

**ECON**

**SOC**

**ENV**

**Sustainable development and structural transformation  
in Africa: Managing trade-offs and leveraging synergies**

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**Bartholomew Armah, PhD**  
*Chief, Renewal of Planning Section*  
*United Nations*  
*Economic Commission for Africa*

# Africa's Development context

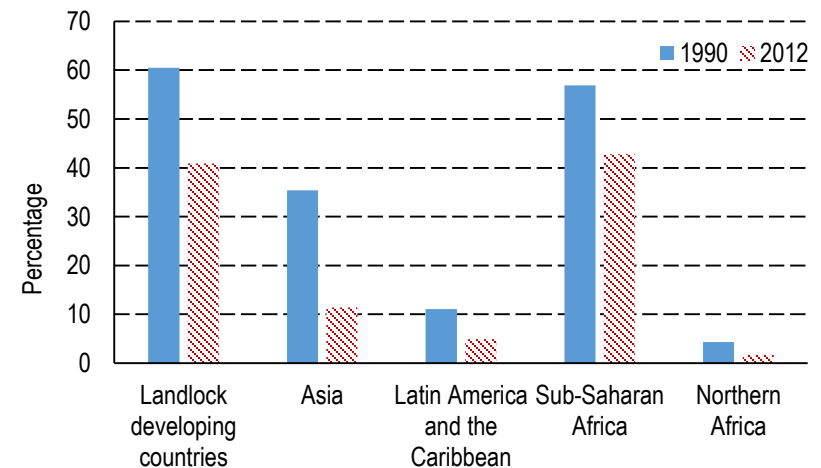
**Africa's growth performance has not been associated with significant reductions in poverty.**

## SOCIO-ECONOMIC DEVELOPMENT

- ➔ **Economic growth acceleration:** 54% GDP increase between 2010 and 2014 in 2005 constant dollars; almost twice the global rate.
- ➔ **Progress on social indicators:** increased primary enrollment; gender parity in education and empowerment of women; decline in incidence of HIV/AIDS and other diseases; decline in child and maternal deaths
- ➔ **But: Growth has been largely jobless** driven by natural resource extractives and commodity exports



