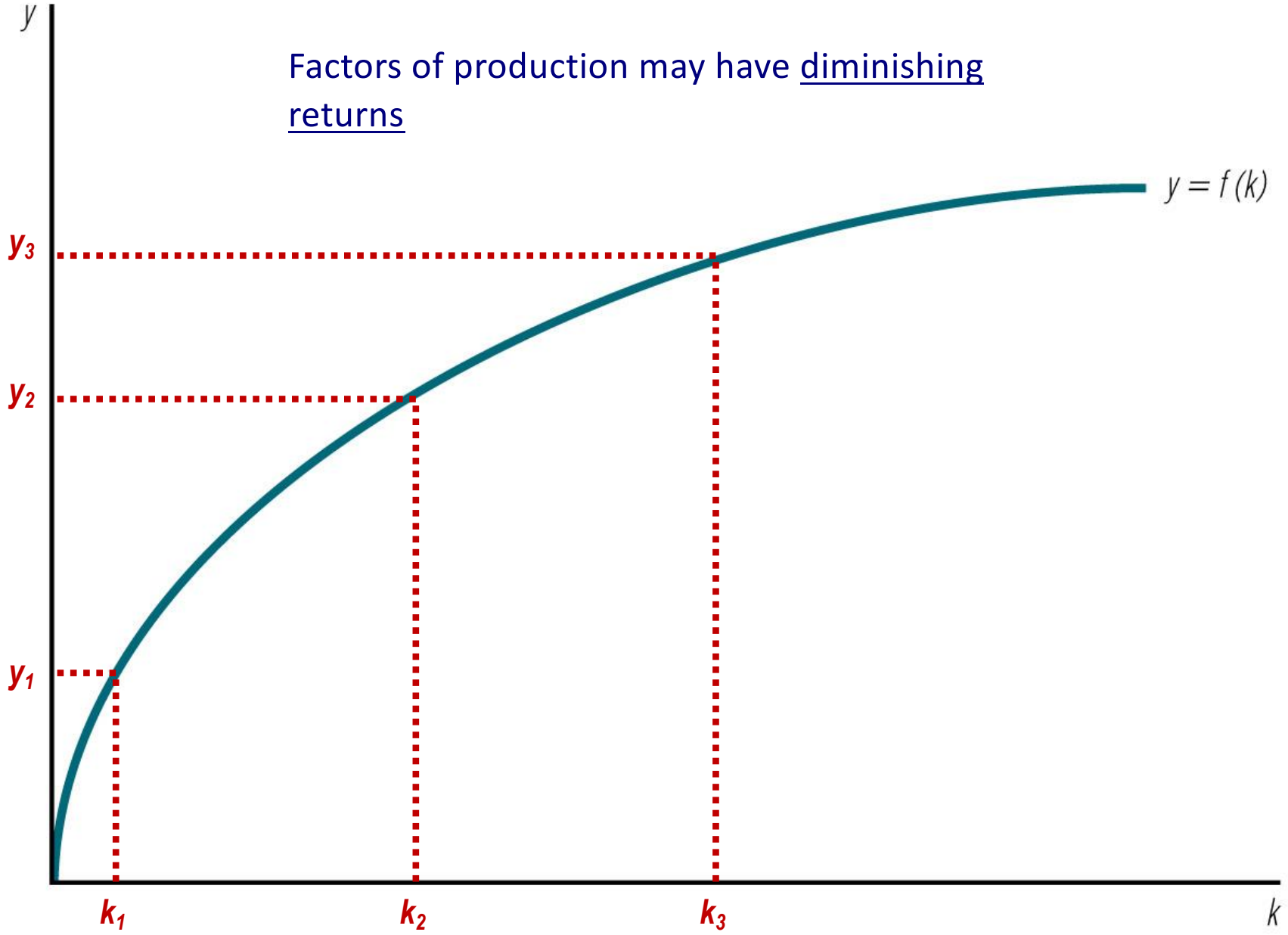
Theories of International Development

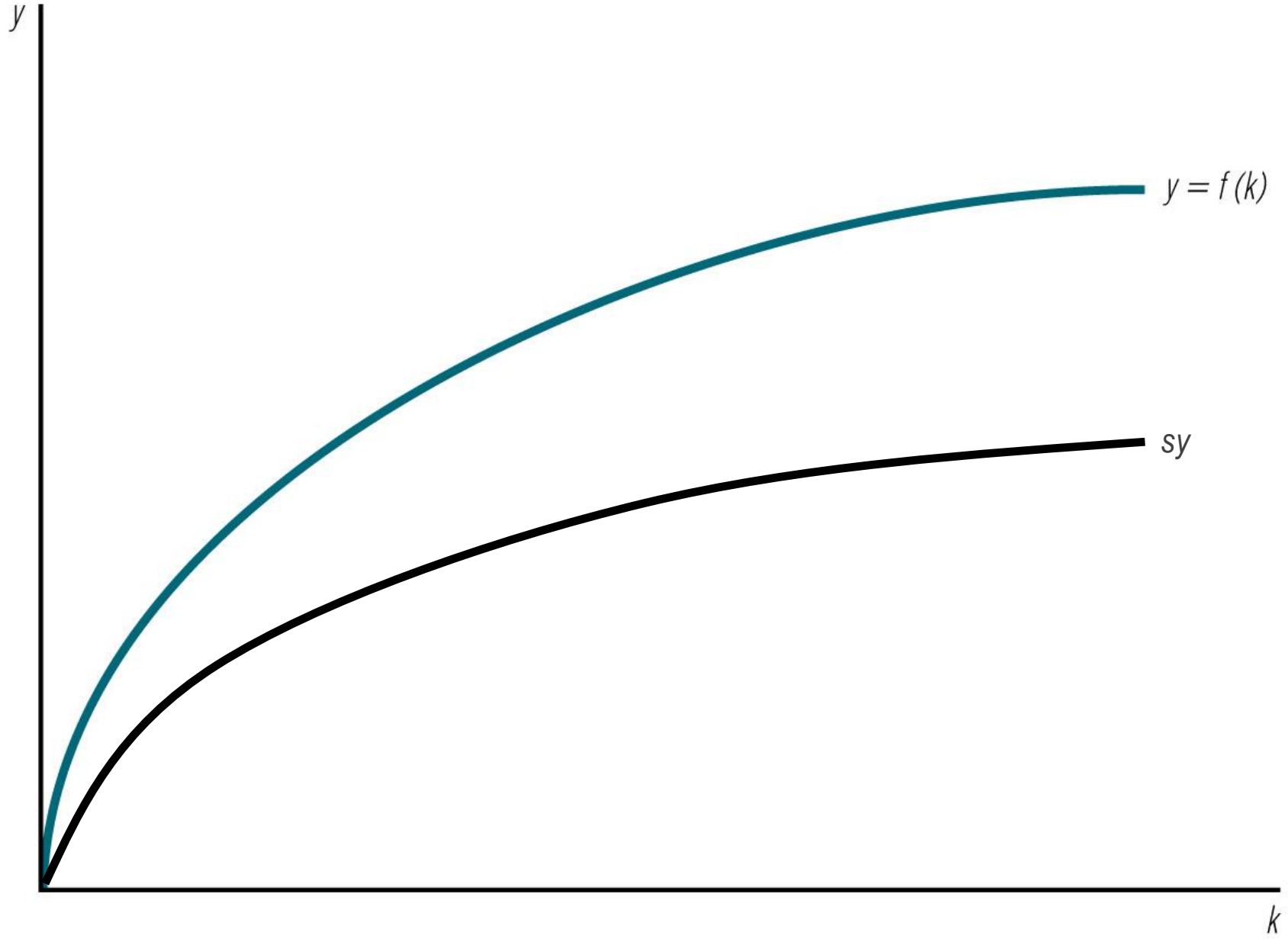
Recall from Lecture 1: Solow growth model

