Structural Change and Growth Trajectories through Counterfactual Quantile Decomposition

Michele Battisti
University of Palermo and ICEA

Antonio Francesco Gravina
University of Messina, Italy

Matteo Lanzafame
Asian Development Bank

Australian Conference of Economists 2025. 6-9 July, 2025

Disclaimer:

This work is part of the Asian Development Bank's TA-10248 REG: Industry, Services, and the Future of Development in Asia.

The views expressed in this presentation and the associated paper are those of the authors and do not necessarily reflect the views or policies of the Asian Development Bank or other institutions.

Outline

ADB

Outline

1. Introduction and Related Literature
2. Data and Variables
3. Empirical Framework
4. Results
   - Cross-Country Analysis
   - Manufacturing Sector Analysis
   - Counterfactual Analysis
5. Conclusions

Motivation and Research Questions

- Productivity growth dynamics in the context of structural transformation remain central to economic development.
- Premature deindustrialization threatens traditional growth paths.

Key Questions:

- How do productivity growth patterns differ across economies at various development stages?
- What drives varying outcomes: observable factors or less tangible capabilities?
- How might growth trajectories differ under alternative growth patterns and convergence mechanisms?

- **Focus:** Understanding heterogeneous effects across the productivity distribution.

Asia's Diverse Growth Experiences

Remarkable diversity of development patterns:

- East Asian Tigers: Export-led manufacturing success (South Korea; Singapore; Taipei,China) (Wade, 1990; World Bank, 1993).
- Service-led growth: India's distinctive development path (Ghani & Kharas, 2010).
- Resource-rich economies: Central Asia's challenges with resource dependency, institutional development, and post-Soviet transition (Pomfret, 2019).

China's journey toward high-income status:

- Remarkable manufacturing growth but increasingly dependent on service sector productivity.
- Baldwin (2024): "Path to high-income status requires boosting productivity across all sectors".

ADB

Literature on Structural Change

Classical Theories:

- Lewis (1954): Productivity disparities trigger transitions toward industrial sectors.
- Kuznets (1957): Income elasticities of demand and comparative advantage drive transitions.
- Fisher (1939), Clark (1957): Three-sector hypothesis characterizing development path.

- **Contemporary Perspectives:**
  - Herrendorf et al. (2014): Non-homothetic preferences, sector-biased technological change.
  - Van Neuss (2019): Income changes, relative prices, input-output linkages, globalization.
- **Asia-specific dynamics:** Varying economic trajectories, institutional features, stages of development.

Premature Deindustrialization Challenge

Emerging Phenomenon:

- Rodrik (2016): Economies deindustrializing at lower income levels than historical precedents.
- Felipe et al. (2019): Loss of manufacturing opportunities before high productivity achieved.

Implications:

- Reduced opportunities for learning-by-doing and productivity spillovers.
- Potential loss of "escalator" industries for developing economies.
- Blurring boundaries between manufacturing and services.

Asian Context: Diversity of experiences from export-led manufacturing successes to service-led growth models.

This paper in a nutshell

What?

- Examines productivity growth patterns across the distribution.
- Investigates economy-wide versus manufacturing-specific convergence patterns.

How?

- Dual panel structure: country-level panel of 91 economies (1960-2019) and country-sector panel covering 34 economies across 14 manufacturing sectors (1980-2019).
- Quantile decomposition and counterfactual analysis techniques.

Key findings:

- Aggregate growth increasingly favors more productive economies.
- Manufacturing shows strong convergence properties for less productive sectors.

Contributions to Literature

Methodological Innovation:

- Extends decomposition techniques to study productivity growth patterns.
- Integrates quantile regression with counterfactual analysis.
- Examines heterogeneous effects across productivity distribution.

Empirical Contributions:

- Identifies divergent patterns: aggregate vs. manufacturing convergence.
- Reveals evolving drivers of productivity growth pre/post-1990.
- Quantifies untapped growth potential through counterfactual analysis.

Policy Relevance: Informs industrial policy design amid shifting global dynamics.

Outline

ADB

Data Sources and Sample

Two-stage hierarchical approach:

- Aggregate patterns → Manufacturing sectors analysis.

Penn World Table 10.01 (Feenstra et al., 2015).

- Balanced panel: 91 advanced and emerging economies (1960-2019), 5369 obs.
- Growth rates of real GDP per worker, physical/human capital, population.

UNIDO Industrial Statistics Database (2024).

- Unbalanced panel: 34 economies, 14 manufacturing sectors (1980-2019), 8227 obs.
- Labor productivity, capital formation—in nominal terms: Rodrik (2013) provides rationale for this (common global inflation rate for each industry: manufactures are tradable, face common world prices).

ADB

Complementary Datasets: Historical Context and Sectoral Depth

Two-stage analytical strategy with distinct purposes:

- PWT provides *historical perspective* (1960-2019):
  - Allows exploration of potential shifts in growth processes pre/post-1990.
  - Enables assessment of convergence patterns across six decades.
- UNIDO offers *sectoral granularity* (1980-2019):
  - Allows examination of productivity dynamics within manufacturing.
  - Enables investigation of potentially heterogeneous patterns across subsectors.
- This approach aims to combine **longitudinal breadth** with **sectoral depth** for a more comprehensive analysis of productivity growth dynamics.

Descriptive Statistics: Key Patterns Across Subperiods

Aggregate Economy (PWT Sample):

- First subperiod (1960-1990) vs. second subperiod (1990-2019).
- Productivity growth declined (2.0% to 1.5%).
- Physical capital accumulation slowed (3.0% to 1.9%).
- Human capital investment increased (1.8% to 2.1%).
- Demographic transition evident: population growth fell (2.0% to 1.5%).

Manufacturing Sector (UNIDO Sample):

- Early subperiod (1980-1990) vs. later subperiod (1990-2019).
- Mixed productivity patterns across subsectors.
- Declining sectors: Basic metals (7% to -0.6%), Machinery (5.3% to 0.5%).
- Resilient sectors: Chemicals (4.3% growth, highest volatility).
- Wood products showed improved performance: from 3.2% to 3.9% growth.

