Growth, Agriculture & Employment: Towards a Climate-Friendly World Without Farmers?

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Introduction

- Ecology *vs.* Poverty ?

There is an apparent disagreement between:

⇨ the "ecological critique" …that accuses "modern agriculture" of jeopardizing many ecological services through monocultures and the overuse of freshwater, fossil energy and other industrial inputs such as chemical fertilizers and pesticides [MEA, 2005; etc.]

⇨ the "techno-productivist approach"
…that led economists to recommend,
after the 2007-08 food crisis, to "revitalize agricultural R&D investments" [Alston et al., 2009]
so that "modern agriculture" plays
"its role as an engine of growth" [FAO, 2009].

Our mental map (economics)

Farm Sector

- Traditional, Backward
- Low productivity, Poverty
- Uneducated, Unskilled
- Unorganized, Informal

Lewisian pattern of growth
Modern economic growth
Structural transformation…

Labour

Modern techno/inputs

Non-Farm Sector(s)

- Modern, Developed
- Capital accumulation
- Educated, Skilled, Innovating
- Organized, Formal

Development economics

Barriers to modern agricultural technology *subject to exogenous technical change* ***jam the whole development process*** [Gollin & al., 2002]

New structural economics

Firms in developing countries can exploit the industrial and technological gap with developed countries [on the global technology frontier] by acquiring industrial and technological innovations that are consistent with their new comparative advantage [Lin, 2011]

Agricultural economics

Population pressure on land resources could be circumvented and ***labour productivity*** *increased by several multiples (****up to the levels of Western Europe in the early 1960s****) by investing in agricultural research, human capital and modern agricultural inputs*
[Hayami & Ruttan, 1971, 1985, 2002]

Neo-classical growth theory

Countries with access to identical technologies should converge to a common income level *…/…*

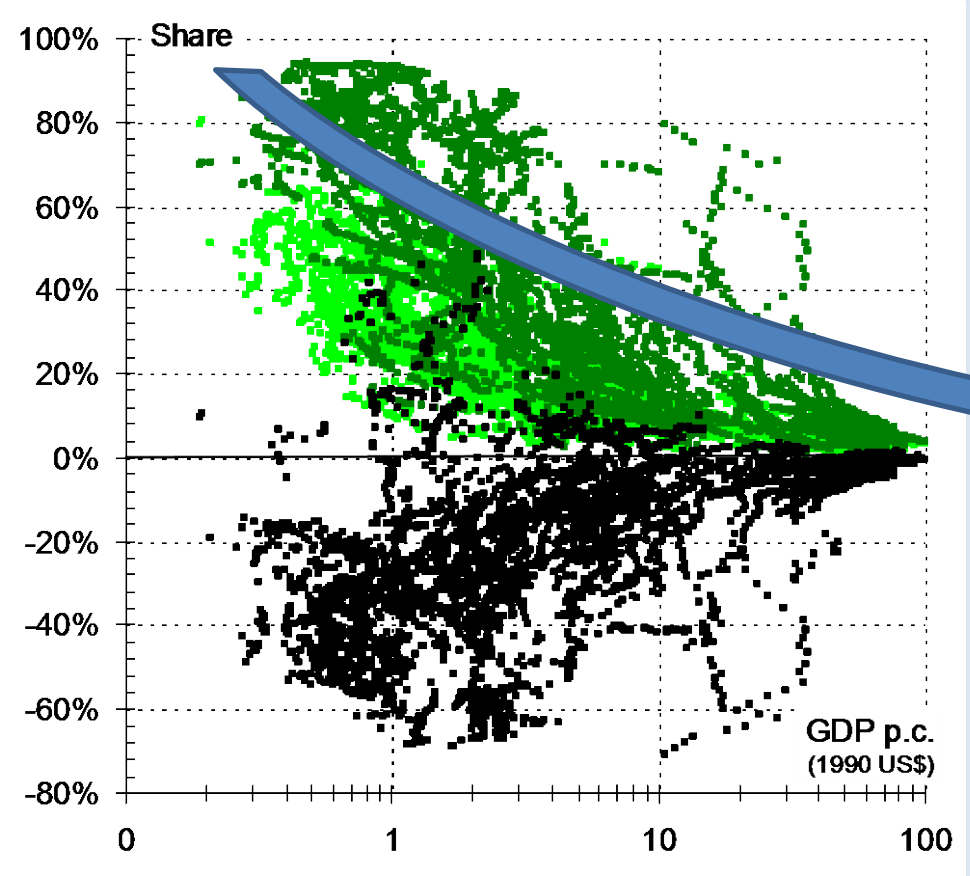
Countries that are poorer and have higher marginal productivity of capital should grow more rapidly in the transition to the long-run steady state …/…

Open global economy, access to foreign capital and foreign markets further strengthen the convergence [in Rodrik, 2013]

1 A Lewisian growth & convergence since the 1960s?

The structural transformation [Chenery & Srinivasan, 1988]

All countries from 1970 to 2007



- share of agriculture in total value-added (*S1*)
- share of agriculture in total employment (*S2*)