Factors of production may have diminishing returns

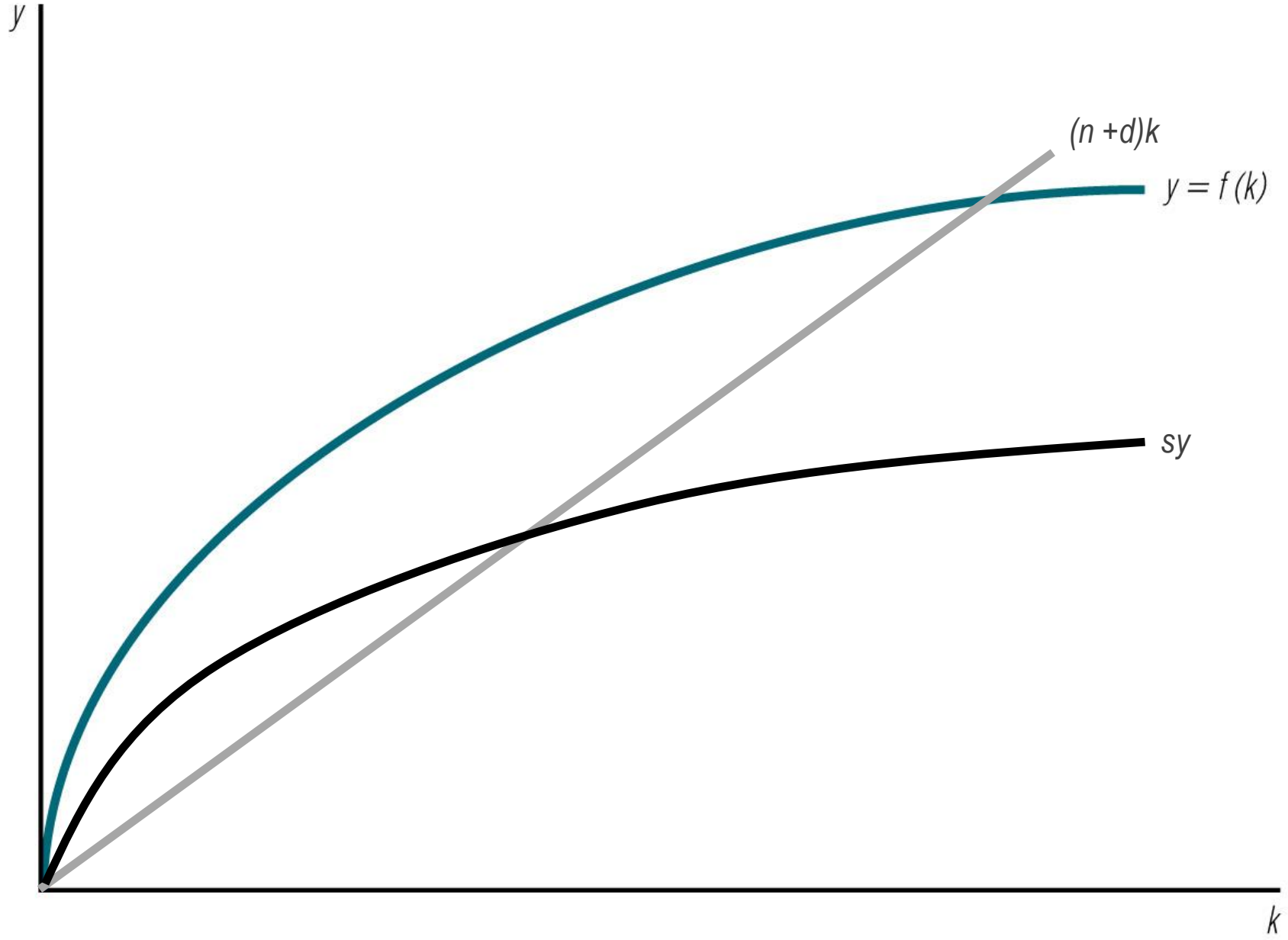


How do we find a country's equilibrium income pc?