Sectoral Composition Evolution

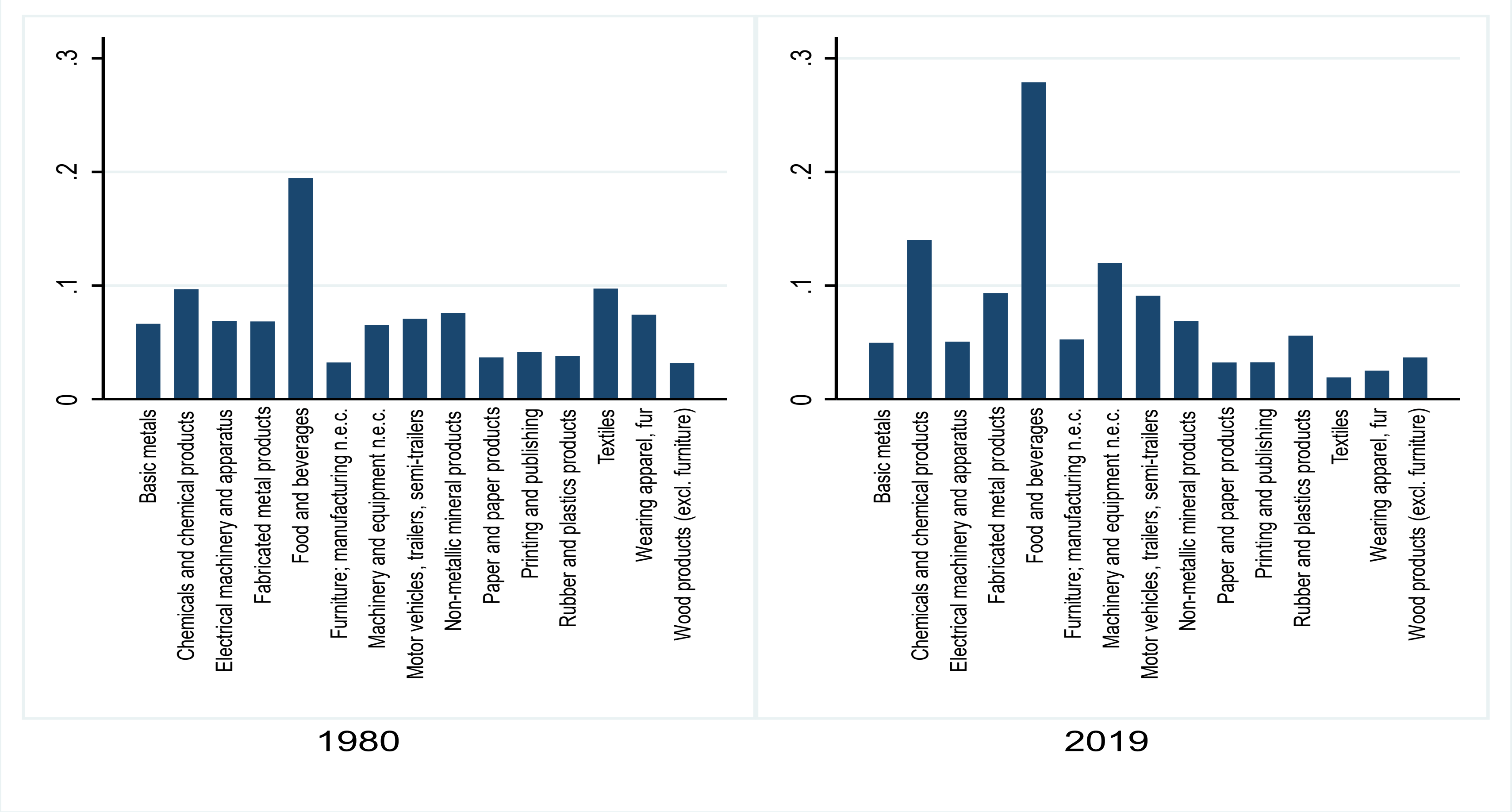


Figure 1: Value-added shares of 14 manufacturing sectors in 1980 and 2019. *Source*: UNIDO (INDSTAT) data.

Regional Convergence Patterns (PWT Sample, 1960-2019)