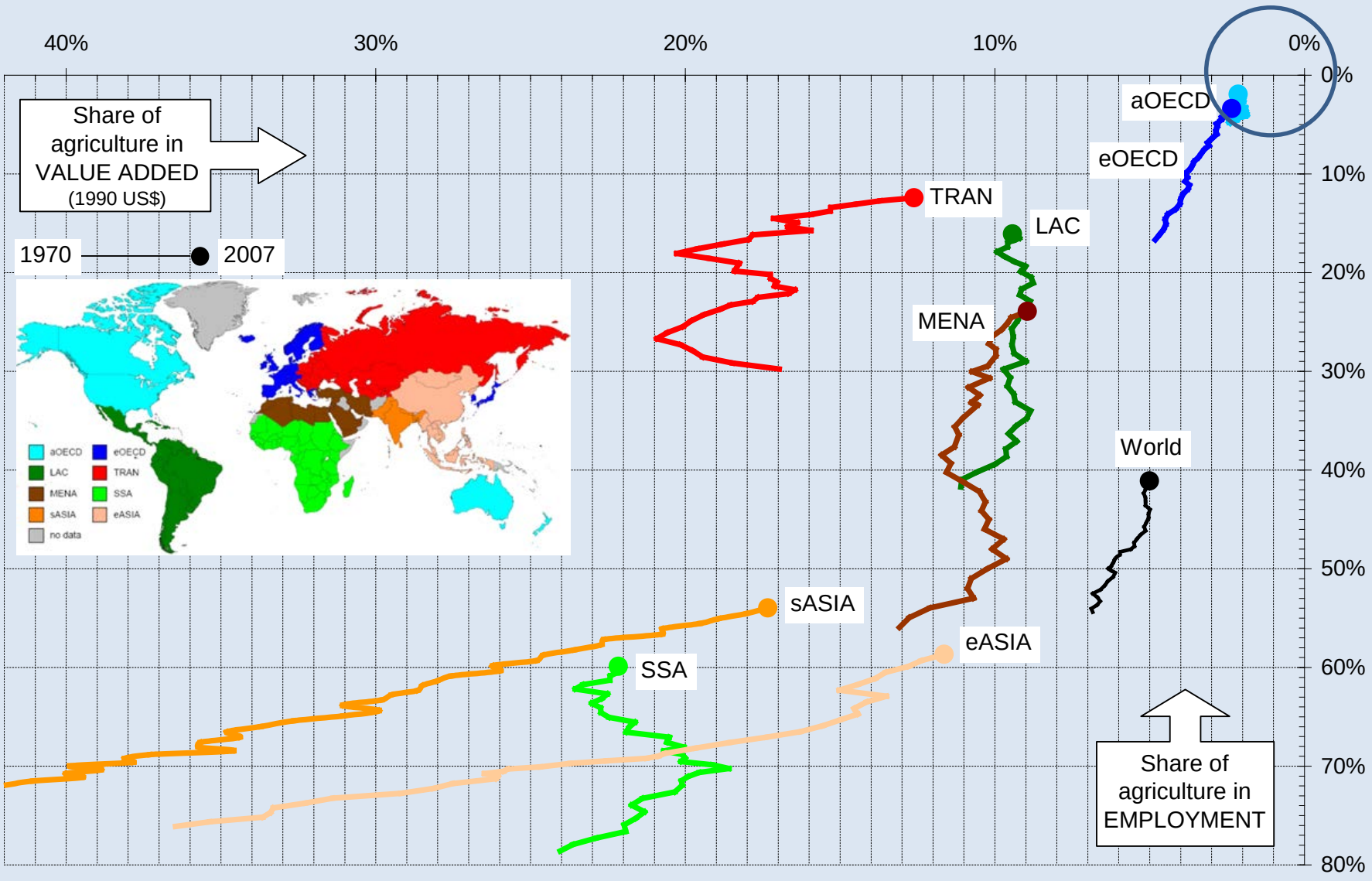
Towards [Timmer, 2009]
a World Without Agriculture

Income convergence
(measurement, per worker)

- *S1 – S2* ⇨ Labour Income Gap (*LIG*)
  [Neg. → 0]

or: *S1 / S2* ⇨ Labour Income Ratio (*LIR*)
[0 → 1]

A World Without Agriculture



One or several pathways of structural change?

Four possible pathways…

Active population in agriculture ↗ / ↘

Income convergence (between farm & non-farm workers) ↗ / ↘

Farmer-Developing	Lewis Path
Lewis Trap	Farmer-Excluding

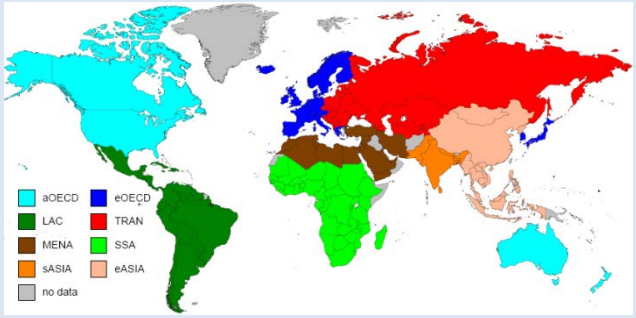
…according to
- Labour productivity growth (θ, θ_a)
- Agricultural sector growth (Y_a)

	$\ln(L_a) > 0$	$\ln(L_a) < 0$
$\ln(LIR) > 0$	$\ln(Y_a) > \ln(\theta_a) > \ln(\theta)$	$\ln(\theta_a) > \ln(Y_a), \ln(\theta)$
$\ln(LIR) < 0$	$\ln(\theta_a) < \ln(Y_a), \ln(\theta)$	$\ln(\theta) > \ln(\theta_a) > \ln(Y_a)$

Worldwide dynamics

1970 ➔ ○2007

(cumulated annual growth rates)