## POPULATION LIVING BELOW \$1.25

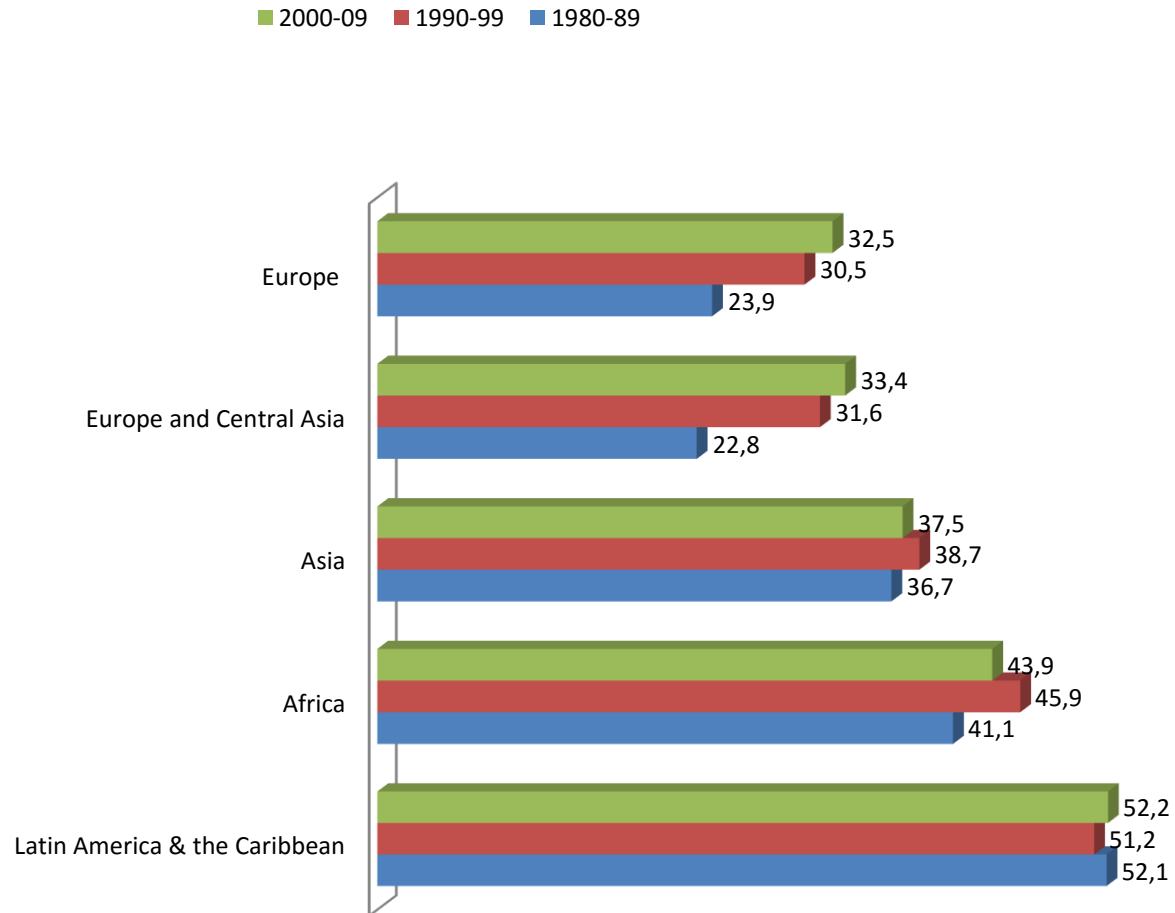


Source: UNSD, 2015

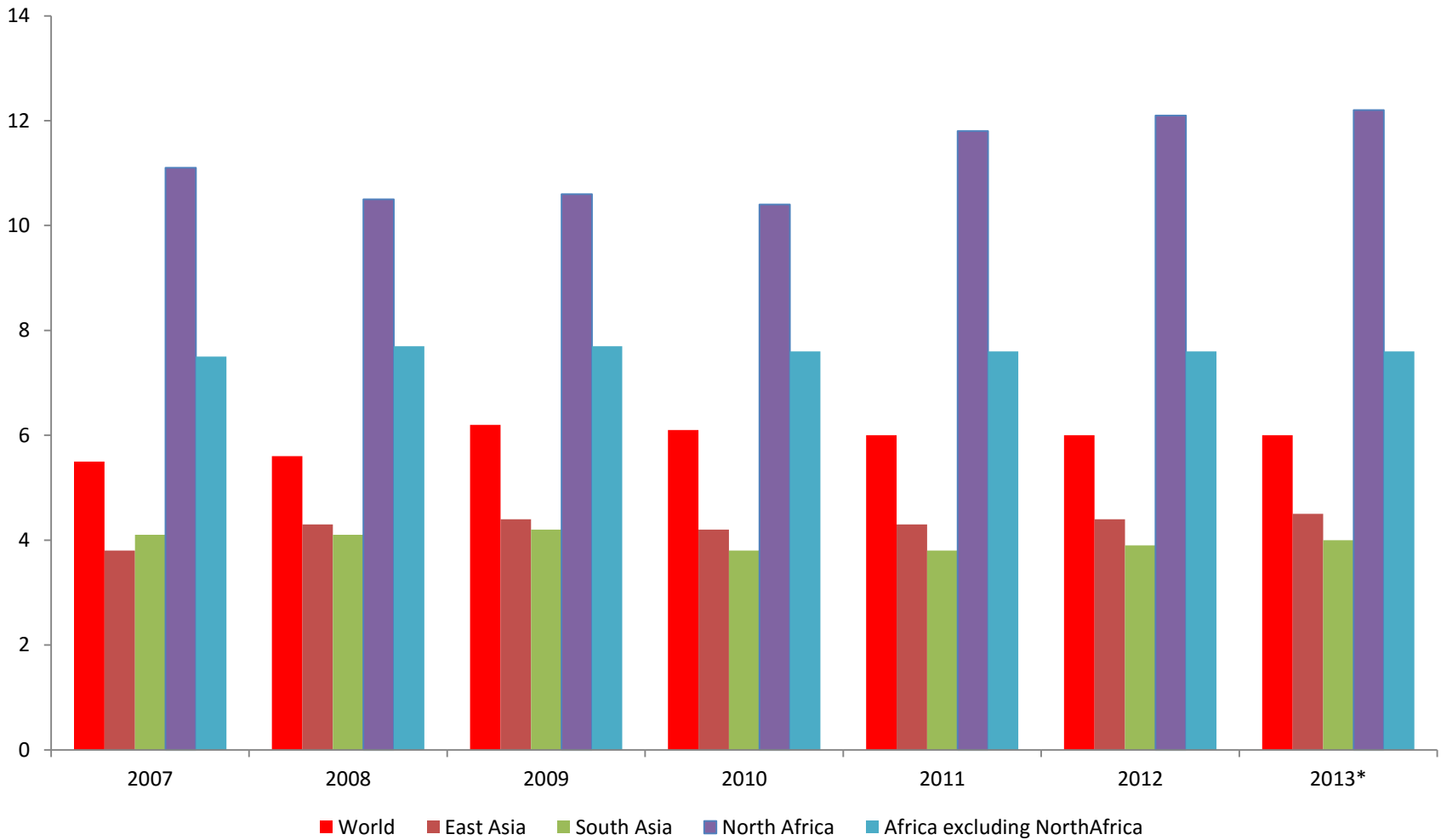
- ➔ **the highest rate of extreme poverty...the number of poor people has increased despite reductions in the poverty rate**

Figure 1.6: Inequality is high in Africa but has started to improve in past decade

# Declining but high Inequality: Africa

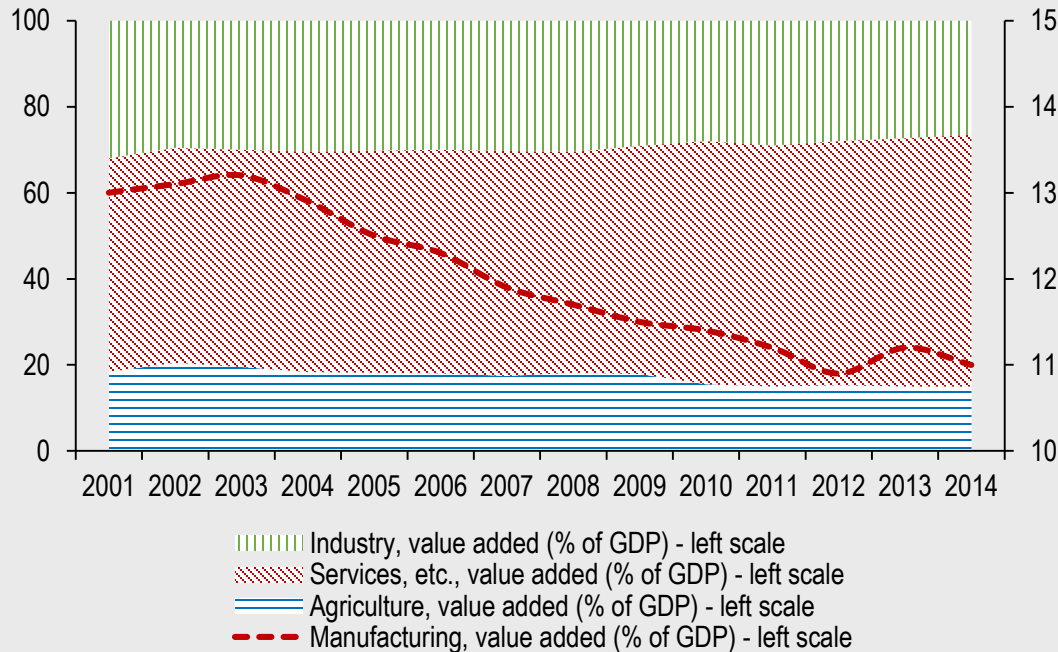


# Unemployment by region



# Development context

## DECLINING CONTRIBUTION OF MANUFACTURING TO GDP



**Prolonged era of *de-industrialisation* as evidenced by a stagnation in manufacturing value-added at around 11% of GDP.**

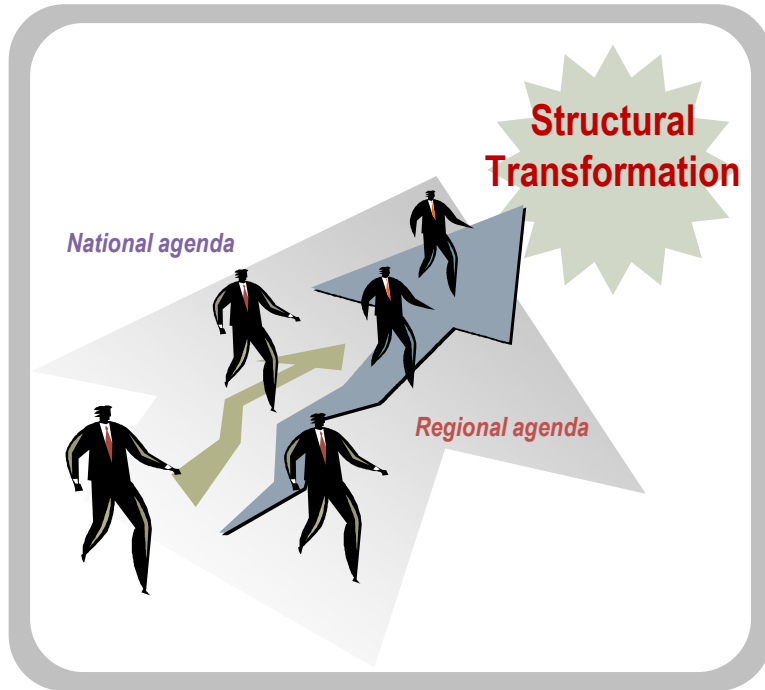
Source: World Bank, 2015

### INCOME INEQUALITY

- **Income inequalities remain high and second only to Latin American and Caribbean countries.**
- **6 out of the 10 most unequal countries worldwide were in Africa (Armah et al., 2014).**