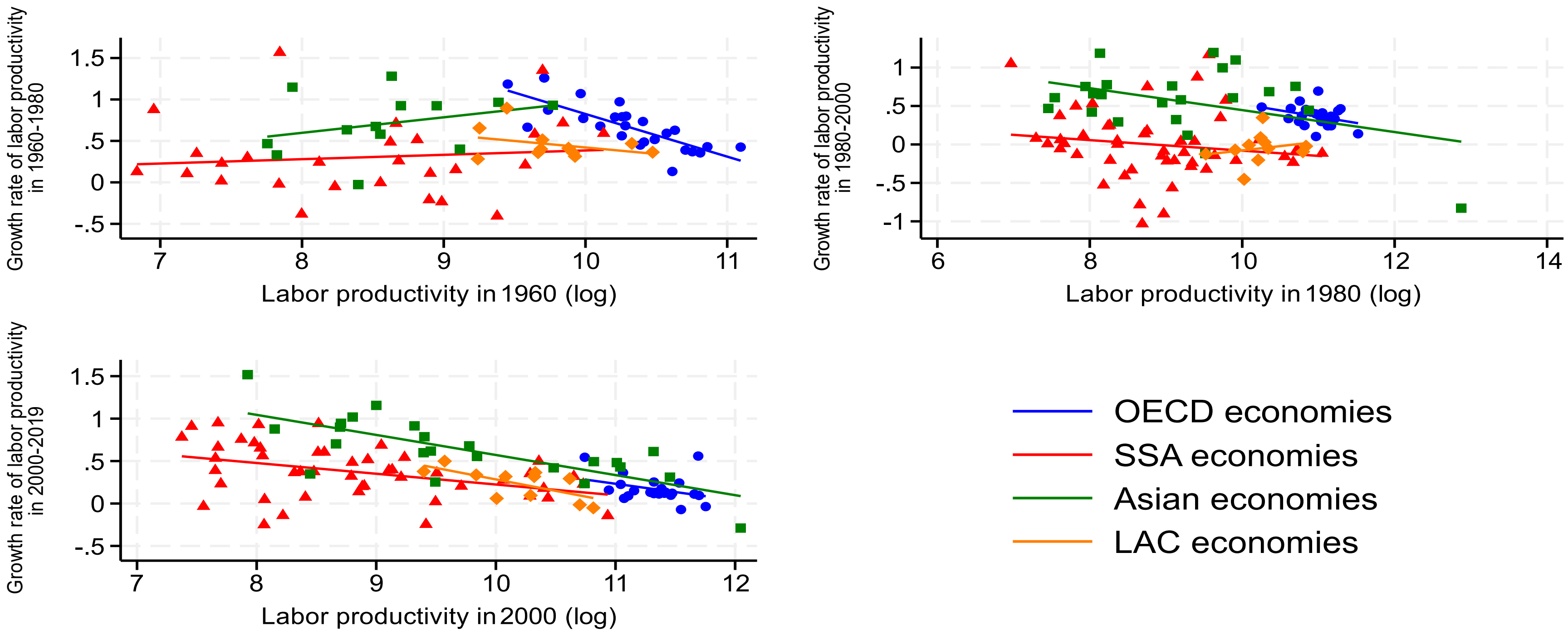
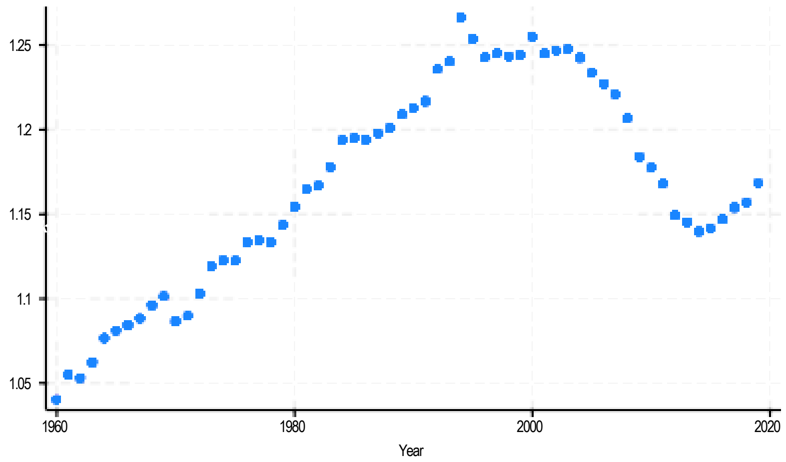
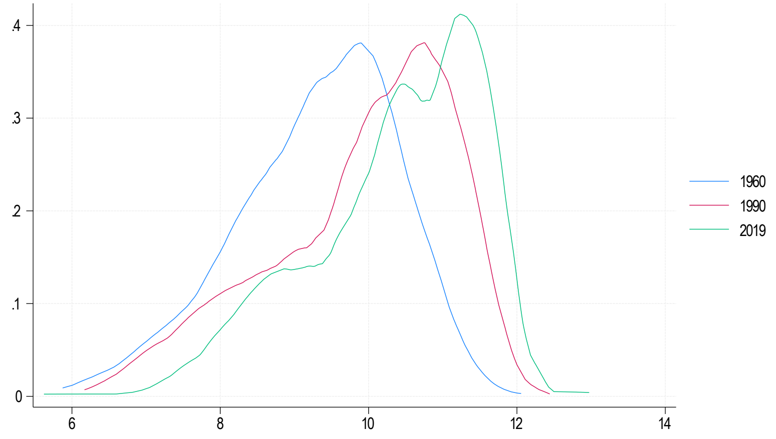


Figure 2: Regional Convergence Patterns in Labor Productivity Growth: OECD, Asian, LAC, and SSA Economies (Panels: a) 1960-1980, b) 1980-2000, c) 2000-2019).

Initial Evidence on Productivity Distribution (PWT Sample, 1960-2019)



Std. dev. of labor productivity.



Kernel densities of labor productivity.

- **Rising dispersion** until early 2000s →"Great Divergence" (Pritchett, 1997).
- Emergence of "twin peaks" distribution (Quah, 1996).
- Evidence of convergence clubs rather than uniform convergence. β-conv

Outline

Growth Decomposition Approach

- Output per worker modeled as weighted sum of sectoral production:

$$y_{i,t} = \sum_{j=1}^{J} sh_{i,j,t} \left[A_{i,j} + \beta^{i,j} k_{i,j,t} \right] \quad (1)$$

  - where $sh_{i,j,t} = \frac{L_{i,j,t}}{L_{i,t}}$ represents employment share of sector j in country i

  - **Simple example:** Two manufacturing subsectors (chemicals and metals):

$$y_t = sh_{C,t} \left[A_{C,t} + \beta_C k_{C,t} \right] + sh_{M,t} \left[A_{M,t} + \beta_M k_{M,t} \right] \quad (2)$$

ADB

Growth Rate Decomposition

- **Growth rate decomposition:** Between periods t and T

$$\begin{aligned}\Delta y_{T-t} = {} & sh_{C,T}[A_{C,T} - A_{C,t}] + sh_{M,T}[A_{M,T} - A_{M,t}] \\ & + sh_{C,t}[k_{C,t}(\beta_{C,T} - \beta_{C,t})] + sh_{M,t}[k_{M,t}(\beta_{M,T} - \beta_{M,t})] \\ & + sh_{C,T}[\beta_{C,T}(k_{C,T} - k_{C,t})] + sh_{M,T}[\beta_{M,T}(k_{M,T} - k_{M,t})] \end{aligned} \quad (3)$$

- **Components interpretation:**
  - First line: Changes in total factor productivity (A)
  - Second line: Changes in returns to capital per worker (β)
  - Third line: Changes in capital accumulation per worker (k)

Quantile Decomposition Methodology

- **Beyond mean-based methods:**
  - Traditional decompositions (e.g., Oaxaca-Blinder) miss distributional heterogeneity.
  - Productivity growth patterns affect economies differently across development stages.

- **Quantile approach** (Chernozhukov et al., 2013; Firpo et al., 2018):
  - Captures heterogeneous effects at different points in distribution (avoiding location-scale effect).
  - Reveals whether factors affect lagging vs. leading economies differently.