Narrowing income gap

Increasing active population in agriculture

Decreasing active population in agriculture

Growing income gap

Farmer-Developing Path

Lewis Path

Lewis Trap

Farmer-Excluding Path

LAC

aOECD

eOECD

MENA

TRAN

SSA

sASIA

eASIA

World

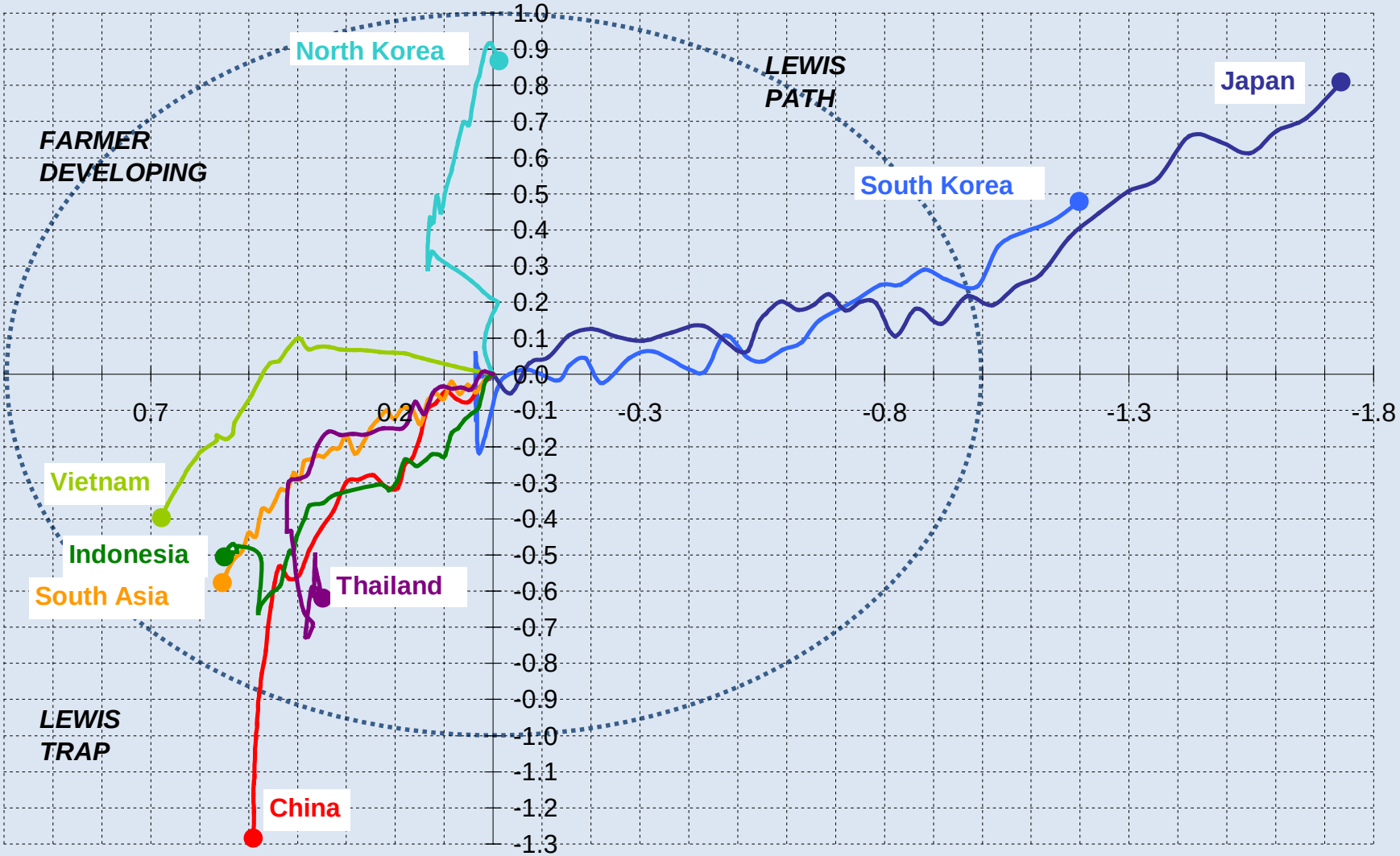
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0 -0.1 -0.2 -0.3 -0.4 -0.5 -0.6 -0.7 -0.8 -0.9 -1.0

1.0 0.5 0.0 -0.5 -1.0

Dynamics of ASIAN countries/regions

1970 ➔ ○2007

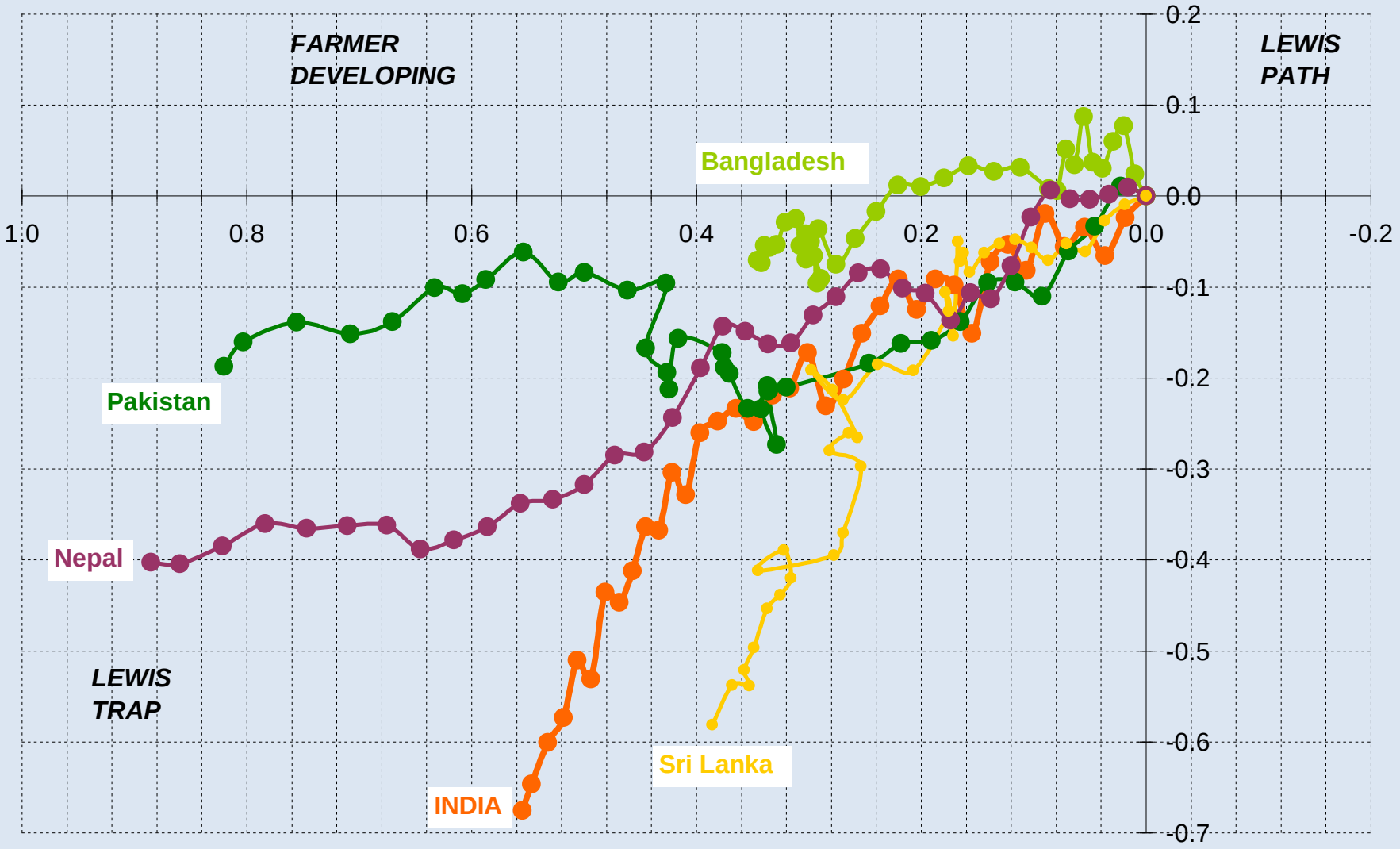
(cumulated annual growth rates)