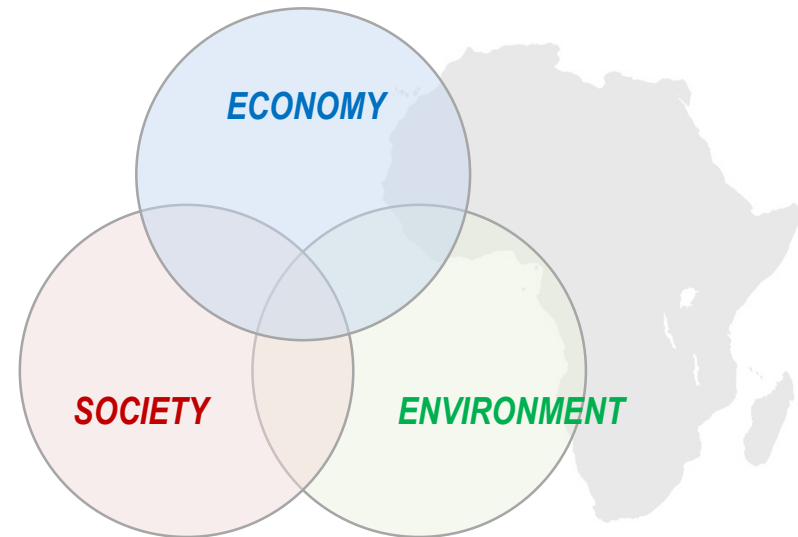
➔ **In effect, growth has not been inclusive translated into benefits for the poor and shared broadly across society for all.**

# SYNERGIES AND TRADEOFFS IN ACHIEVING TRANSFORMATION IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT?



Africa has identified **structural transformation** as a development priority in their national, regional development frameworks.

## SUSTAINABLE DEVELOPMENT GOALS



**UN 2030 Agenda for sustainable development** comprises 17 Goals, 169 targets and 230 indicators that encapsulate the **three dimensions of sustainable development** in a balanced and integrated manner.

➔ Main purpose of the study is to **empirically investigate the relationship** among the three dimensions of sustainable development and structural transformation

# What is Agenda 2063?

- Agenda 2063, is a long term development framework (50 year) that aims to materialize Africa's vision of: an *integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the world*
- It is divided into 5 Ten Year implementation periods. The First Ten Year Implementation Plan (FTYIP) covers the period 2013-2023
- Comprises 7 aspirations, 20 Goals 172 national targets and over 200 indicators

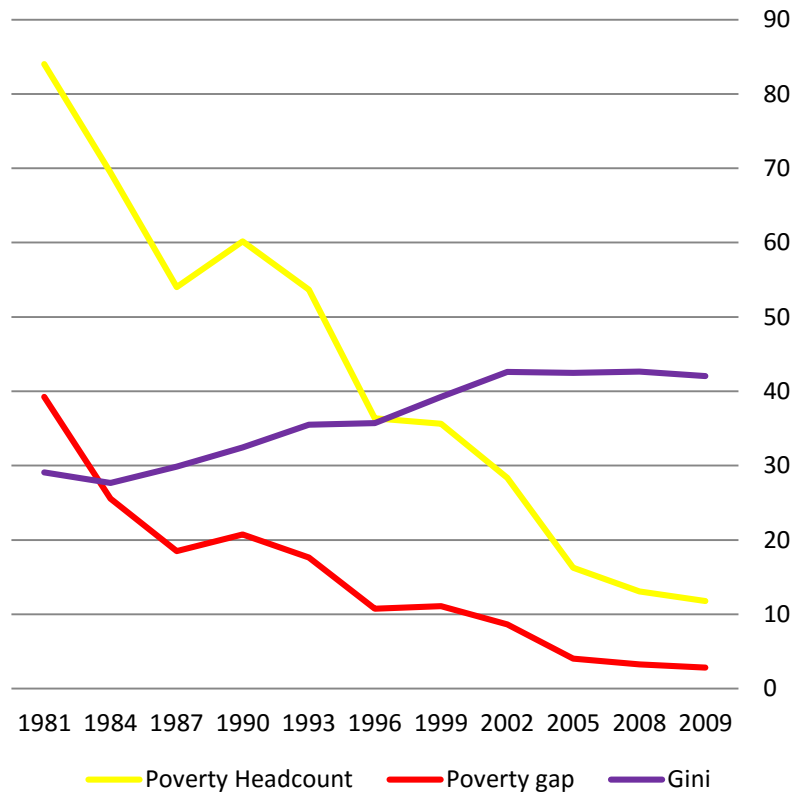
# Aspirations of 2063

	Agenda 2063
1	<i>A Prosperous Africa based on inclusive Growth and Sustainable Development:</i>
2	<i>An integrated continent, politically united, based on the ideals of Pan Africanism and the vision of Africa's Renaissance</i>
3	<i>An Africa of good governance, respect for human rights, justice and the rule of law</i>
4	<i>A peaceful and secure Africa</i>
5	<i>An Africa with a strong cultural identity, common heritage, values and ethics</i>
6	<i>An Africa whose development is people-driven, relying on the potential of African people, especially its women and youth, and caring for children</i>
7	<i>Africa as a strong, united, resilient and influential global player and partner</i>