Counterfactual Decomposition Procedure

- For each quantile τ_q of distribution τ:

$$\Delta y_{T-t}|\tau_q = \Delta y_{T-t}|(A_{T,q}, \beta_{T,q}, X_T) - \Delta y_{T-t}|(A_{T,q}, \beta_{t,q}, X_T) + \Delta y_{T-t}|(A_{T,q}, \beta_{T,q}, X_T) - \Delta y_{T-t}|(A_{T,q}, \beta_{T,q}, X_t) + \varepsilon_{T,q} - \varepsilon_{t,q} \quad (4)$$

- **Three key components:**
  - **Coefficient effect:** First term in equation - changes in returns to observable characteristics (how efficiently factors are utilized).
  - **Characteristics effect:** Second term in equation - changes in the levels/distribution of observable factors (e.g., physical and human capital accumulation).
  - **Residual effect:** Third term in equation - unobservable factors (technology, institutions).

Implementation and Statistical Inference

- **Multi-stage analysis:**
  - Cross-country decomposition (PWT data).
  - Manufacturing sector decomposition (UNIDO data).
  - Counterfactual scenarios analysis.
- **Statistical inference:**
  - Bootstrap methods for robust confidence intervals.
  - Kolmogorov-Smirnov (KS) tests for "no effect" and "constant effect" hypotheses.
  - Cramer-von-Mises (CMS) tests for distributional differences.
- **Advantages:** Captures heterogeneity across the productivity distribution without restrictive linear assumptions.

Outline

ADB

Outline

Cross-Country Decomposition Results

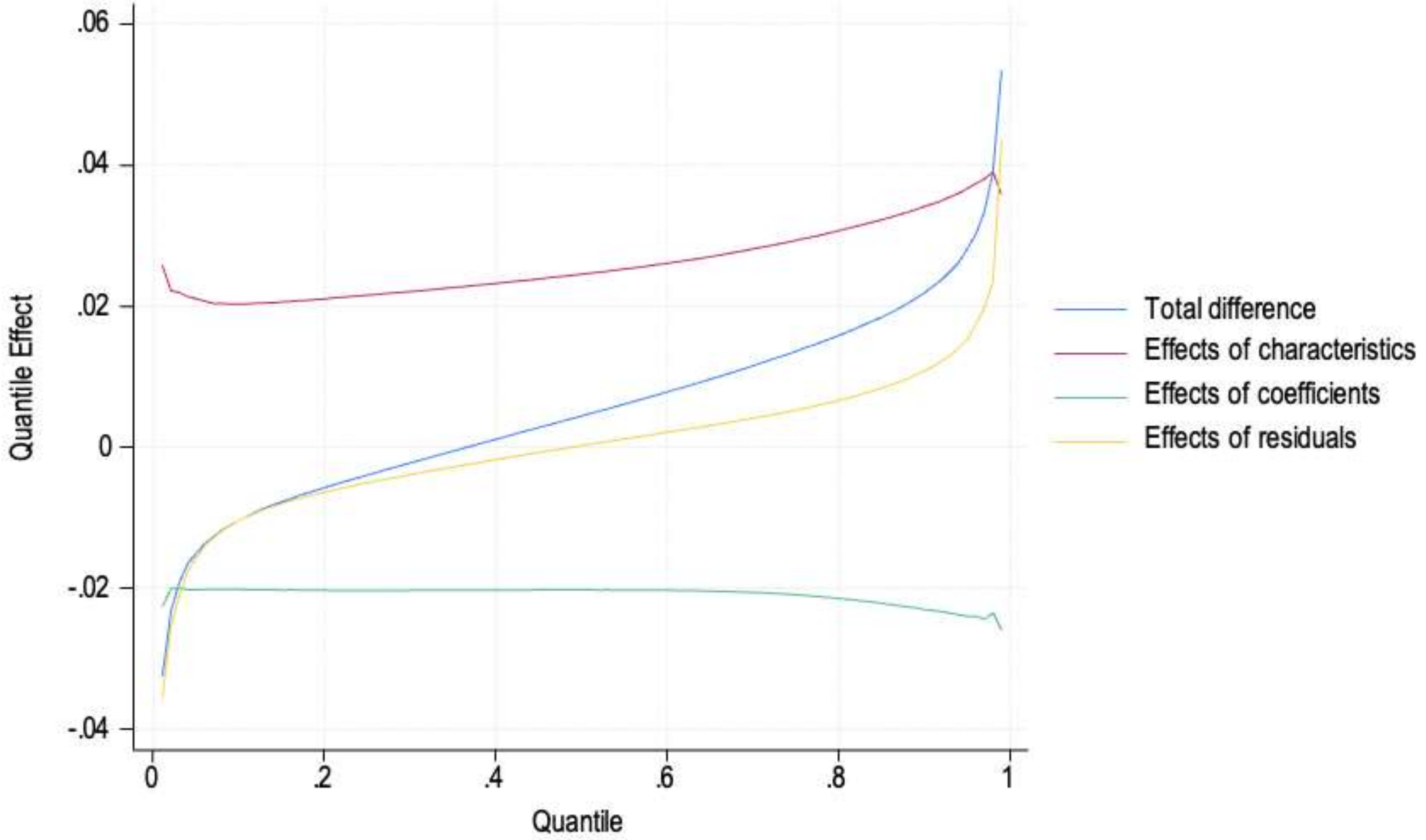


Figure 3: Quantile decomposition of productivity growth differences between 1960-1990 and 1990-2019.

Key Findings

- **Statistical significance:** KS and CMS tests confirm significant heterogeneity across quantiles.

Proof

- **Total effect:** Increasing across distribution.
  - Lower quantiles: Negative (-1 percentage point).
  - Median: Modest positive (0.4-0.5 percentage points).
  - Upper quantiles: Substantially positive (exceeding 2 percentage points).

- **Driver decomposition:**
  - Characteristics effect: Consistently positive, strengthening at higher quantiles.
  - Coefficients effect: Uniformly negative across distribution (-2 percentage points).
  - Residuals effect: Negative at lower quantiles, increasingly positive at upper tail.

Implications

- **Divergence in productivity growth patterns:**
  - More productive economies increasingly pulling ahead.
  - Less productive economies struggling to translate improved fundamentals into growth.
- **Growth mechanisms shifting:**
  - Broad-based deterioration in returns to observable factors.
  - Unobservable factors (technology, institutions) becoming more important.
  - Factor accumulation remains valuable but with diminishing effectiveness.
- **Policy relevance:** Need for differentiated strategies based on development stage.