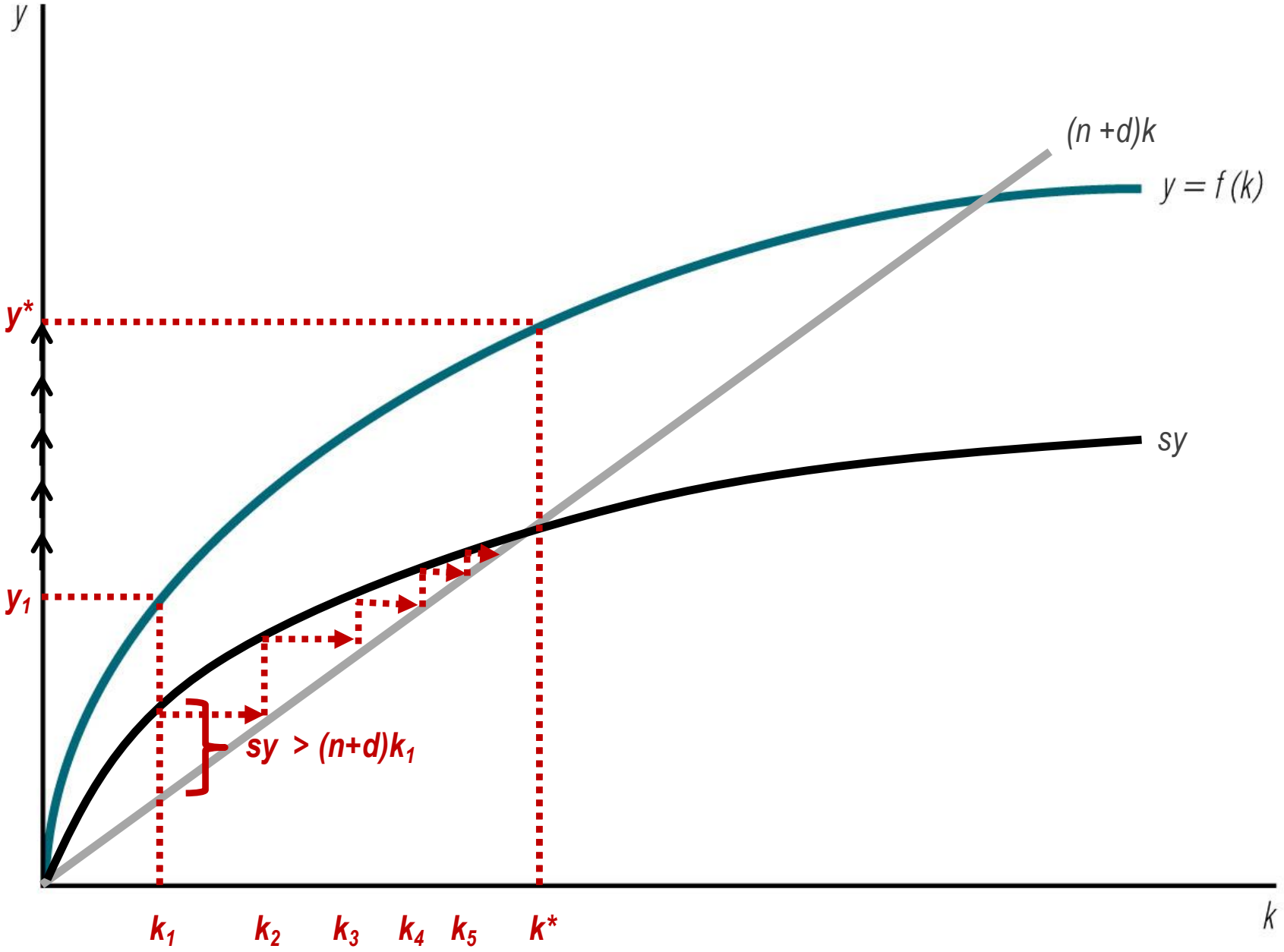
First, note that a country saves a fraction *s* of its income each year



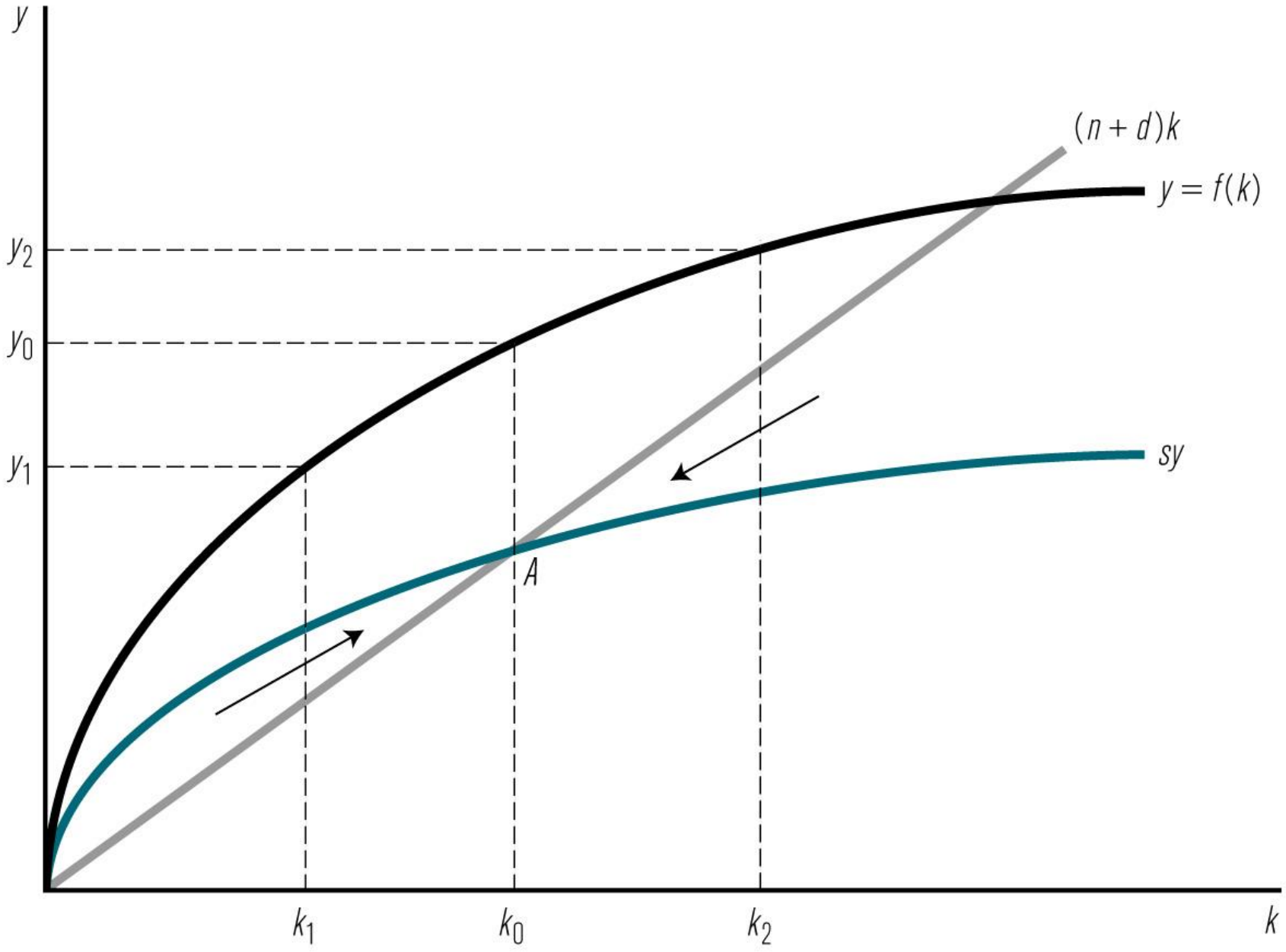
The replacement rate: each year a proportion of capital depreciates, *d*, or goes to equip the new population, *n*