Dynamics of SOUTH ASIAN countries

1970 ➔ 2007

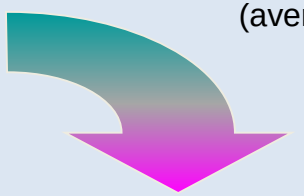
(cumulated annual growth rates)



Conclusion 1

55% of the 2007 world population (29 nations of 1970)
have embarked upon a Lewis Trap since 1970
16% upon a Farmer-Developing path (49 nations)
29% upon a Lewis Path (46 nations)

Farmer-Developing	Lewis Path
Lewis Trap	Farmer-Excluding

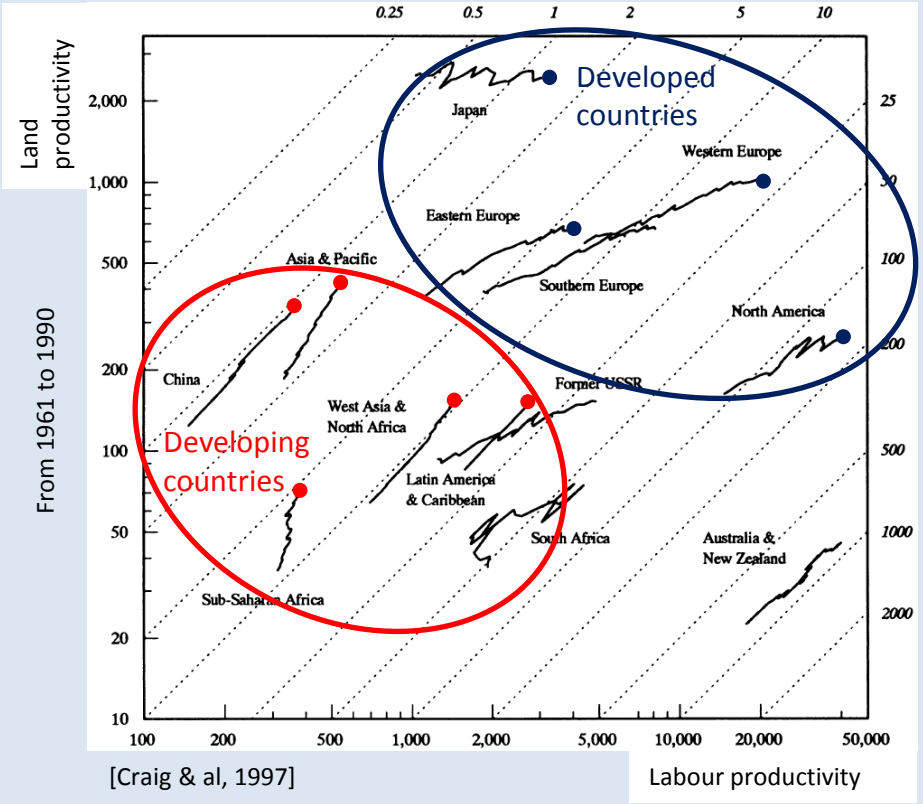


1970 → 2007
(average annual growth rates)

	Population (heads)	Workforce (workers)		Economic growth (1990-US$)		Labour productivity (1990-US$)		Income convergence
	Total	Total	Agriculture	Total	Agriculture	Total	Agriculture	*S1 / S2*
OECD	0.69%	1.11%	–2.93%	2.81%	1.40%	1.68%	4.46%	2.75%
- Am&Oc	1.08%	1.62%	-0.89%	2.91%	2.76%	1.27%	3.69%	2.40%
- Eurasia	0.47%	0.82%	-3.42%	2.74%	0.79%	1.90%	4.36%	2.42%
TRAN	0.38%	0.38%	–1.96%	1.91%	1.07%	1.50%	3.07%	1.67%
LAC	1.89%	2.92%	0.30%	3.50%	3.03%	0.56%	2.73%	2.21%
MENA	2.44%	3.00%	0.67%	4.10%	3.07%	1.08%	2.40%	1.36%
SSA	2.75%	2.80%	2.05%	3.28%	3.09%	0.46%	1.01%	0.55%
ASIA	1.75%	2.14%	1.40%	6.76%	3.69%	4.53%	2.27%	–2.16%
- South	2.13%	2.28%	1.49%	5.17%	2.76%	2.82%	1.25%	–1.56%
- East	1.49%	2.07%	1.35%	7.61%	4.38%	5.44%	3.00%	–2.31%
World	1.61%	1.95%	1.18%	3.10%	2.25%	1.13%	1.06%	–0.07%

❷ A matter of low yield & barriers to modern technology?

■ Usual representation



[Craig & al, 1997]

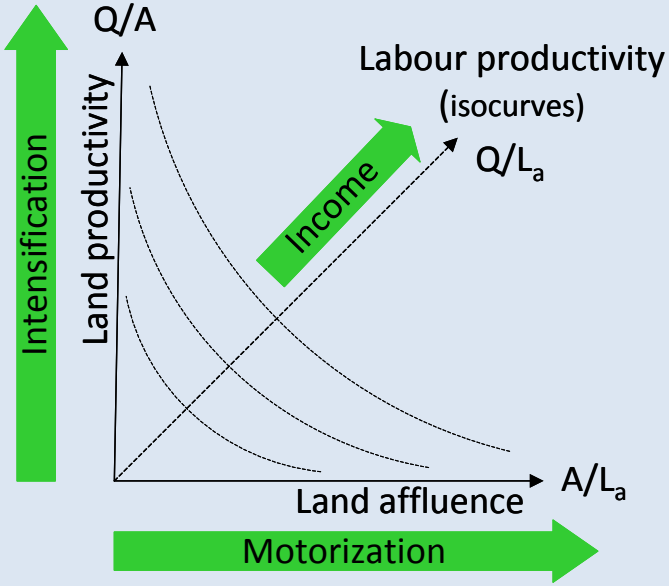
■ Our representation

① A "TALA" identity

$$Q/A \bullet A/L_a = Q/L_a$$

Technology (Land productivity) **A**ffluence of land (Land/Worker) **La**bour productivity