Outline

Manufacturing Decomposition Results

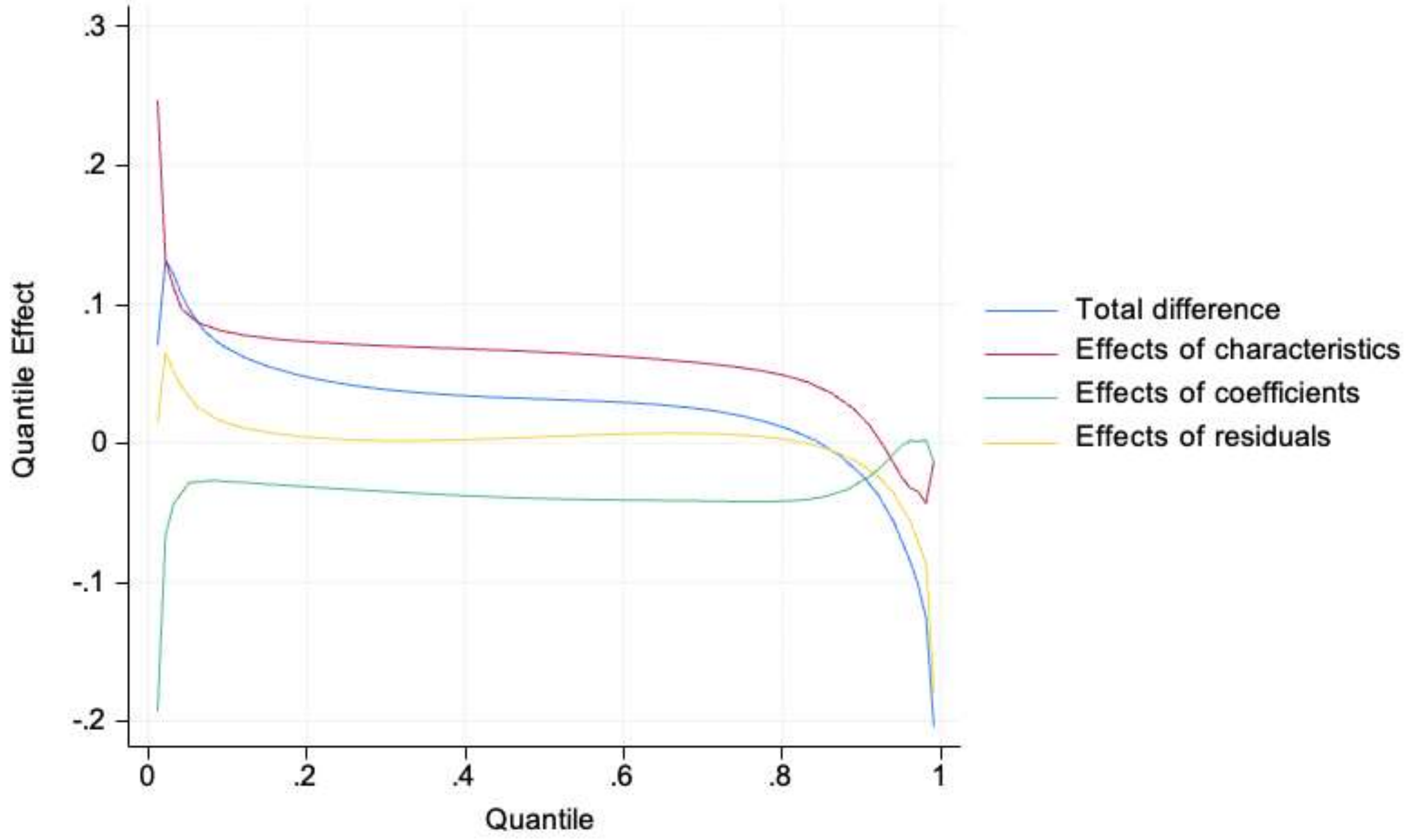


Figure 4: Quantile decomposition of productivity growth differences between 1980-1990 and 1990-2019 in manufacturing sectors.

Key Findings

- **Total effect:** Clear downward slope across quantiles.
  - Lower quantiles: Strong positive (7% at 10th percentile).
  - Upper quantiles: Negative (-2% at 90th percentile, not statistically significant).
- **Component analysis:**
  - Characteristics effect: Positive but declining gradient (8% to 2%)
  - Coefficients effect: Stable negative pattern (-3% to -4%)
  - Residuals effect: Inverted U-shape, positive at bottom and negative at top
- **Statistical confirmation:** KS and CMS tests strongly support heterogenous effects.

Proof

Implications

- **Manufacturing as "escalator":**
  - Still provides substantial catch-up opportunities.
  - Particularly beneficial for less productive sectors.
  - Contrasts with aggregate pattern favoring already-productive economies.

- **Growing challenges:**
  - Negative coefficients effect: difficulties in translating inputs into productivity.
  - Likely reflects increased global competition and technological complexity.
  - Factor accumulation alone provides diminishing returns at higher productivity levels, requiring complementary capabilities.

- **Technological capability gap:** Inverted U-shaped residuals effect suggests varying technological absorption capacity.

Outline

ADB

Counterfactual Analysis Approach

- **Why?** Exploring alternative productivity growth trajectories.
  - What if economies had different characteristics?
  - What if they experienced different returns to factors?
  - What if they benefited from different unobservable factors?

- **Implementation:**
  - Based on methodology from Machado and Mata (2005).
  - Uses quantile regression techniques for counterfactual distributions.
  - Examines both economy-wide (PWT) and manufacturing-specific (UNIDO) scenarios.

- **Comparisons:**
  - Asian economies vs. global top decile.
  - Bottom vs. top decile economies (globally).
  - Bottom vs. top decile manufacturing sectors.