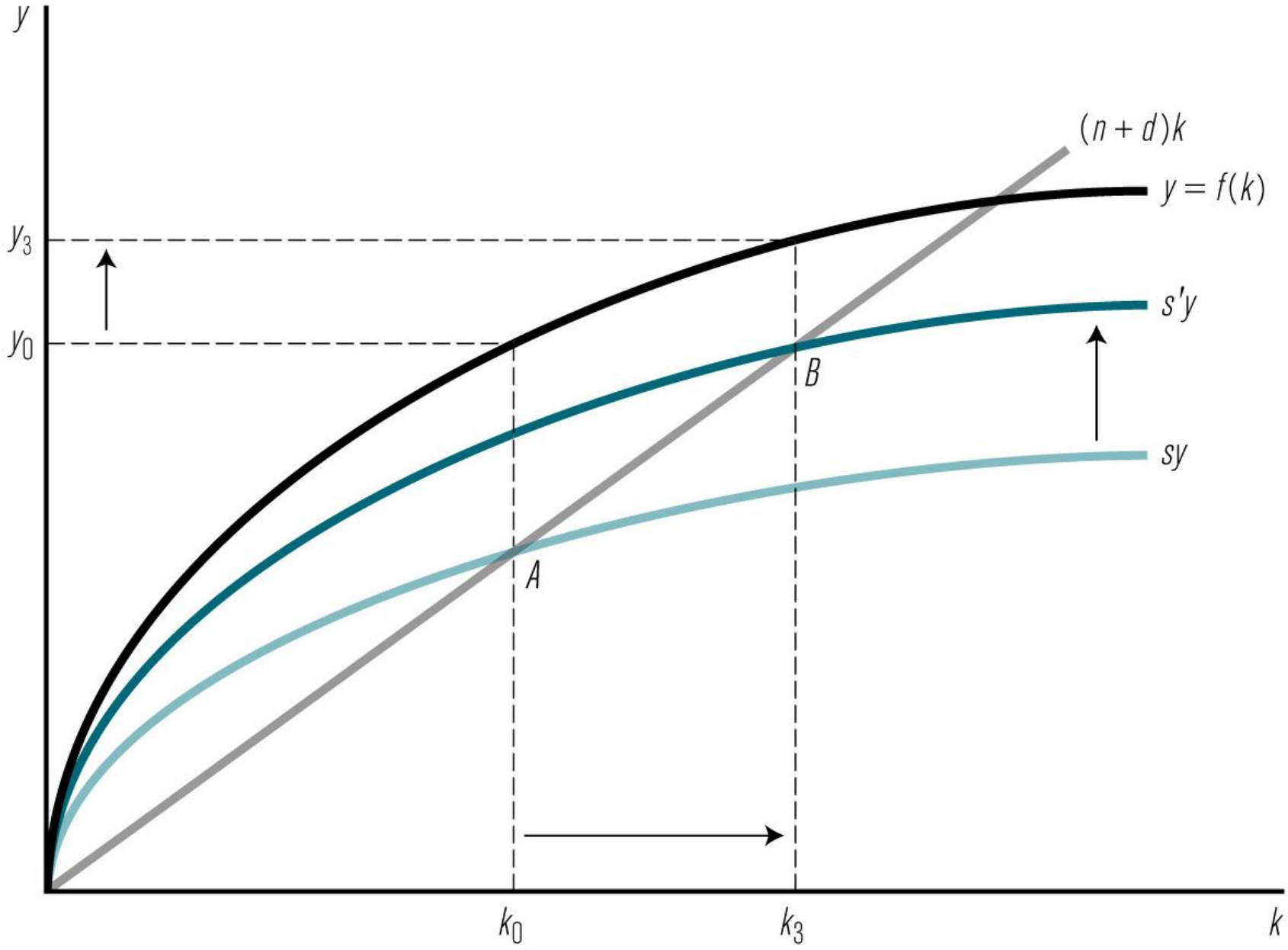
What if a country starts out with low capital per person?