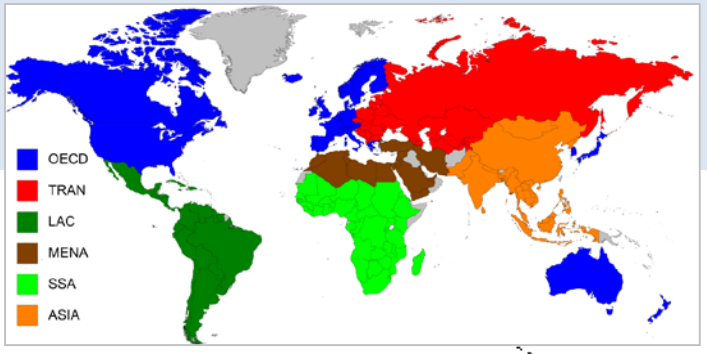
② The corresponding figure



③ With new estimates for *Q* :

- all plant food (cereals, pulses, F&V, etc.)
- produced during a year (1,2,3… crops)
- converted & aggregated into kcal

A silent bifurcation (1961-2007)



Yield (kcal.ha^{-1}.day^{-1} of plant food)

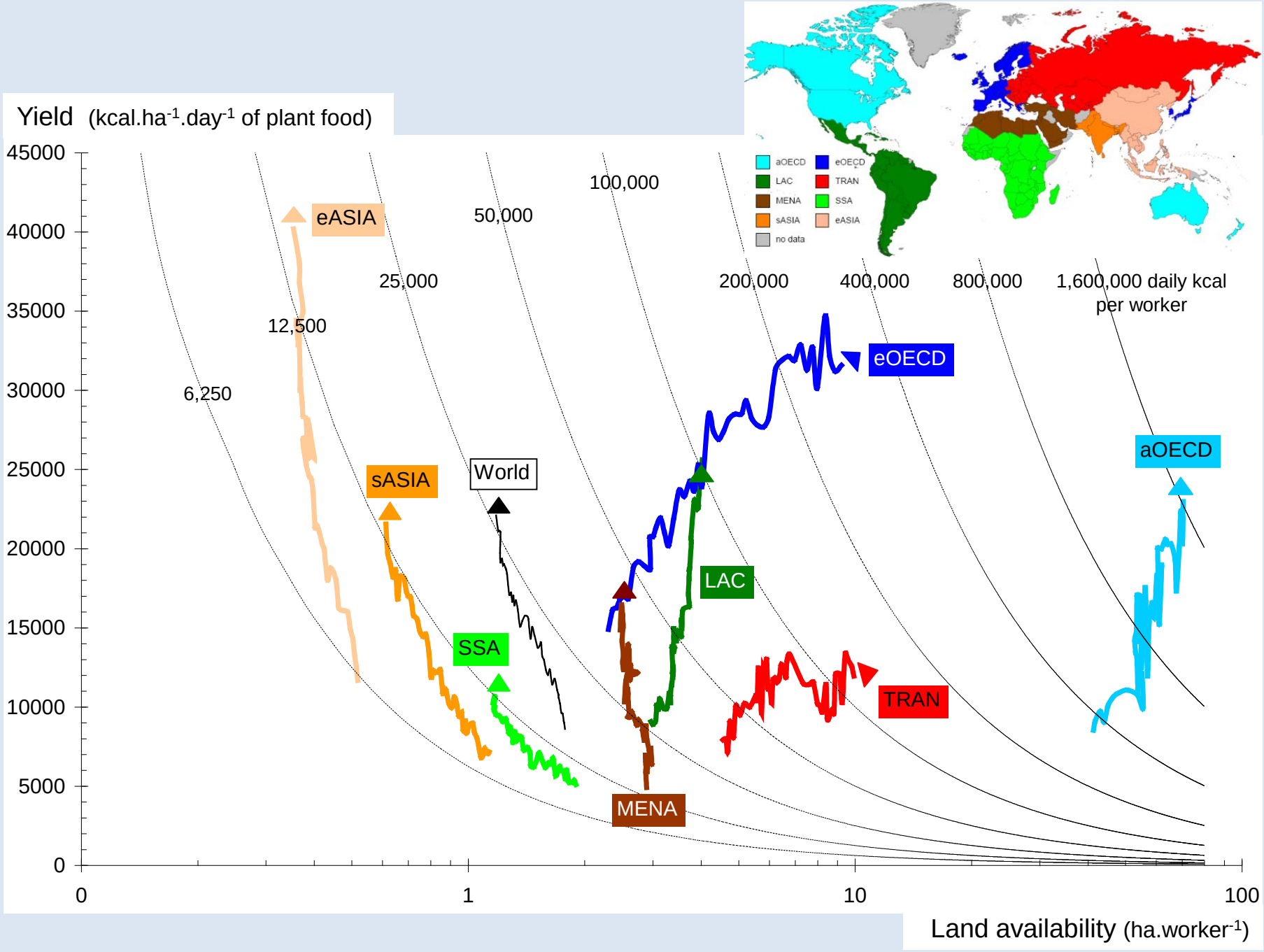
35000
30000
25000
20000
15000
10000
5000
0

ASIA
LAC
World
MENA
SSA
TRAN
OECD

800,000 daily kcal per worker
400,000 daily kcal per worker
200,000 daily kcal per worker
100,000 daily kcal per worker
50,000 daily kcal per worker
25,000
12,500
6,250

0
5
10
15
20
25
30

Land availability (ha.worker^{-1})