Aggregate Counterfactual Results (PWT Sample)

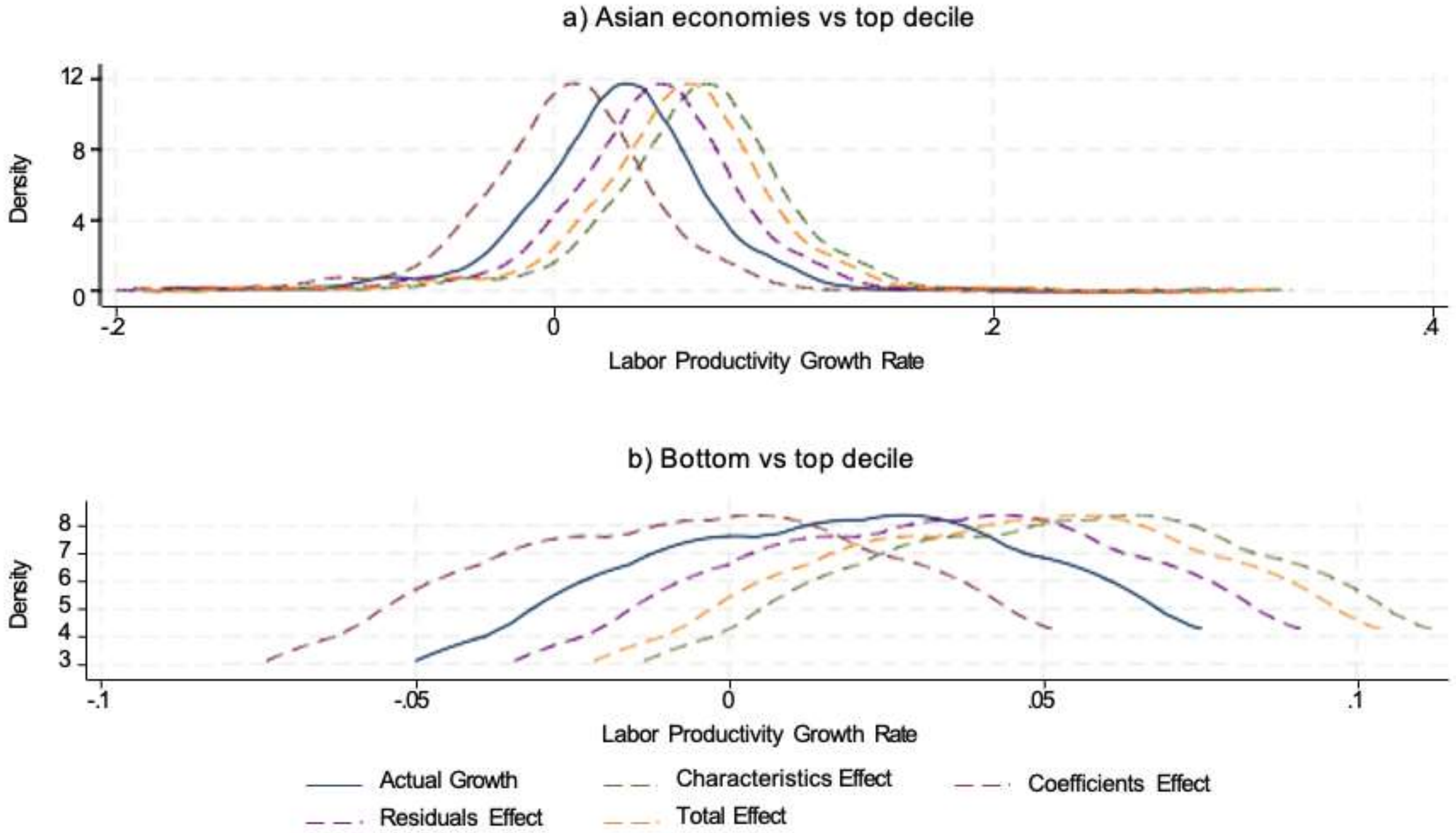


Figure 5: Counterfactual growth scenarios comparing Asian economies vs top decile (Panel a)) and bottom vs top decile (Panel b)).

Aggregate Counterfactual Findings

- **Asian economies vs. top performers:**
  - Actual growth: 2.7%. With top performers':
    - Characteristics: gain of approximately 1%.
    - Returns: negative adjustment (approximately -0.3%).
    - Unobservable factors: additional gain of approximately 2.2%.
  - Combined effect: 5.6% total growth (gain of 2.9% over actual).

- **Bottom vs. top performers:**
- With top performers':
  - Characteristics: gain of approximately 3.7%.
  - Returns: negative adjustment (approximately -0.6%).
  - Unobservable factors: additional gain of approximately 0.3%.
- Combined effect: 5.2% total growth (gain of 3.4% over actual).

Manufacturing Counterfactual Results (UNIDO Sample)