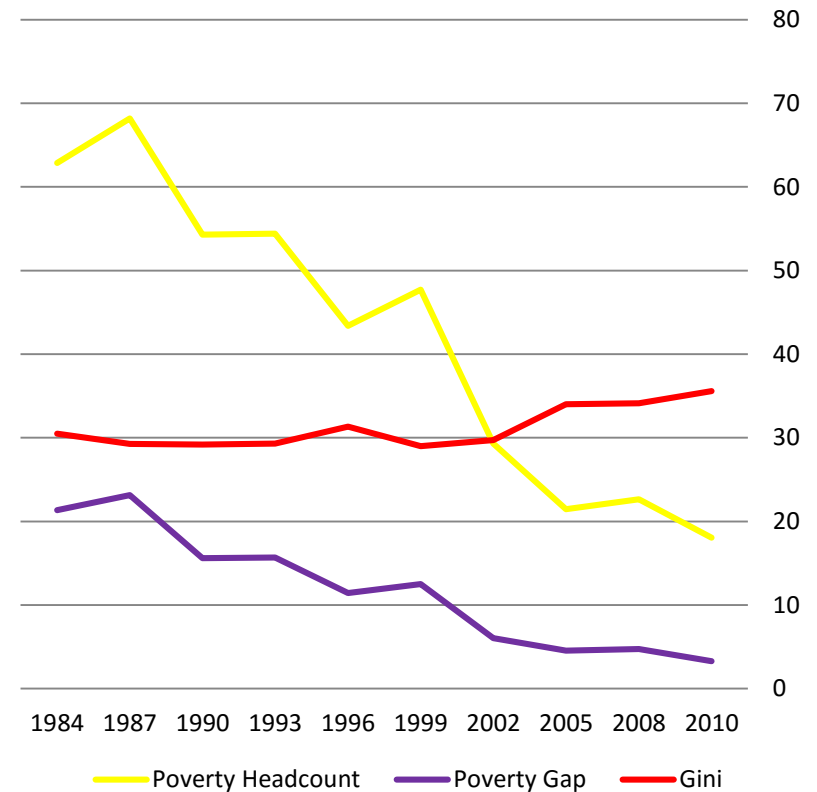


# Poverty and inequality tradeoffs

## China

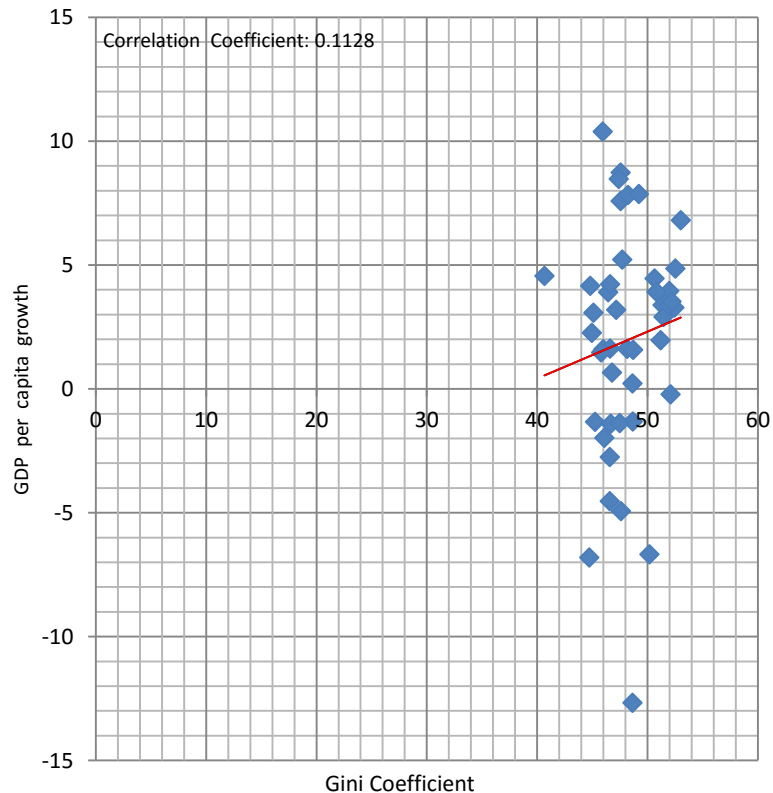


## Indonesia

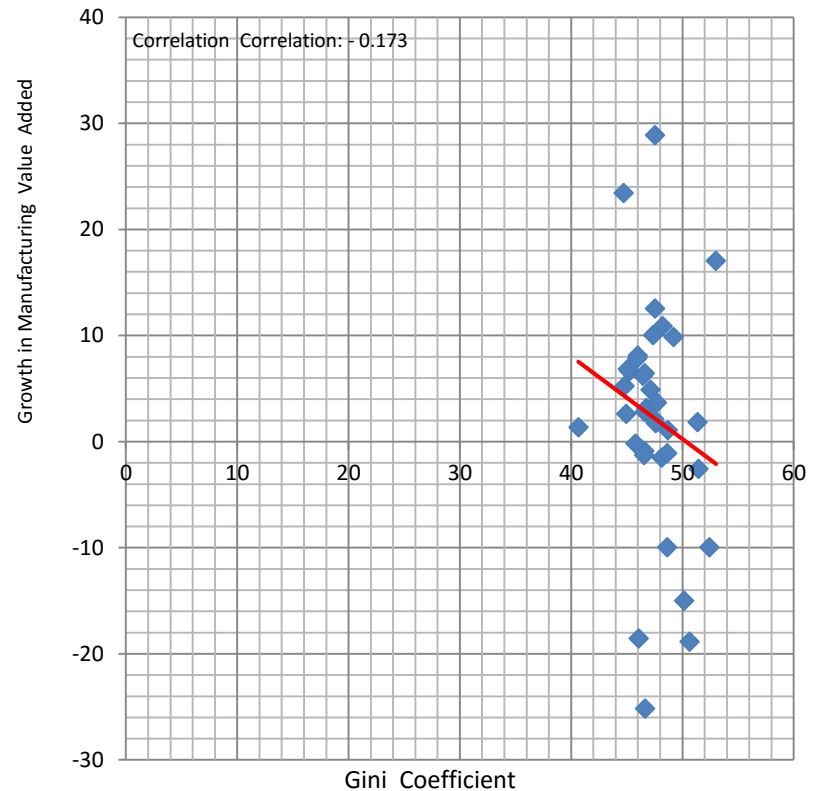


# Tradeoffs between Growth, Manufacturing and Inequality - Panel of Botswana, Eritrea, Ethiopia, Lesotho, South Africa (2000-2008)

## GDP per capita growth and Inequality



## Manufacturing growth and Inequality



# Structural Transformation

- Increase in the relative GDP share of manufacturing and services; declining share of agriculture
- Triggered by reallocation of economic activities from low productivity to more productive ones e.g., agriculture to manufacturing
- Rural urban shifts
- Demographic transitions: high to low fertility
- Which sector drives the transformation?
  - Lewis model; manufacturing leads
  - Schultz model; agriculture leads

# A more challenging context for transformation in Africa

- Africa's transformation must meet the litmus test of economic, social and environmental sustainability
- Which dimension should lead the transformation process?
- What if any are the tradeoffs among the three dimensions and how do these in turn affect structural transformation?
- Will efforts to improve economic sustainability e.g., cutbacks in crude oil production undermine growth and or social inclusion (through reduced budget for social spending) and hence constrain structural transformation?

# Estimating tradeoffs and synergies: Structural Equation Modelling (SEM)

## Why SEM?

- Allows for computation of the **direct and indirect** effects of variables under study
- Incorporates both **observed and unobserved** (latent) variables
- Provides explicit estimates of error variance parameters

## What is SEM?

- A statistical approach that tests hypothesis about relationships among observed and latent variables
- Comprises two subsets of models:
  - **measurement model**: relates observed variable to latent variable using confirmatory analysis
  - **structural model**: defines the relationship among the latent variables (i., transformation versus, economic, social and environmental dimensions)

# Estimating tradeoffs and synergies: Structural Equation Modelling (SEM)

## Steps in SEM

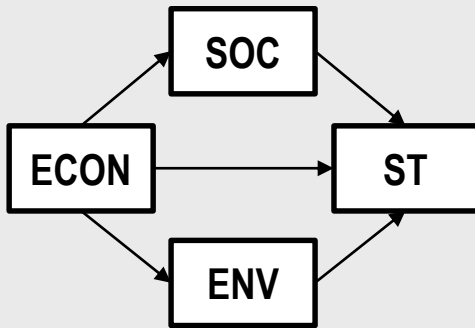
- Model specification
- Model identification
- Parameter estimation
- Model fit
- Model re-specification

# STRUCTURAL EQUATION MODELLING

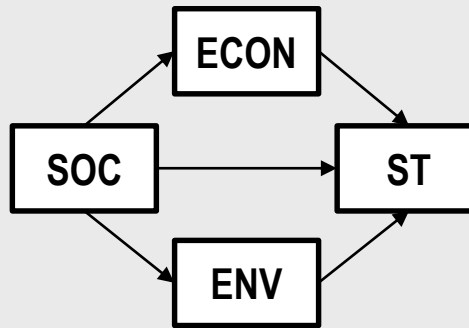
## THREE HYPOTHETICAL MODELS

Structural equation modelling incorporates observed indicators (individual indicator level) and unobserved latent variables (dimensional level: economic, social and environmental).

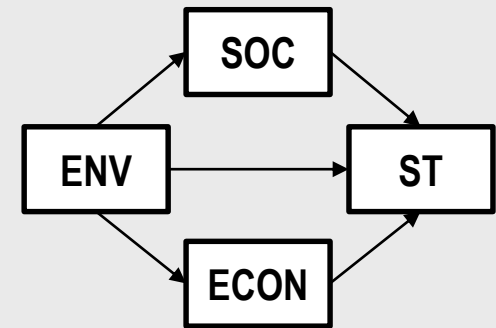
**Model I:** total structural effects of **economic** development to structural transformation



**Model II:** total structural effects of **social** development to structural transformation



**Model III:** total structural effects of **environmental** development to structural transformation



## CONFIRMATORY FACTOR ANALYSIS

- **Confirmatory factor analysis** how latent variables are measured based on the observed variables.