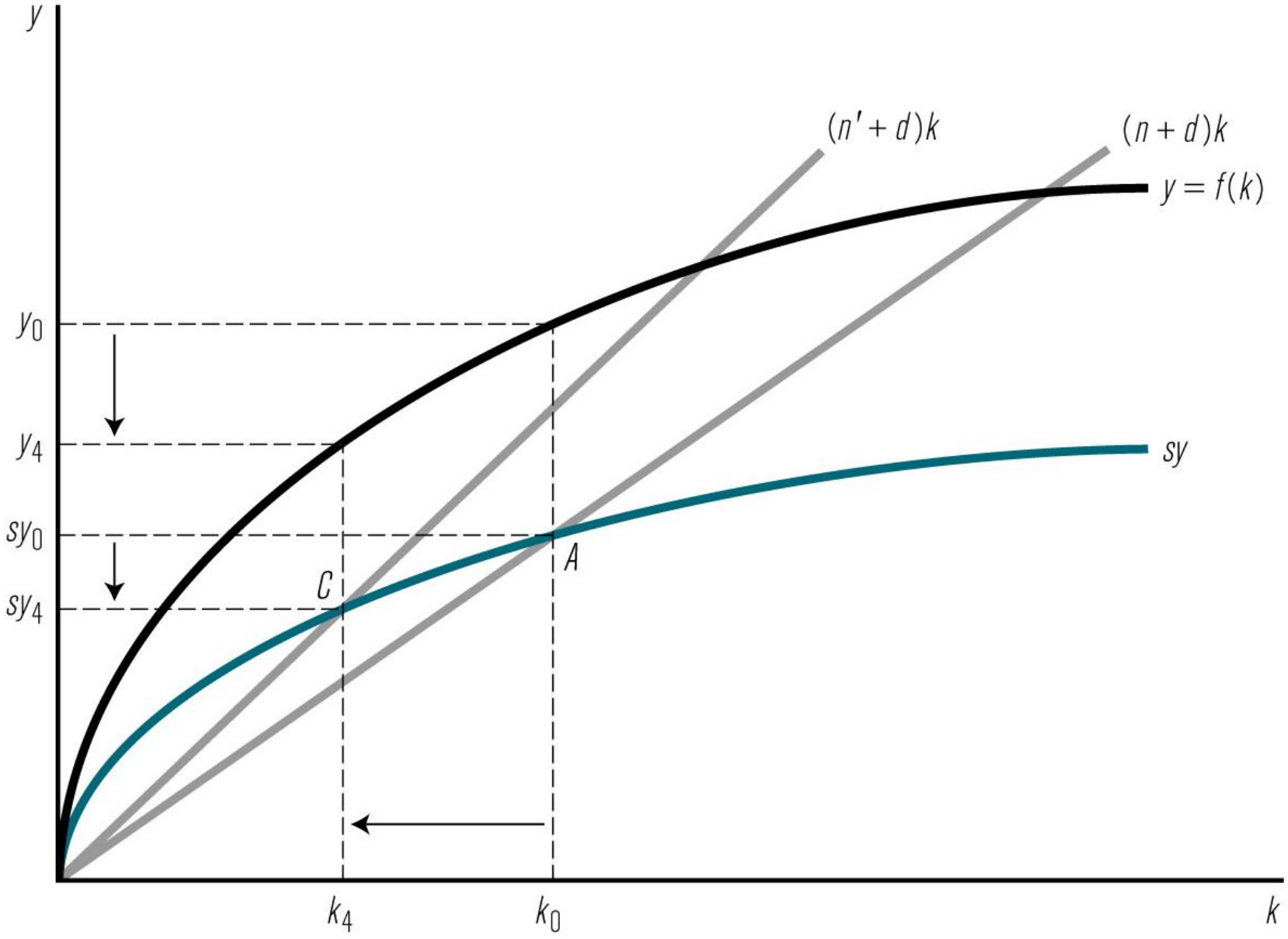
No matter what level of capital per person, income always converges to the equilibrium determined by *s*, *n*, and *d*.



Increase saving, and you increase the level of income per person



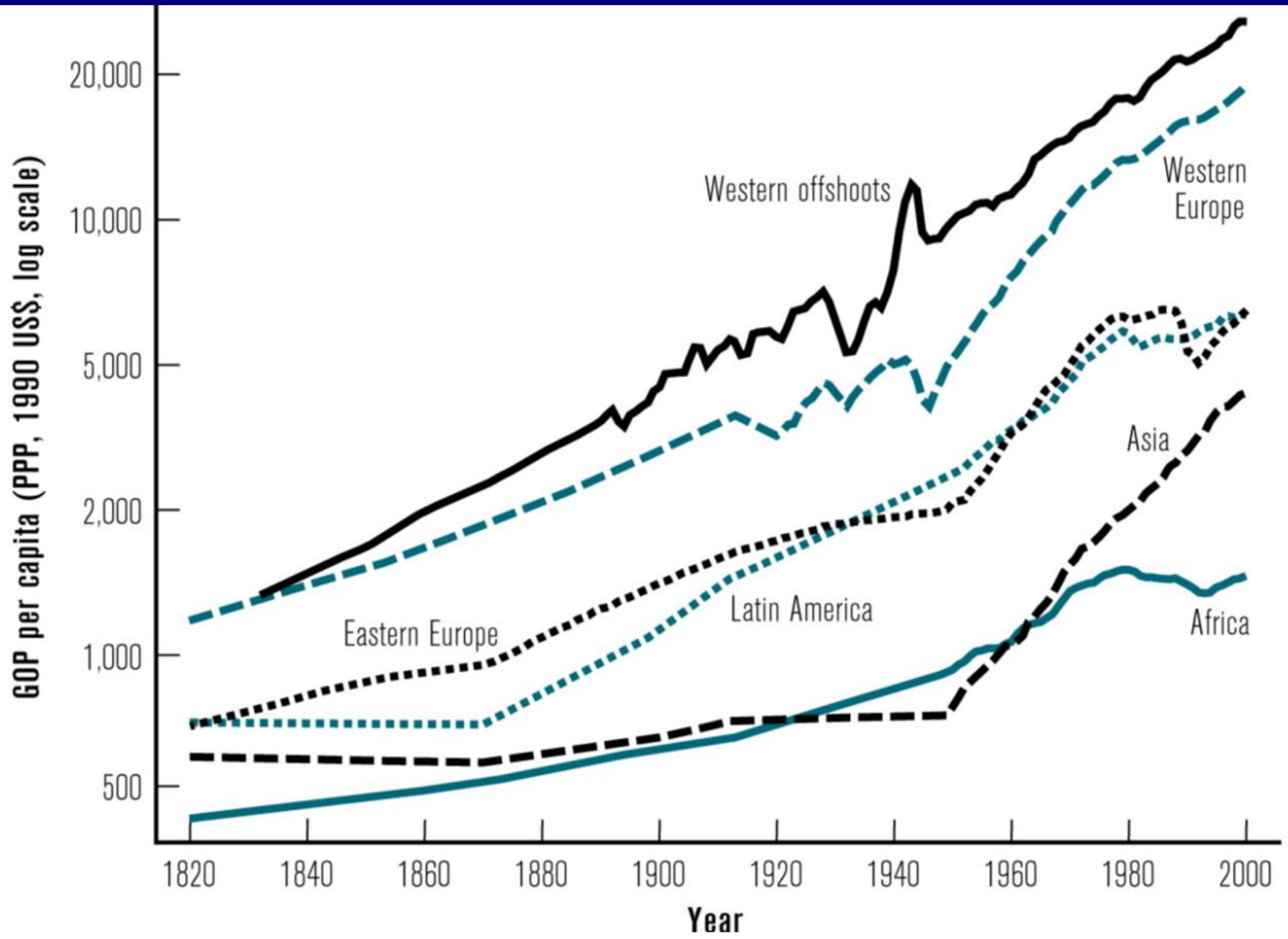
Increase population growth or depreciation, and you decrease the level of income per person