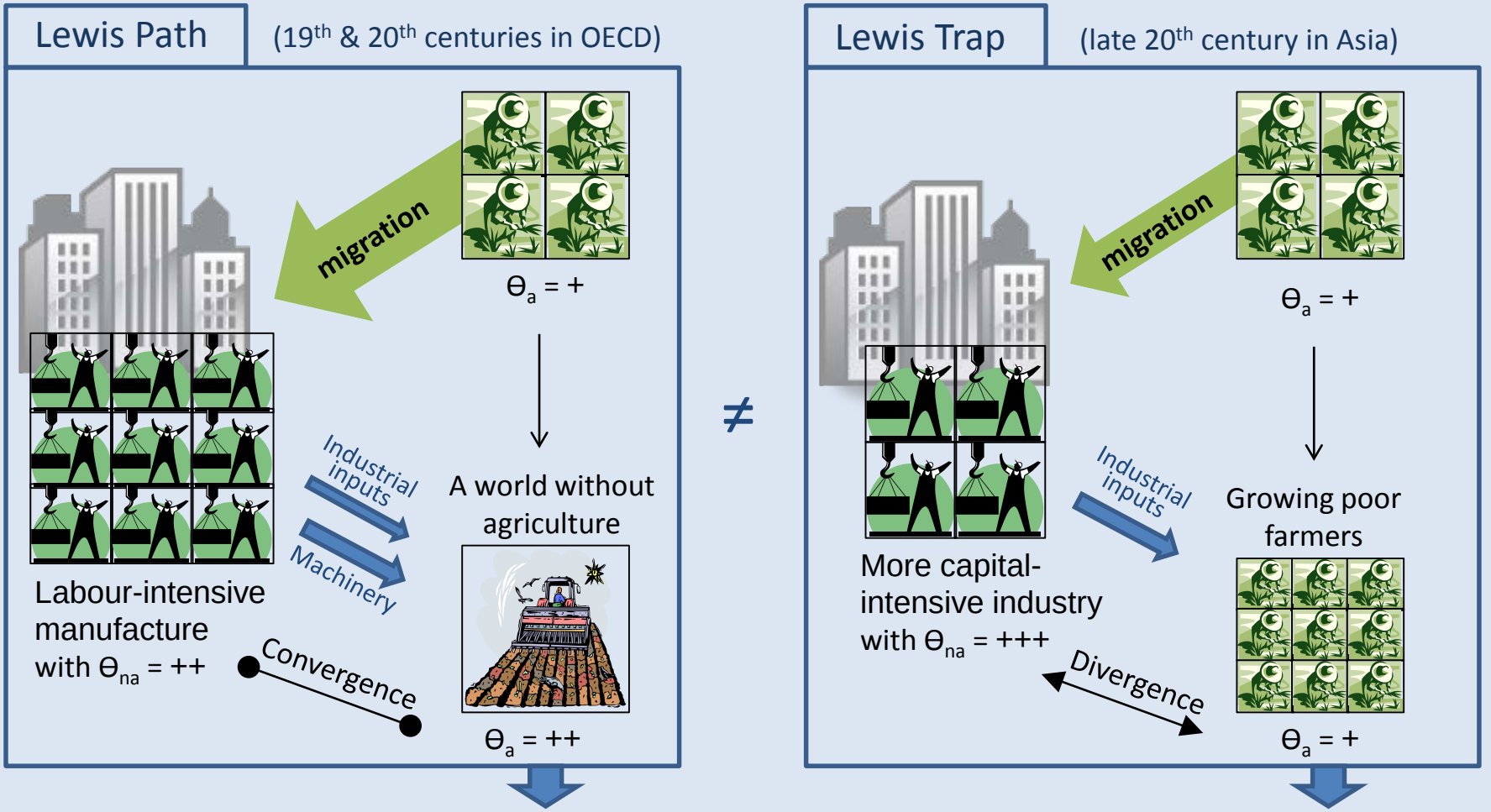

Yield (kcal.ha-1.day-1 of plant food)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
1
10
100
Land availability (ha.worker-1)
6,250
12,500
25,000
50,000
100,000
200,000
400,000
800,000
1,600,000 daily kcal per worker
eASIA
sASIA
World
SSA
MENA
LAC
eOECD
TRAN
aOECD
aOECD
eOECD
LAC
MENA
sASIA
no data
SSA
TRAN
eASIA

Conclusion 2

Historical evidences

Higher land acreage per farmer was the main driver for boosting:
- agricultural labour productivity
- convergence of incomes across sectors