## PATH ANALYSIS

- Assessment of predictive validity and **analysis of direct and indirect (mitigated) effects** among the latent variables

# LATENT AND OBSERVED VARIABLES/INDICATORS

## SELECTING INDICATORS

**29 African countries** spanning the period **1995-2011**

**Three dimensions:** based on the methodology adopted by the Commission on Sustainable Development (UN, 2001)

**Structural transformation:** based on the key features of the structural transformation process (Christiaensen et al., 2011; LDC IV Monitor, 2015).

	Dimension	Area of Importance	Proxy Indicator and description	Source	
Independent variable	Economic	Economic growth	GDP per capita (annual %)	WDI	
		Investment	Total investment (% of GDP)	WEO	
		Green economy	Renewable energy consumption (% of total final energy consumption)	WDI	
			Energy use	Energy intensity level of primary energy	WDI
	Social	Poverty	Unemployment rate (% of total labour force)	WDI	
		Sanitation	Sanitation facilities (% of population with access)	WDI	
		Life quality	Life expectancy at birth (years)	WDI	
		Maternal health	Adolescent fertility rate (births per 1,000 women ages 15-19)	WDI	
	Environmental	Climate change		Emissions of carbon dioxide (metric tons per capita)	WDI
				Arable land (hectares per person)	WDI
Forests		Forest area (square km)	WDI		
Water		Improved water source (% of population with access)	WDI		
Dependent variable	Structural Transformation	Higher agricultural productivity by achieving a higher cereal yield	Cereal yield (kg per hectare)	WDI	
		Higher share of manufacturing in value addition	Agriculture gross per capita production index (2004-2006 = 100)	FAOSTAT	
		Increases in the share of ICT in services exports	Manufacturing value added (% of GDP)	WDI	
		Better telecommunications infrastructure	Services value added (% of GDP)	WDI	
		Improving health services by decreasing infant mortality rate	Internet users (per 100 people)	WDI	
		More developed financial market	Infant mortality rate (per 1,000 live births)	WDI	
			Domestic credit provided by financial sector (% of GDP)	WDI	

Notes: WDI stands for the World Bank-World Development Indicators Database (2015); WEO stands for the IMF-World Economic Outlook Database (2015); and FAOSTAT stands for the FAO Statistics Division Database (2015).



# MODELLING RESULTS: CONFIRMATORY FACTOR ANALYSIS

## TEST OF CONVERGENT VALIDITY

	$\lambda^1$	S.E.	C.R. <sup>2</sup>	S $\lambda^3$	AVE <sup>4</sup>	C.R. <sup>5</sup>
<b>ECON (<math>\Pi_\alpha</math>)</b>						
$\alpha_{INVjt}$	1	-	-	0.327	0.8746137	0.8820857
$\alpha_{RECjt}$	-5.805	0.771	-7.525	-0.790		
$\alpha_{EILjt}$	-2.452	0.319	-7.697	-0.648		
<b>SOC (<math>\Pi_\beta</math>)</b>						
$\beta_{SANITjt}$	1	-	-	0.773	0.946573	0.7915107
$\beta_{LIFEjt}$	0.153	0.011	13.740	0.589		
$\beta_{AFRjt}$	-1.079	0.054	-20.081	-0.784		
<b>ENV (<math>\Pi_\gamma</math>)</b>						
$\gamma_{WATSjt}$	1	-	-	0.803	0.925487	0.9409649
$\gamma_{CO2jt}$	5.362	0.245	21.881	0.872		
$\gamma_{ARALjt}$	-0.586	0.092	-6.381	-0.292		
<b>ST (<math>\Pi_\delta</math>)</b>						
$\delta_{SERVAjt}$	1	-	-	0.420	0.8693104	0.9621941
$\delta_{CREYjt}$	2.663	0.449	5.933	0.493		
$\delta_{MANVAjt}$	2.998	0.343	8.730	0.625		
$\delta_{CREDITjt}$	6.880	1.038	6.628	0.735		

### Goodness-of-fit measures

Chi-square = 713.848 ( $p = .000$ )

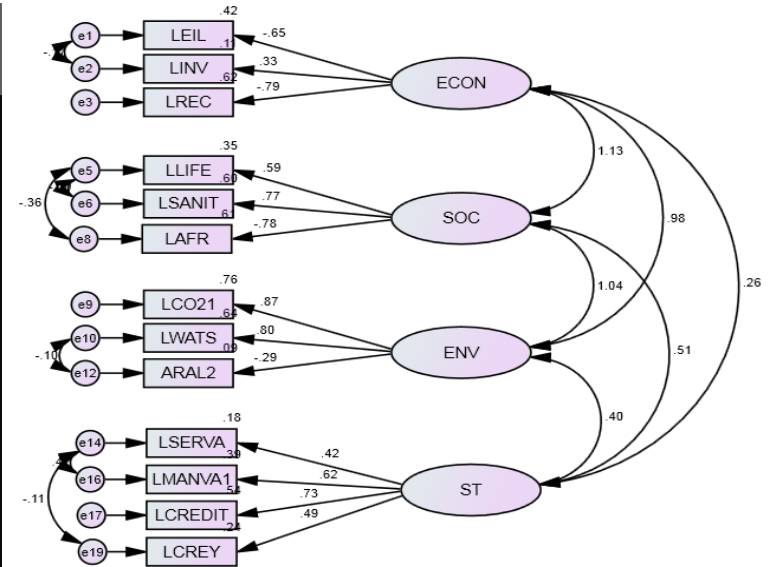
SRMR<sup>6</sup> = .082

IFI<sup>7</sup> = .807

CFI<sup>8</sup> = .806

Notes:  $\Pi_\alpha$  stands for economic dimension;  $\Pi_\beta$  stands for social dimension;  $\Pi_\gamma$  stands for environmental dimension;  $\Pi_\delta$  stands for structural transformation dimension; INV stands for investment; REC stands for renewable energy consumption; EIL stands for energy intensity level of primary energy; SANIT stands for sanitation facilities; LIFE stands for life expectancy at birth; AFR stands for adolescent fertility rate; WATS stands for improved water source; CO2 stands for emissions of carbon dioxide; ARAL stands for arable land; SERVA stands for services value added; CREY stands for cereal yield; MANVA stands for manufacturing value added and CREDIT stands for domestic credit.

1. Factor loading; 2. Construct reliability of each indicator; 3. Standardised factor loading; 4. Average variance extracted; 5. Construct reliability of each construct; 6. Standard root-mean-square residual; 7. Incremental fit index; and 8. Comparative fit index

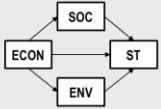


- Indicators that show coefficient below .2 are unacceptable thus excluded for further analysis (Jöreskog, 1993).
- Each of the standardised regression weights is greater than critical value at .01 significant level.
- All these four Average Variance Extracted (AVE) far exceeds the recommended level of .500.
- All four Construct Reliability (C.R.) far exceeds the recommended level of .700.