Implications

- A steady-state level of GDP pc to which all countries converge.
- It just takes time…
- To speed it up:
  - K (= aid).
  - Also raise s, lower n.
  - Also technology.

Problem: many poor countries are not converging



What could explain divergence?

1. Poor countries have lower steady states
2. → Something is missing from the Solow model
3. We need a completely different model

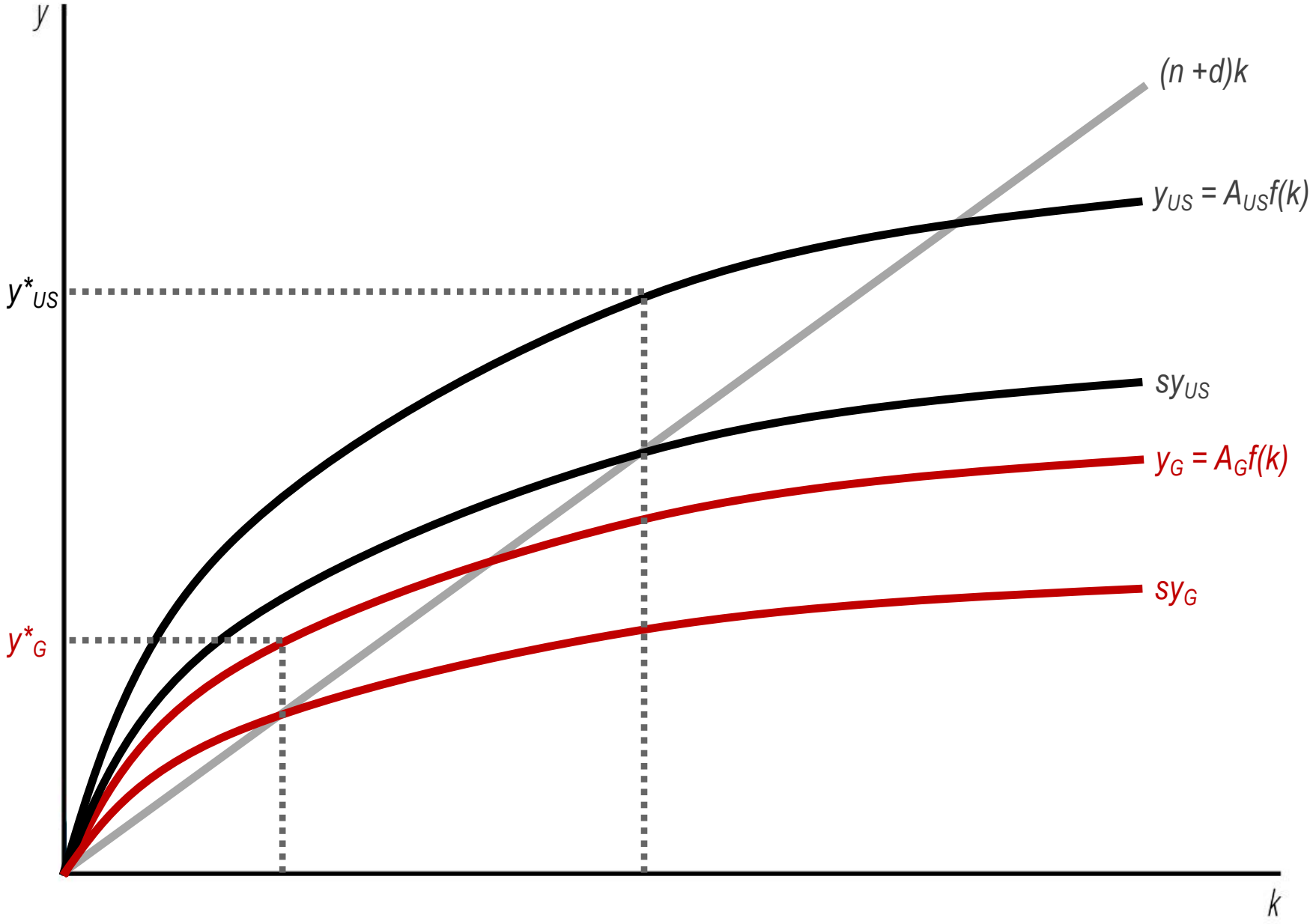
Missing from the model:
Total factor productivity (TFP)

- "Technology" is shorthand for things that affect productivity
  - New products and techniques
  - Systems of organization and management
  - Rules, norms, and laws
  - Culture and work ethic
- Often represented by parameter *A*

We will see:

- More technology → higher income levels
- More technological growth → higher income growth

What happens when we introduce technology (A)?