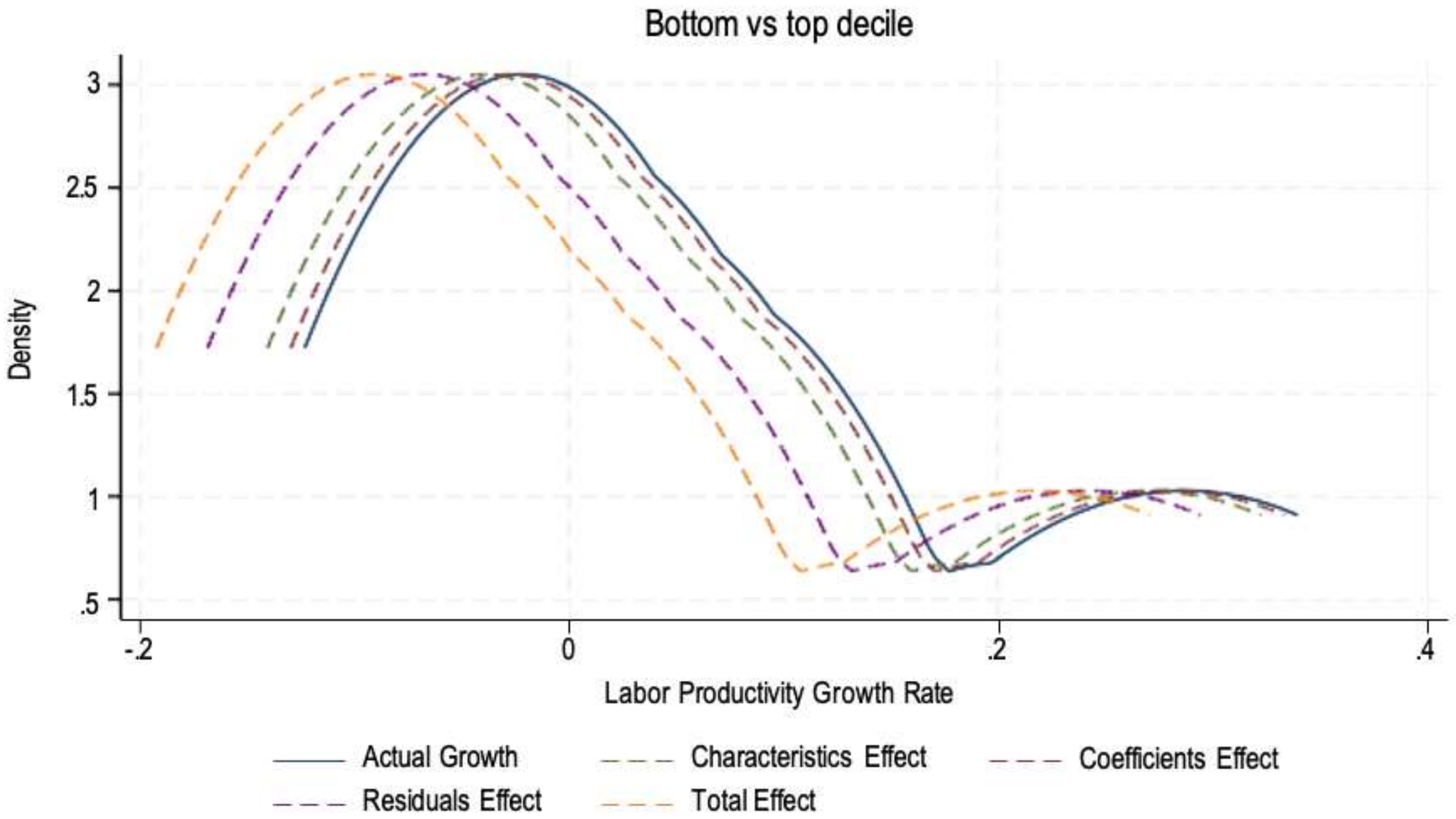


Figure 6: Counterfactual growth scenarios comparing bottom vs top decile in manufacturing sectors.

Manufacturing Counterfactual Findings

- **Surprising pattern:** Bottom-decile sectors show robust performance (5.5% growth).

- **Counterfactual scenarios with top performers':**
  - Characteristics only: Growth would decrease to 3.8% (impact: -1.7%).
  - Returns only: Growth would decrease to 4.9% (impact: -0.6%).
  - Unobservable factors only: Growth would decrease to 3.5% (impact: -2.0%).
  - All factors combined: Growth would plummet to -1.4% (total reduction: 6.9%).

- **Interpretation:** Strong convergence forces dominate manufacturing, with existing factor endowments supporting rapid growth in lagging sectors.

Contrasting Counterfactual Patterns

- **Aggregate economy:**
  - Substantial positive impacts from adopting top performers' characteristics.
  - Observable factors (physical and human capital accumulation) drive potential gains.
  - Significant room for improvement across all economies.

- **Manufacturing sector:**
  - Convergence dynamics result in stronger growth for lagging sectors.
  - Existing factor endowments more conducive to rapid growth in bottom than top performers'.
  - Convergence operates through channels beyond simple factor accumulation.

- **Policy implications:** Different approaches needed for economy-wide vs. manufacturing-specific development strategies.

Outline

Concluding Remarks

- Investigation of productivity growth patterns across different quantiles of the productivity distribution.
- Analysis conducted on two samples: panel of 91 advanced and emerging economies (1960-2019) and manufacturing-specific panel covering 34 economies and 14 sectors (1980-2019).
- Comparison of productivity convergence patterns: economy-wide divergence versus strong manufacturing-specific convergence.
- Identification of changing mechanisms driving productivity growth pre/post-1990.
- Quantification of untapped growth potential through counterfactual scenarios.
- Assessment of implications for industrial policy design amid premature deindustrialization challenges.

Summary of Key Findings

- **Divergent Convergence Patterns:**
  - Aggregate growth favors already-productive economies.
  - Manufacturing offers strong convergence for less productive sectors.
- **Evolving Growth Drivers:**
  - General decline in returns to observable factors post-1990.
  - Increasing importance of unobservable factors (technology, institutions).
  - Manufacturing convergence beyond simple factor accumulation.
- **Untapped Growth Potential:**
  - Asian economies: potential 3 percentage point growth gain.
  - Strong convergence advantages in manufacturing for lagging sectors.
  - Different drivers for aggregate vs. manufacturing productivity.

Policy Implications

Stage-Specific Strategies:

- Early-stage: Strengthen manufacturing as growth engine.
- Middle-stage: Enhance technological capabilities and institutions.
- Advanced-stage: Address frontier productivity challenges.

Beyond Physical Capital:

- Facilitate technology absorption and knowledge spillovers.
- Develop absorptive capacity and innovation capabilities.
- Strategic integration into global value chains.

Addressing Productivity Challenges in Manufacturing:

- Preserve "escalator industries" while building sophistication.
- Develop high-productivity service sectors.
- Industrial policies harmonized to global competitive dynamics.

Work in Progress and Future Research

- **Work in Progress:**
  - Fleshing out role of structural change more directly
  - Counterfactuals that simultaneously account for sectoral reallocation effects.
  - Robustness on manufacturing analysis to address nominal values issue—e.g. use EUKLEMS data, deflators by Haraguchi and Amann (2023).
  - Refining quantile decomposition to better handle parameter instability.
  - Applying decomposition of service sector productivity growth.

- **Avenues for Future Research:**
  - More granular human capital measures to capture skill-biased tech. change.
  - Exploring interactions between global value chain participation and premature deindustrialization.
  - Analyzing policy interventions that successfully preserved manufacturing convergence properties.
  - Extending counterfactual analysis to service sector productivity dynamics.