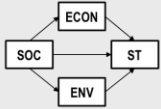
# MODELLING RESULTS: PATH ANALYSIS

## THREE HYPOTHETICAL MODELS

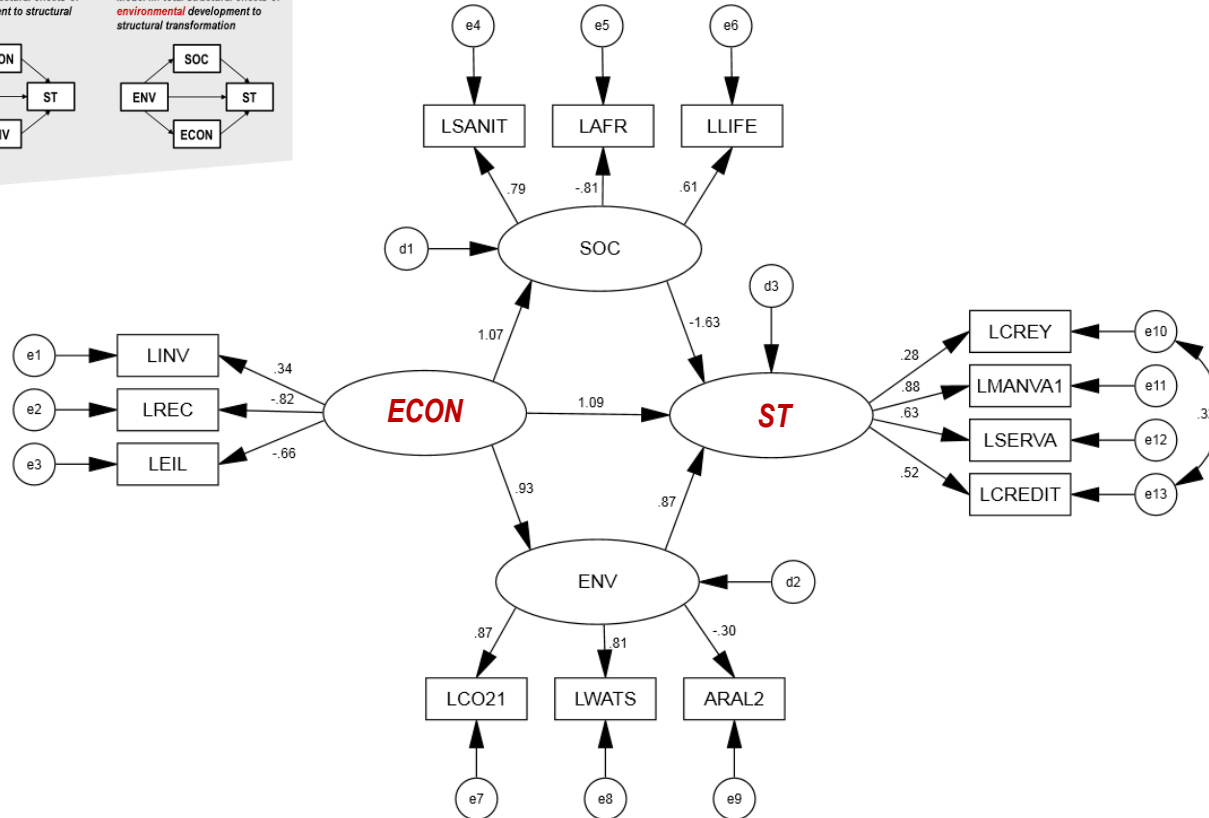
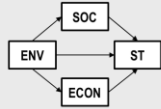
Model I: total structural effects of economic development to structural transformation



Model II: total structural effects of social development to structural transformation

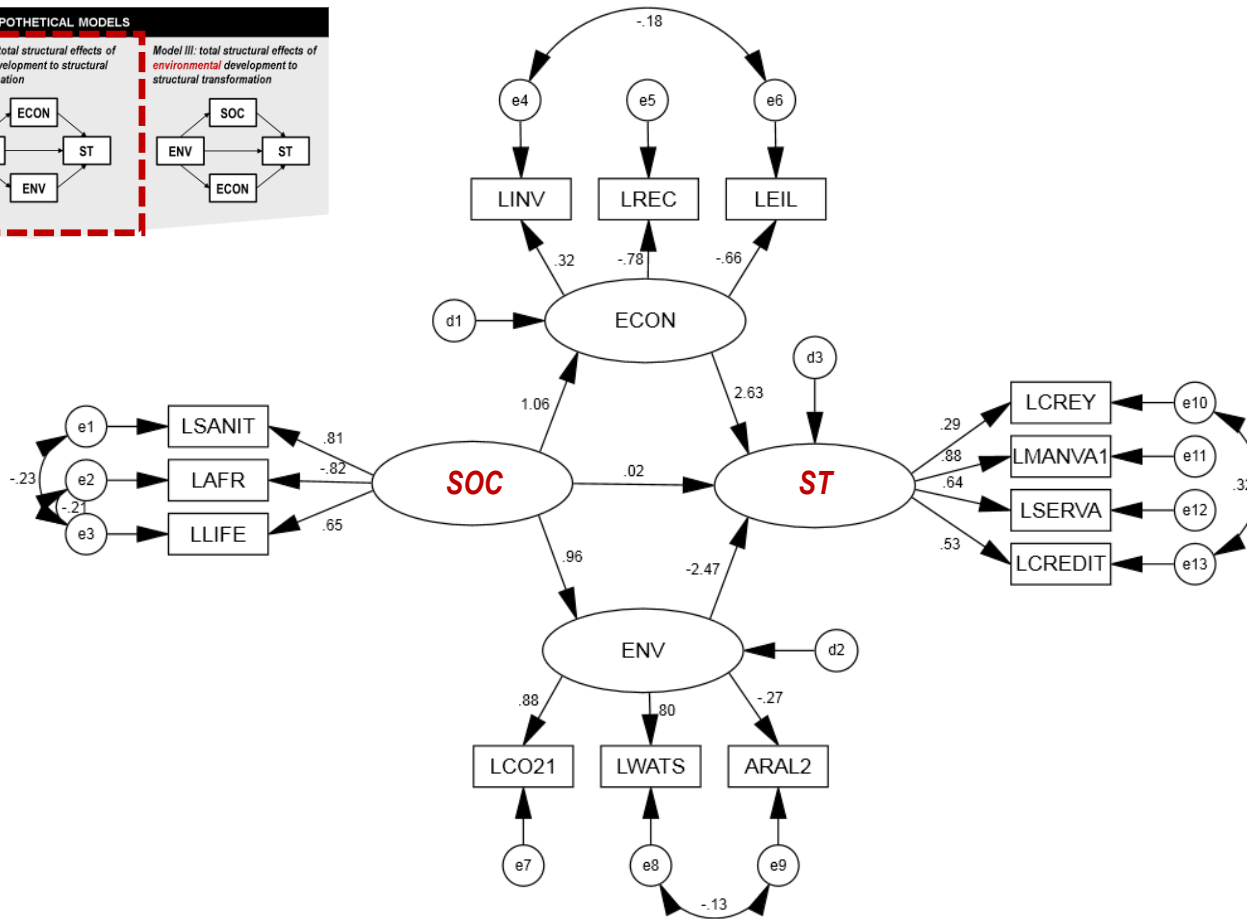
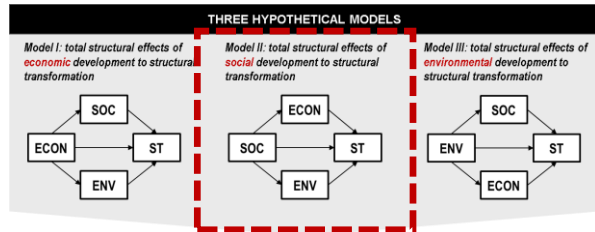