Productivity growth

Innovation

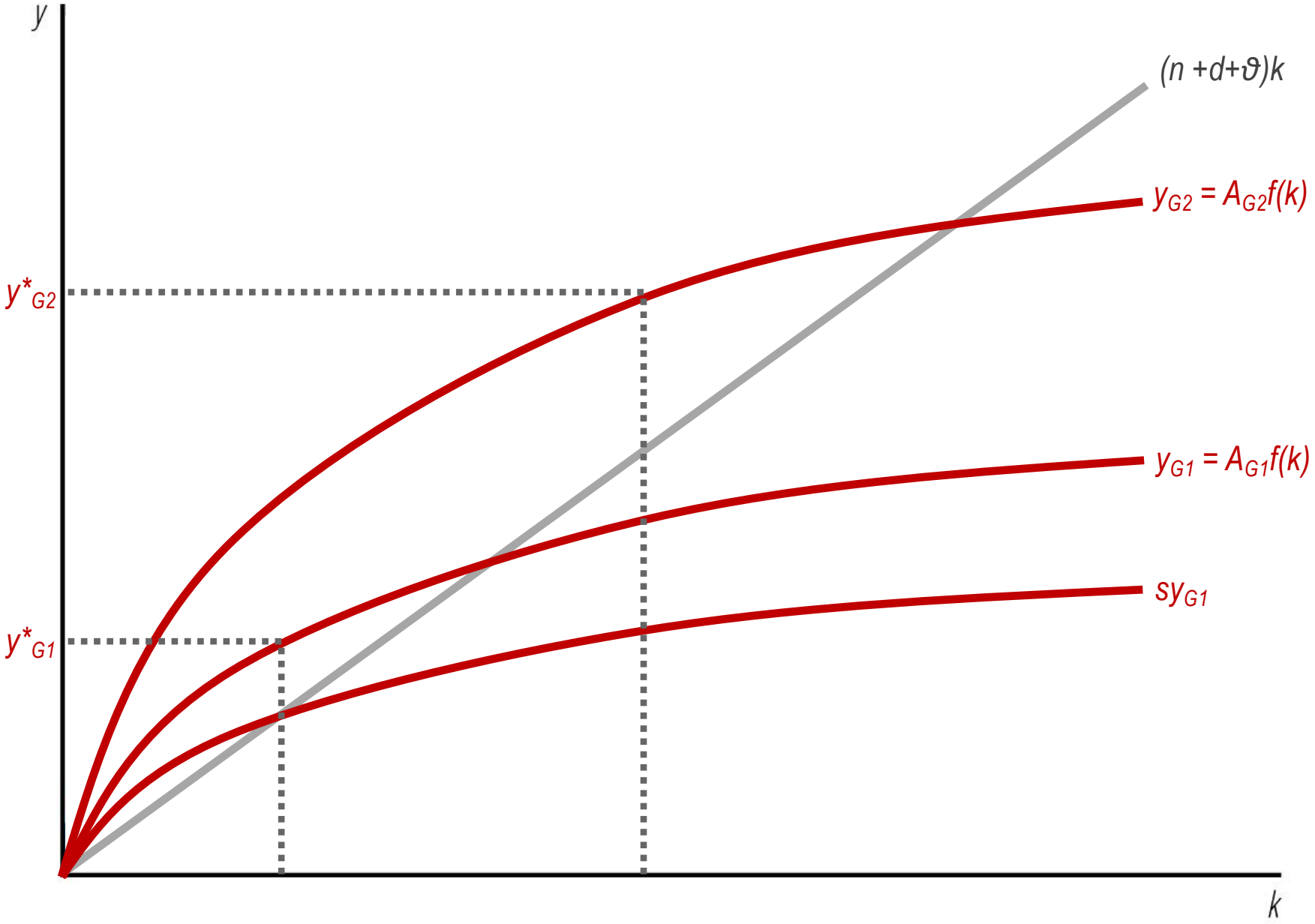
- New inventions
  - New products
  - New inputs
  - New production techniques
- New systems of organization
  - Scientific management
  - Quality control
  - Supply chain optimization
- New norms and laws
  - Limited liability corporations
  - Enforceable contracts
  - Intellectual property

Diffusion

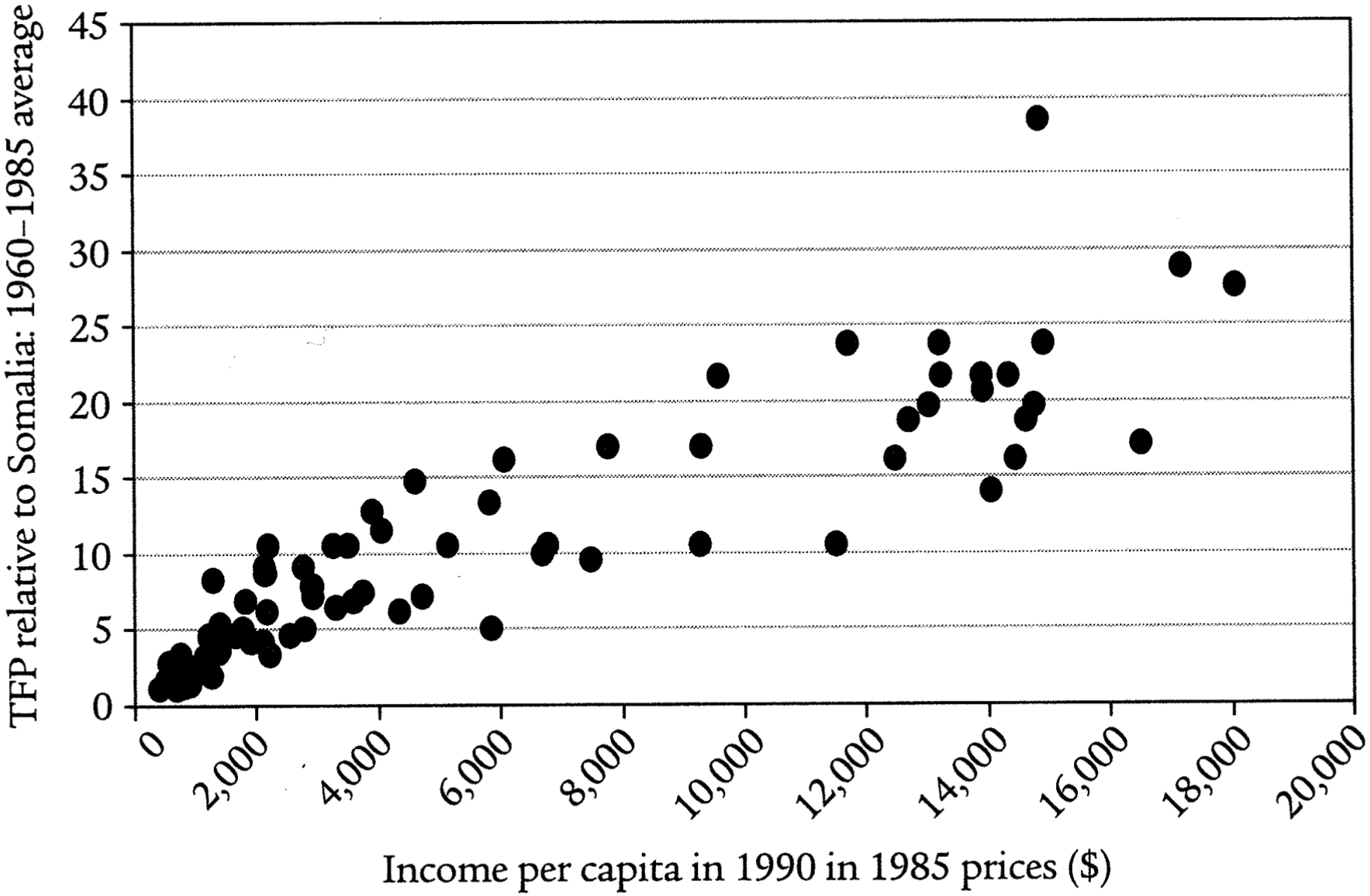
- Spread of inventions
- Adapt to local conditions