Basic mechanism

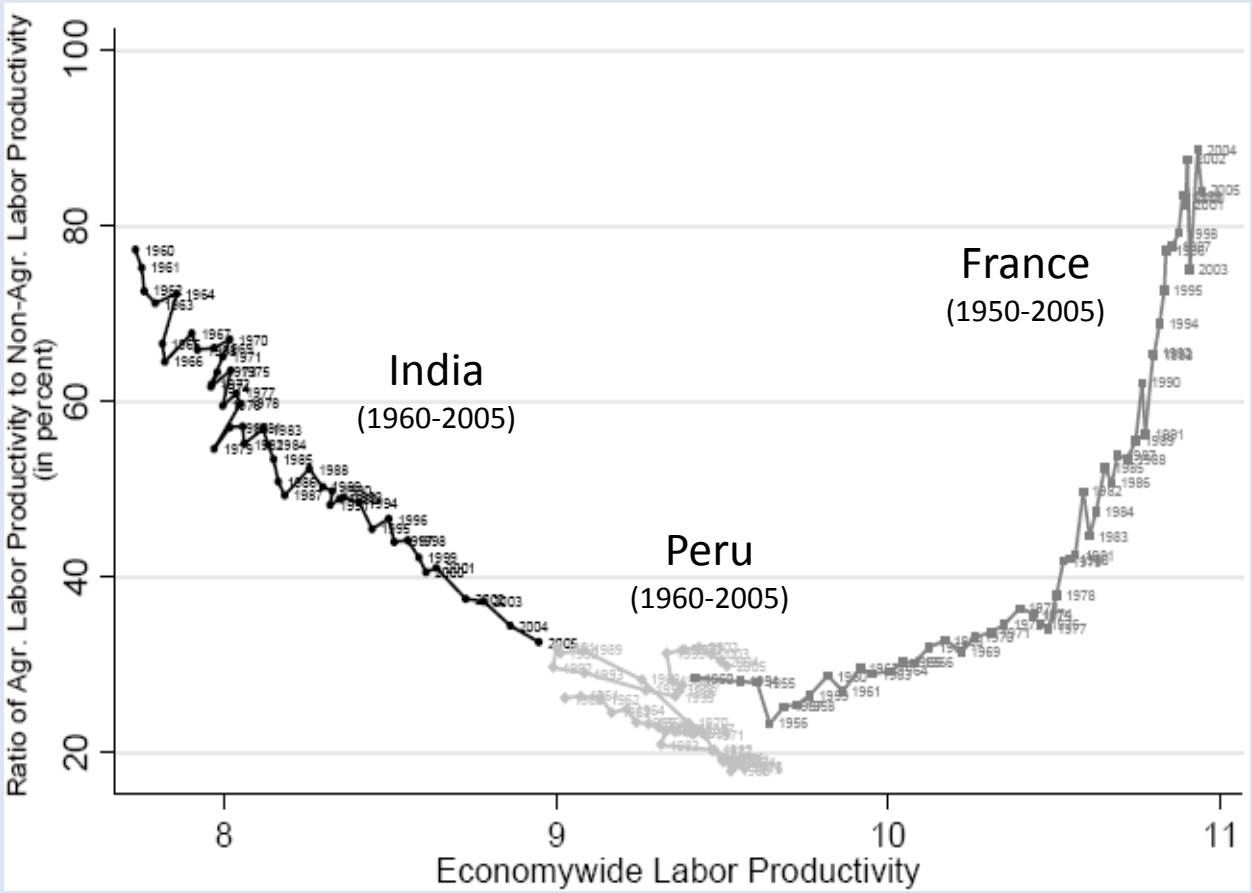


Few monocultures & few agro-industries
Low resilience to economic & climatic shocks

Quicker depletion of natural resources (soil, water…)
Risk of severe social and political crises

❸ A long historical process with widening gap in early stages?

- Nothing wrong, let us wait?

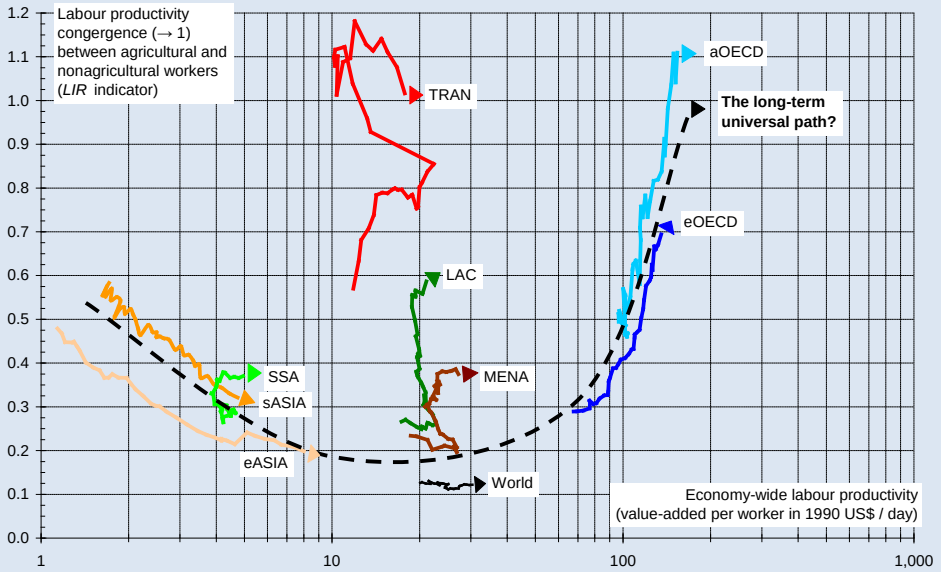


Structural transformation is a long historical process characterized in the early stages by a widening gap between farm and non-farm labour productivity (?)

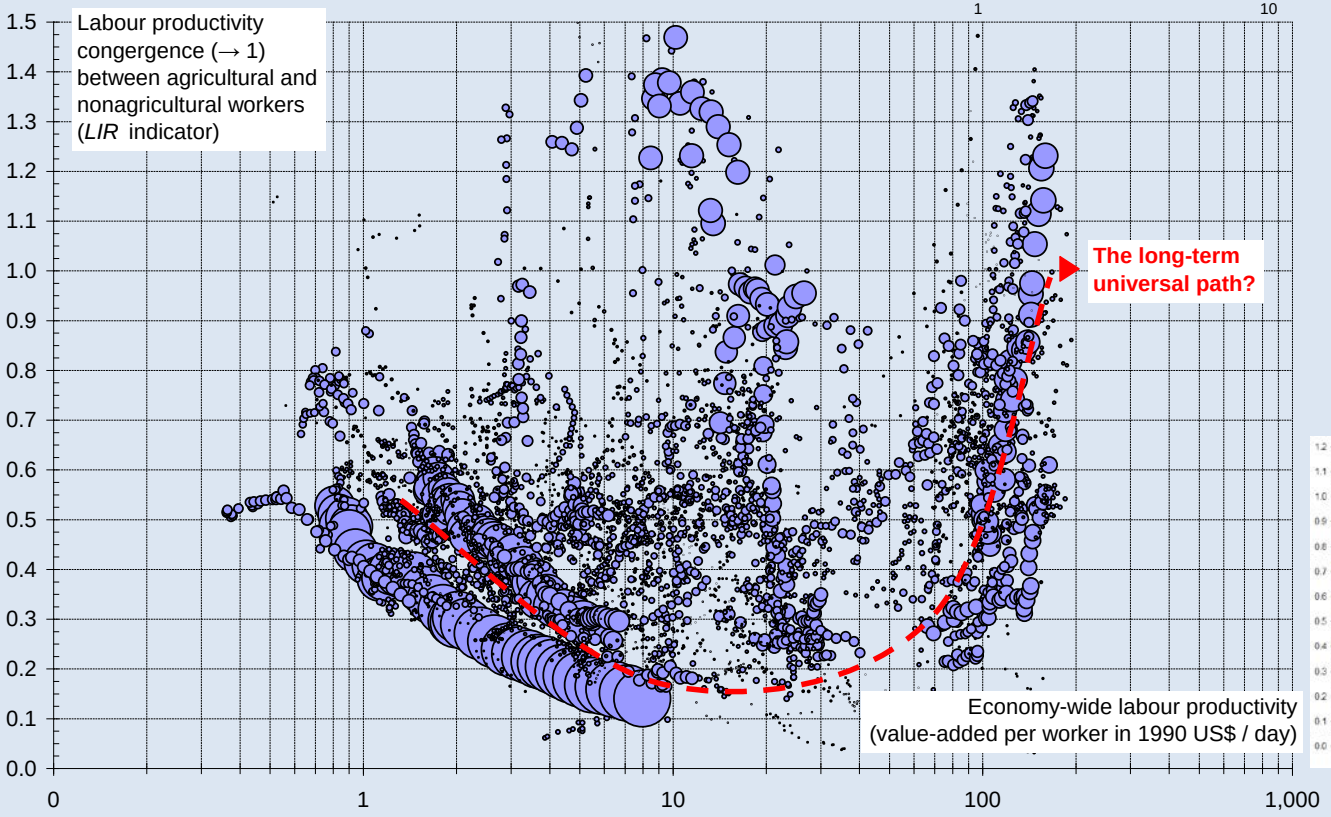
[McMillan & Rodrik, 2012, pp. 9-10]