Model III: total structural effects of environmental development to structural transformation



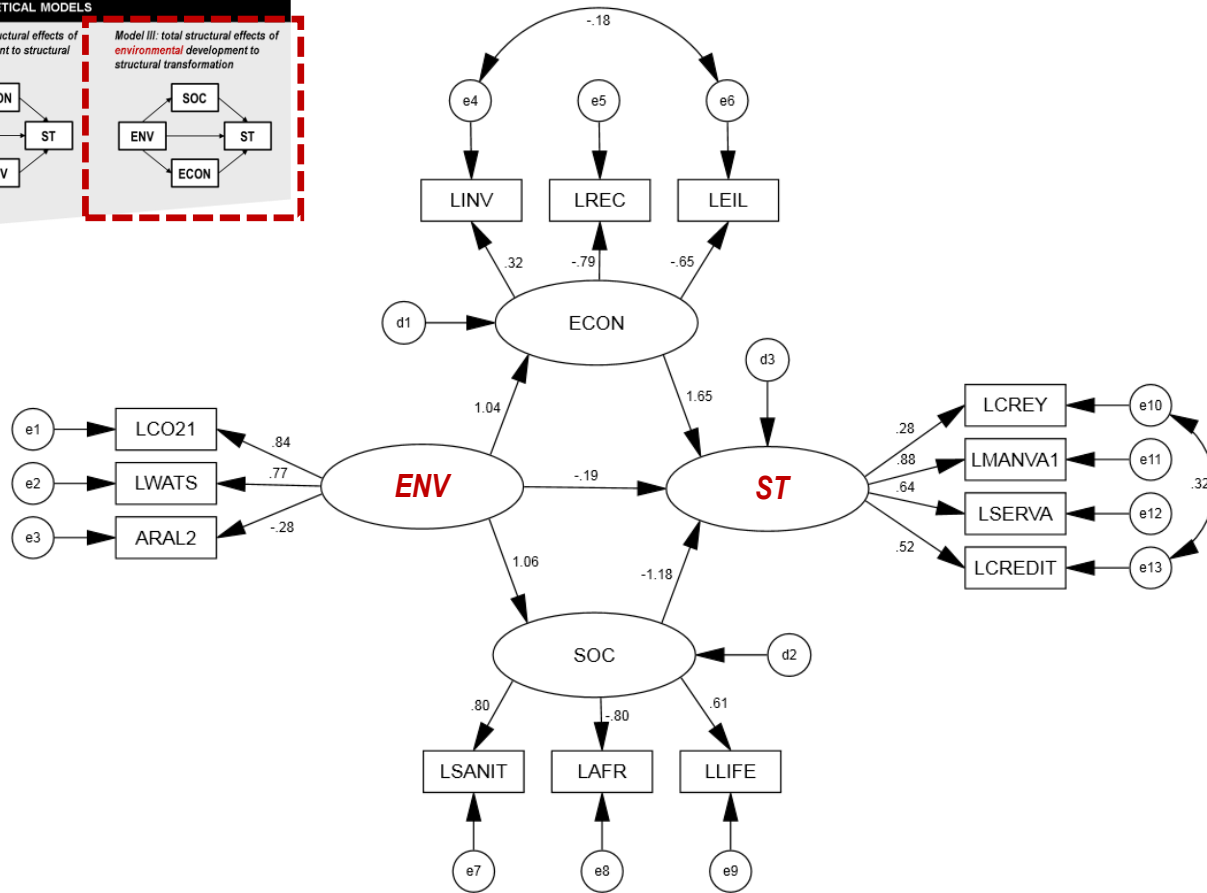
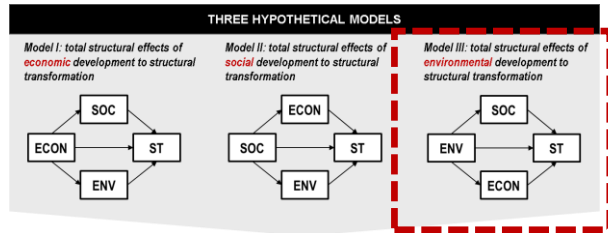
➔ Economic development has a **direct positive effect of 1.091** on African structural transformation (which implies structural transformation goes up 1.091 standard deviation when economic development goes up by 1 standard deviation) but this magnitude of positive effects is reduced by 86 per cent (due to indirect effect of .939) so that **total structural effect is estimated to be .152**.

# MODELLING RESULTS: PATH ANALYSIS



➔ Social development has a **direct effect of .021** on transformation but **this effect is synergised by 1,995 per cent** (due to indirect effect of .419) so that **total effect is estimated to be .440**.

# MODELLING RESULTS: PATH ANALYSIS



➔ **Environmental development has a *negative direct effect of .191* on structural change but *this negative effect is mitigated and even turned to be positive by indirect effect of .459* so that *total effect is estimated to be .269*.**

# MODELLING RESULTS: PATH ANALYSIS

## RESULT OF STRUCTURAL EQUATION MODELS

	MODEL I	MODEL II	MODEL III
ECON → SOC	1.073***		
ECON → ENV	.933***		
ECON → ST	1.091**	2.629***	1.645**
SOC → ST	-1.630***	.021	-1.184***
ENV → ST	.869*	-2.472***	-.191
SOC → ECON		1.060***	
SOC → ENV		.958***	
ENV → ECON			1.039***
ENV → SOC			1.056***
TOTAL EFFECT	.152*	.440***	.269***
DIRECT EFFECT	1.091**	.021	-.191
INDIRECT EFFECT	-.939**	.419	.459
Chi-square	805.420***	753.322***	811.047***
RMR <sup>1</sup>	.009	.009	.009
IFI <sup>2</sup>	.782	.796	.780
CFI <sup>3</sup>	.781	.795	.779
SRMR <sup>4</sup>	.0944	.0920	.0937
GFI <sup>5</sup>	.815	.825	.819

Notes: \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; and \*  $p < 0.1$ .

1. Root-mean-square residual; 2. Incremental fit index; 3. Comparative fit index; 4. Standard root-mean-square residual; and 5. Goodness-of-fit index

\* **Relatively high modification indices are addressed to improve model-to-data fit** by adding covariance between error terms: in the Model I between cereal yield & domestic credit within structural transformation construct; in the Model II between sanitation facility & life expectancy at birth and between adolescent fertility rate & life expectancy at birth within social development construct, between investment & energy intensity level within economic development construct, between improved water source & agricultural land quality within environmental development construct, and between cereal yield & domestic credit within structural transformation construct; in the Model III between investment & energy intensity level within economic development construct and between cereal yield & domestic credit within structural transformation construct.

➔ **All the models reveal that *t-values of all standardised regression weights are statistically significant*. Also, these models are improved for their fitness through the examination of the *modification indices*\***.

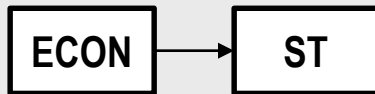
# PANEL DATA ECONOMETRICS

## PANEL DATA MODEL SPECIFICATIONS

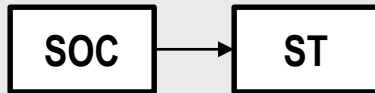
$$\Pi_{it} = \beta_{0i} + \beta_1 \delta_{it} + \beta_2 \eta_{it} + \beta_3 \gamma_{it} + \beta_4 \lambda_{it} + \varepsilon_{it}$$

where  $i$  is country dimension ( $i = 1, \dots, N$ ),  $t$  represents the time dimension ( $t = 1, \dots, T$ );  $\Pi_{it}$  is composite structural transformation index;  $\delta_{it}$  is a vector of indicators representing the economic dimension of sustainability;  $\eta_{it}$  represents indicators of social sustainability;  $\gamma_{it}$  is environmental dimension of sustainable development; and  $\lambda_{it}$  is institutional quality.

