on existing integration momentum
- ✓ **Central/Southern Africa: First:** Strengthen basic institutions and infrastructure; **Then:** Introduce sophisticated regulations. Address conflict/governance as prerequisites

Findings and Discussion

Policy Implications - Why This Matters for Smallholder Inclusion

Our findings suggest trade regulation can drive inclusive innovation through:

- ✓ Public investment channel
- ✓ Infrastructure spillovers
- ✓ Ecosystem effects

Policy implication: Support smallholder aggregation (cooperatives, outgrower schemes) to access these innovation ecosystems

Findings and Discussion

Limitations:

- ⚠ Innovation index may miss other informal DUI innovations
- ⚠ Causality challenges despite GMM (omitted time-varying factors)
- ⚠ National-level analysis abstracts from within-country heterogeneity

Future Research:

- ✓ Firm-level data, Household-level data, process-tracing case studies, digital technology interactions
- ✓ NTM proxy imperfect (validated but indirect)

Conclusion

Findings: Smart trade regulation can drive agricultural innovation, but only with strong institutions and regional integration.

Core Argument: For economies built on smallholder farming, industrial policy should start by upgrading the informal sector through rules, not just factories.

This offers a realistic path to transform agriculture from a subsistence sector into the foundation for inclusive, sustainable growth.

Thank you for your attention!

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