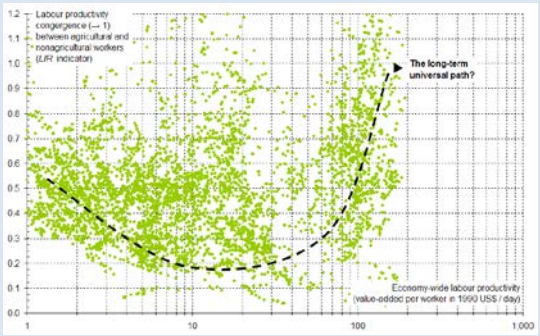
A long-term universal OECD path ???

All countries into eight regions (1970-2007)



All countries weighted by their active population (1970-2007)





A heuristic numerical experiment on India

	Past 1980 => 2007	Shukla & Dhar's scenario 2007 => 2050	"Lewis Path" scenario 2007 => 2050
Population	+1.94 % => 1165 M	**+0.76 % => 1615 M**	**+0.76 % => 1615 M**
Growth (GDP)	+6.1 %	**+7.3 %**	**+7.3 %**
- agriculture	+3.0%	**+2.6 %**	**+2.6 %**
- non-agriculture	+7.2%	**+7.7 %**	**+7.7 %**
Labour productivity	+3.9 %	**+6.2 %**	**+6.2 %**
- agriculture	+1.6 %	**+3.0 %**	**+9.3 %**
- non-agriculture	+3.7%	**+5.4 %**	**+4.6 %**
Workforce	+2.2 % ⇨ 463 M	**+1.1 % ⇨ 735 M**	**+1.1 % ⇨ 735 M**
- agriculture	+1.4 % ⇨ 259 M (56%)	–0.4 % ⇨ 217 M (30%)	–6.2 % ⇨ 17 M (2%)
- non-agriculture	+3.4 % ⇨ 204 M (32%)	+2.2 % ⇨ 518 M (70%)	+3.0 % ⇨ 718 M (98%)
Income gap Agri/Non-Agri	1 / 6	1 / 17	1 / 1

Workforce in agriculture (change over the period)	+ 82 M workers (+146 M people)	– 41 M workers (– 156 M people)	– 242 M workers (– 547 M people)
Land availability (end year)	0.66 ha/worker	0.78 ha/worker	Max 10 ha/worker

Conclusion 3

Unless labour is as free to move worldwide as capital today,
a country like India can hardly follow the Lewis Path of OECD countries

(1) Industry is less able to absorb labour than at the time of "manufacture"

- Labour productivity ↗ (economy of scale, motorization/automation)
- Sector growth slows down (increasing cost of oil and other non-renewable raw materials, strengthening of environment-friendly regulations, market saturation in industrialized countries, slower increase of wages in developed economies not compensated by an increase elsewhere…)

(2) It would require a mega-urbanization ever faced in history

- No more "open spaces" for exporting labour surpluses
  (60 million Europeans emigrate to the "New Worlds" between 1850 and 1930)
- Lewis Path scenario for India (2050): 80% of the population (1.3 billion people out of 1.6) lives in cities whose density reaches 55,000 inhabitants per km^2
  (35,000 in Dhaka and 27,100 in Mumbai in 2010, the two current densest cities in the world)

(3) Farm labour productivity cannot be boosted as in OECD countries

Limited prospects of:

- Large-scale moto-mechanization: max 10 ha/farmer in 2050 (150 in CA, 63 in US, 30 in FR... in 2007)
- Higher yield with modern industrial inputs (fertilizer, pesticide, oil…):
  ever-increasing costs + decreasing marginal productivity + negative externalities
  (on natural resource, climate, animal and human health…)
- International market: trade barriers + market powers
  (from large-scale and well-organized agro-industries that emerged during the past century)

Concluding discussion

Towards a paradigm shift ?

- The equation at stake
- A 2050 vision

Increasing farmers' income & production

…without sending most of them to shantytowns

$$\theta_a = (pQ - Y_{na}^a) / L_a$$

Prices

Costs of non-agricultural inputs

Science & farmers managing
a mosaic of agro-ecosystems
boosting local synergies
amongst many plant and animal species
above & below the ground surface.

The "agro-ecological perspective" [Altieri, 1999] ?
or "matrix" [Perfecto & Vandermeer, 2010] ?
The "Ecological intensification" (www.cirad.fr) ?
The "Reverse innovation" [Vijay Govindarajan] ?
The "Nano eco-friendly capitalism" ?
The "Agricultural eco-friendly Jugaad" ?
…/…

R&D agendas ?

1. Higher biodiversity & biological synergies
   ↗ production ***Q*** (total useful biomass)
   ↗ resilience to economic & climatic shocks
2. Saving of inputs ***Y***
   ↘ production costs (higher incomes)
   ↘ environmental costs
3. Higher prices ***p***
   ↗ quality (tasty/nutritious food)
   ↗ co-products (wood, fuel, fibre, drugs…tourism)
   ↗ ecosystem services (local & global)
4. Higher labour intensity L_a:
   - for knowledge-intensive & context-specific work
   - small family farms usually more productive & profitable per hectare [Sen 1964; Wiggins et al. 2010]

Two pending questions…

❶ How our societies and their institutions get organized to promote and remunerate properly collective and public goods provided by agriculture?

❷ How this new agriculture and rural organization can emerge and coexist with large-size agro-industries that now feed a growing portion of humankind?

Thanks for your attention

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• …/…

Bullet points

1. The Lewisian pattern of growth is bound to land availability (besides technological and non-agricultural dynamics)
2. Only OECD and transition countries have embarked upon the final stage of “modern economic growth” (Lewis Path)
3. Agricultural labour force increased elsewhere (1961-2007) and farm plots shrank
4. Labour income gap of Asian farmers widened despite best growth and ranking in yield
5. Small-scale agro-ecological farms might be an alternative to mega-slum-urbanization