β-Convergence Results

Table A1: β-Convergence Results: Panel Regression Analysis

	Full Sample (1960-2019)			1960-1990			1990-2019		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
y_{t-1}	-0.0192***	-0.0126***	-0.0125***	-0.0421***	-0.0378***	-0.0378***	-0.0164***	-0.0255***	-0.0246***
	(0.0033)	(0.0028)	(0.0028)	(0.0062)	(0.0061)	(0.0060)	(0.0058)	(0.0067)	(0.0068)
Δk		0.5854***	0.5868***		0.6342***	0.6411***		0.5804***	0.5701***
		(0.0351)	(0.0353)		(0.0448)	(0.0451)		(0.0604)	(0.0619)
Δhc			0.0206			0.0639			-0.0588
			(0.0660)			(0.1177)			(0.0795)
Δpop		0.5503**	0.5260**		0.5078*	0.4733*		1.2097***	1.2067***
		(0.2427)	(0.2461)		(0.2616)	(0.2675)		(0.4449)	(0.4477)
Implied λ	0.0194	0.0127	0.0126	0.0430	0.0385	0.0385	0.0165	0.0258	0.0249
Half-life (years)	35.8	54.6	55.0	16.1	18.0	18.0	42.0	26.9	27.8
No. of economies	91	91	90	91	91	90	91	91	90
Observations	5,369	5,369	5,310	2,730	2,730	2,700	2,639	2,639	2,610
R^2 (within)	0.026	0.175	0.176	0.049	0.189	0.193	0.007	0.169	0.164

Notes: Dependent variable is Δy (growth rate of real GDP per worker). All regressions include country and year fixed effects.
Standard errors clustered at country level in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Go Back

ADB

Quantile decomposition (PWT Sample)

Table A2: Quantile decomposition of labor productivity growth differences (1960-1990 vs 1990-2019)

	Quantiles								
Component	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
Panel A: Total Effect									
Estimate	-0.0103***	-0.0057***	-0.0022	0.0011	0.0044***	0.0078***	0.0116***	0.0158***	0.0219***
	(0.0022)	(0.0016)	(0.0014)	(0.0012)	(0.0011)	(0.0011)	(0.0012)	(0.0015)	(0.0020)
Panel B: Characteristics Effect									
Estimate	0.0202***	0.0210***	0.0220***	0.0232***	0.0245***	0.0261***	0.0281***	0.0307***	0.0342***
	(0.0023)	(0.0021)	(0.0020)	(0.0019)	(0.0019)	(0.0019)	(0.0020)	(0.0021)	(0.0024)
Panel C: Coefficients Effect									
Estimate	-0.0202***	-0.0203***	-0.0204***	-0.0203***	-0.0203***	-0.0203***	-0.0207***	-0.0215***	-0.0231***
	(0.0031)	(0.0027)	(0.0025)	(0.0024)	(0.0023)	(0.0022)	(0.0022)	(0.0023)	(0.0025)
Panel D: Residuals Effect									
Estimate	-0.0103***	-0.0064***	-0.0039***	-0.0017***	0.0002	0.0021***	0.0041***	0.0066***	0.0108***
	(0.0012)	(0.0007)	(0.0005)	(0.0004)	(0.0004)	(0.0005)	(0.0006)	(0.0008)	(0.0012)

Bootstrap Inference on Counterfactual Quantile Processes		
Null-hypothesis	KS-statistic	CMS-statistic
Differences between the observable distributions		
No effect: QE(τ)=0 for all τs	0.000	0.000
Constant effect: QE(τ)=QE(0.5) for all τs	0.000	0.000
Effects of characteristics		
No effect: QTE(τ)=0 for all τs	0.000	0.000
Constant effect: QE(τ)=QE(0.5) for all τs	0.000	0.000
Effects of coefficients		
No effect: QE(τ)=0 for all τs	0.000	0.000
Constant effect: QE(τ)=QE(0.5) for all τs	0.110	0.440
Effects of residuals		
No effect: QE(τ)=0 for all τs	0.000	0.000
Constant effect: QE(τ)=QE(0.5) for all τs	0.000	0.000

Notes: Bootstrapped standard errors in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. The decomposition is based on 100 bootstrap replications. All regressions include country and year fixed effects. The final rows provide the p-values from KS and CMS bootstrap tests for various null hypotheses.

Go Back

ADB

Quantile decomposition (UNIDO Sample)

Table A3: Quantile decomposition of labor productivity growth differences in manufacturing sectors (1980-1990 vs 1990-2019)

	Quantiles								
Component	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
Panel A: Total Effect									
Estimate	0.0675***	0.0477***	0.0386***	0.0343***	0.0318***	0.0295***	0.0244***	0.0118	-0.0232
	(0.0159)	(0.0099)	(0.0070)	(0.0050)	(0.0038)	(0.0042)	(0.0064)	(0.0101)	(0.0170)
Panel B: Characteristics Effect									
Estimate	0.0800***	0.0734***	0.0703***	0.0682***	0.0657***	0.0624***	0.0577***	0.0492***	0.0183***
	(0.0102)	(0.0093)	(0.0090)	(0.0088)	(0.0086)	(0.0083)	(0.0080)	(0.0071)	(0.0060)
Panel C: Coefficients Effect									
Estimate	-0.0267	-0.0304**	-0.0339***	-0.0369***	-0.0389***	-0.0399***	-0.0406***	-0.0407***	-0.0265
	(0.0168)	(0.0131)	(0.0112)	(0.0100)	(0.0091)	(0.0083)	(0.0076)	(0.0073)	(0.0106)
Panel D: Residuals Effect									
Estimate	0.0142**	0.0047	0.0022	0.0030	0.0050***	0.0070***	0.0073**	0.0033	-0.0151**
	(0.0068)	(0.0042)	(0.0032)	(0.0025)	(0.0019)	(0.0020)	(0.0029)	(0.0043)	(0.0068)

Bootstrap Inference on Counterfactual Quantile Processes		
Null-hypothesis	KS-statistic	CMS-statistic
Differences between the observable distributions		
No effect: QE(τ)=0 for all τs	0.000	0.000
Constant effect: QE(τ)=QE(0.5) for all τs	0.010	0.060
Effects of characteristics		
No effect: QTE(τ)=0 for all τs	0.000	0.000
Constant effect: QE(τ)=QE(0.5) for all τs	0.000	0.000
Effects of coefficients		
No effect: QE(τ)=0 for all τs	0.000	0.000
Constant effect: QE(τ)=QE(0.5) for all τs	0.250	0.310
Effects of residuals		
No effect: QE(τ)=0 for all τs	0.000	0.010
Constant effect: QE(τ)=QE(0.5) for all τs	0.020	0.170

Notes: Bootstrapped standard errors in parentheses. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$. The decomposition is based on 100 bootstrap replications. All regressions include country, sector, and year fixed effects. The final rows provide the p-values from KS and CMS bootstrap tests for various null hypotheses.

Go Back

ADB

Thank you.