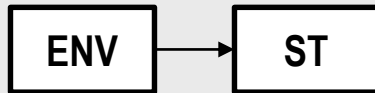
*Model I*



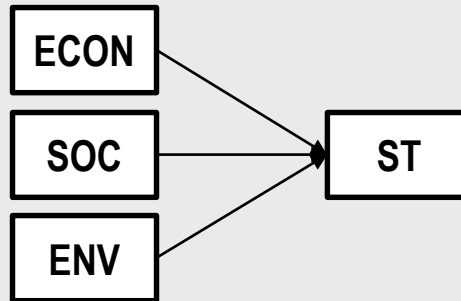
*Model II*



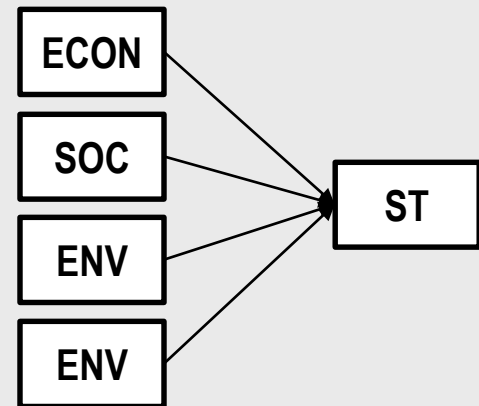
*Model III*



*Model IV*



*Model V*



# EMPIRICAL FINDINGS FROM PANEL DATA MODELLING

MODELS	DESCRIPTIONS OF THE RESULTS
MODEL I	<ul style="list-style-type: none"><li>• Higher levels of investment and more efficient use of energy have a positive impact on structural transformation.</li><li>• Potential trade-offs between clean energy, as proxied by the renewable energy indicator, and structural transformation.</li></ul>
MODEL II	<ul style="list-style-type: none"><li>• Provision of good sanitation services and related infrastructure supports country's structural transformation efforts.</li><li>• Longer life expectancy is positively associated structural transformation but reverse is true for rising adolescent fertility rate (consistent with the findings by Klima (1998) and McQueston et al. (2012)).</li></ul>
MODEL III	<ul style="list-style-type: none"><li>• Structural transformation is enhanced by increased carbon dioxide emissions and improved access to water.</li><li>• However access to arable land has a significantly negative impact on transformation while forest cover has no significant impact as well.</li></ul>
MODEL IV	<ul style="list-style-type: none"><li>• A positive and significant contribution of per capita incomes to structural transformation.</li><li>• However, renewable energy now has a positive and significant impact and carbon dioxide emissions no longer has a significant impact when the economic and social dimensions are taken into account.</li></ul>
MODEL V	<ul style="list-style-type: none"><li>• Including institutional variables further improves the explanatory power of the model.</li><li>• However, the level of significance of per capita incomes and renewal energy consumption are lower implying a weaker impact on transformation.</li></ul>

➔ **An inclusive and sustainable structural transformation agenda requires tackling the economic, social and environmental dimensions of sustainable development in an integrated way. A siloed approach that focuses on one dimension at the expense of the other has a less optimal impact on transformation.**

# PANEL DATA ECONOMETRICS

## RESULT OF PANEL DATA MODELLING

Variable		MODEL I	MODEL II	MODEL III	MODEL IV	MODEL V
ECON	GDP per capita	.0034			.0038(2.003)**	.0035(1.863)*
	Investment	.0060(4.369)***			.0038(2.851)***	.0039(2.962)***
	Renewable energy consumption	-.0043(-1.766)*			.0049(1.983)**	.0047(1.878)*
	Energy intensity level	-.3031(-4.942)***			-.1684(-2.520)**	-.1053
SOCI	Unemployment rate		.0566		.0452	.0873
	Sanitation facilities		.0144(4.104)***		.0115(2.760)***	.0121(2.899)***
	Life expectancy at birth		.0073(2.333)**		.0049	-.0042
	Adolescent fertility rate		-.6066(-6.268)***		-.4074(-3.993)***	-.4303(-4.220)***
ENV	Emissions of carbon dioxide			.0881(2.614)***	.0302	.0095
	Arable land			-.2895(-4.766)***	-.1824(-2.857)***	-.2179(-3.365)***
	Forest area			.0000	.0000	.0000
	Improved water source			.0138(8.327)***	.0063(2.848)***	.0064(2.643)***
INST	Government stability					.0005
	Socioeconomic conditions					.0199(2.027)**
	Corruption					-.0007
	Democratic accountability					.0229(2.429)**
	<i>constant</i>	5.8540(36.236)***	6.8667(12.160)***	3.7593(14.894)***	5.8918(9.454)***	5.5994(8.593)***
Hausman Test						
	Chi-Sq. Statistic	10.6523**	47.4023***	14.0502***	58.4661***	55.5932***
Wald Test						
	F-statistic	145.7811***	136.6526***	101.1344***	61.7847***	62.4995***
	Chi-square	3936.091***	3689.621***	2730.628***	1668.188***	1687.487***
Appropriate Model		Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect
	Adjusted R-squared	0.8965	0.9120	0.9086	0.9187	0.9199
	Log likelihood	191.4405	231.3463	221.9623	255.1122	261.2915
	F-statistic	134.2430	160.3597	153.8327	139.9591	129.5693

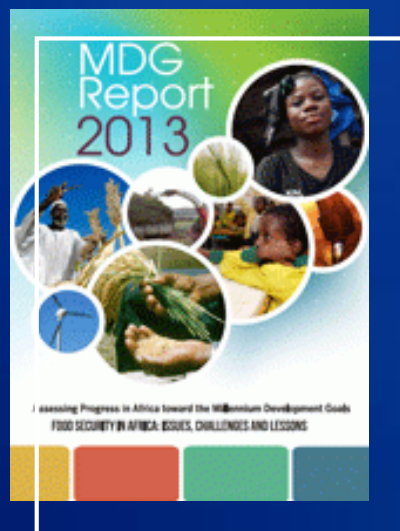
Notes: \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; and \*  $p < 0.1$ .



# ***MAIN FINDINGS AND CONCLUSION***

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- **An inclusive and sustainable structural transformation agenda requires tackling the economic, social and environmental dimensions of sustainable development in an integrated way.**
- **A silo approach that focuses on one dimension at the expense of the other has a less optimal impact on transformation.**
- **Trade-off relation is observed in the Model I (economic) while synergy effect is observed in the Model II (social) and III (environmental).**
- **Environmental development impact on structural transformation (Model III) is greater than that of economic development (Model I). In other words, Africa should note that environmental policy can be one of the best developmental options for structural transformation while also pursuing environmental sustainability.**
- **It should also be noted that such integrated approach with the focus on social development (Model II) would generate the greatest effect on Africa's transformation.**



# Transforming our Africa!

Bartholomew Armah ([barmah@uneca.org](mailto:barmah@uneca.org))