- Knowledge is a public good

What if technology and productivity grows at rate θ?



Average productivity (TFP) and income per capita



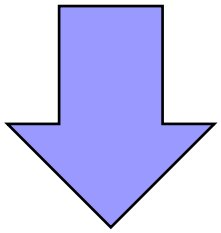
So if growth = "A", what drives the rate of innovation and productivity?

Many ideas and proposals

- Trade
- Communications
- Migration
- Property rights
- Political stability
- Political freedom
- Competition
- Creative destruction
- R&D investments
- Entrepreneurial spirit

Common thread:

- Factors that affect people's incentives and ability to invest in innovation



- Political stability
- "Institutions"
- Geography
- Policy environment

What could explain divergence in the Solow model?

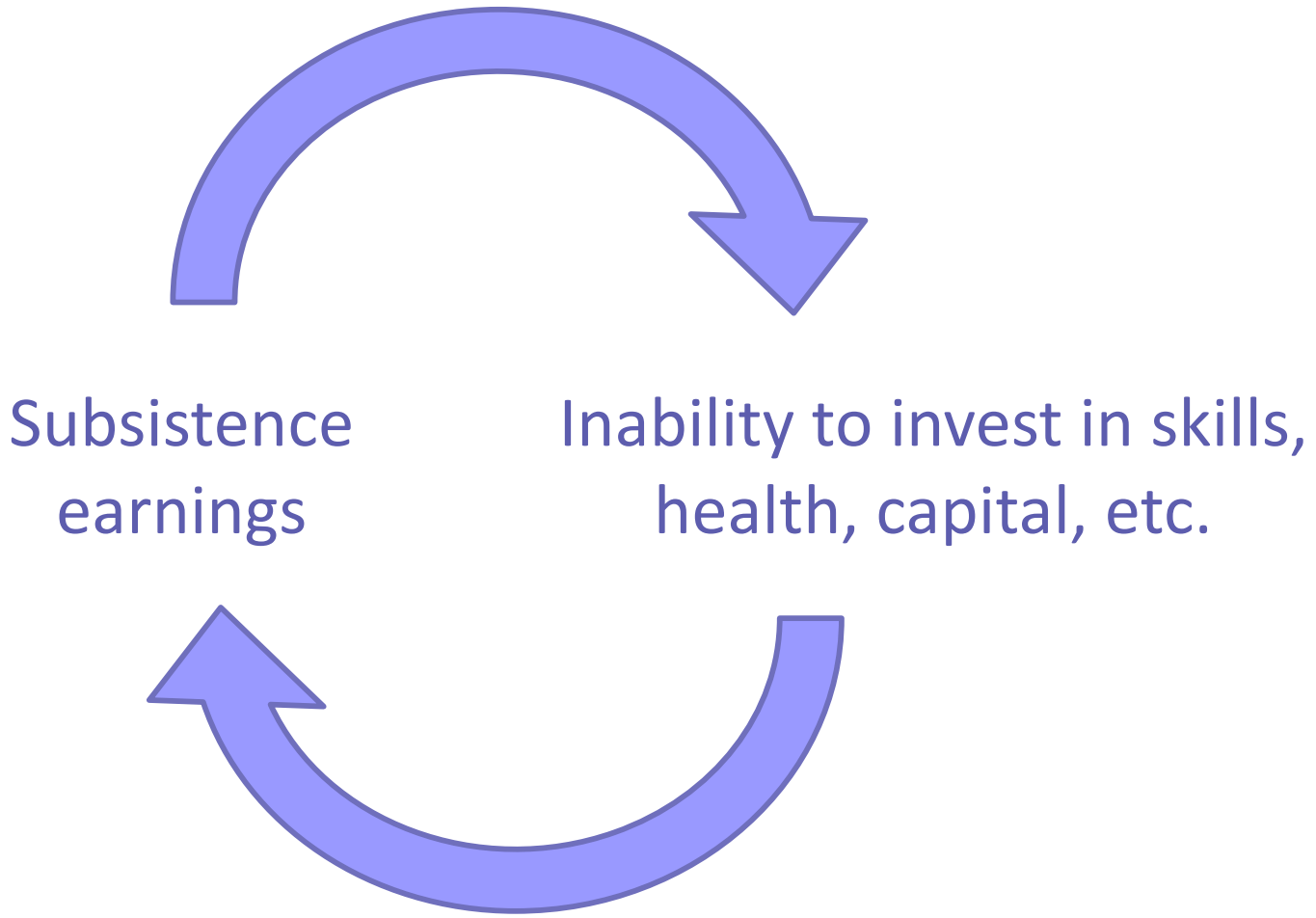
1. Poor countries have lower steady states
2. Something is missing from the Solow model (A)
3. → We need a completely different model

Another model…

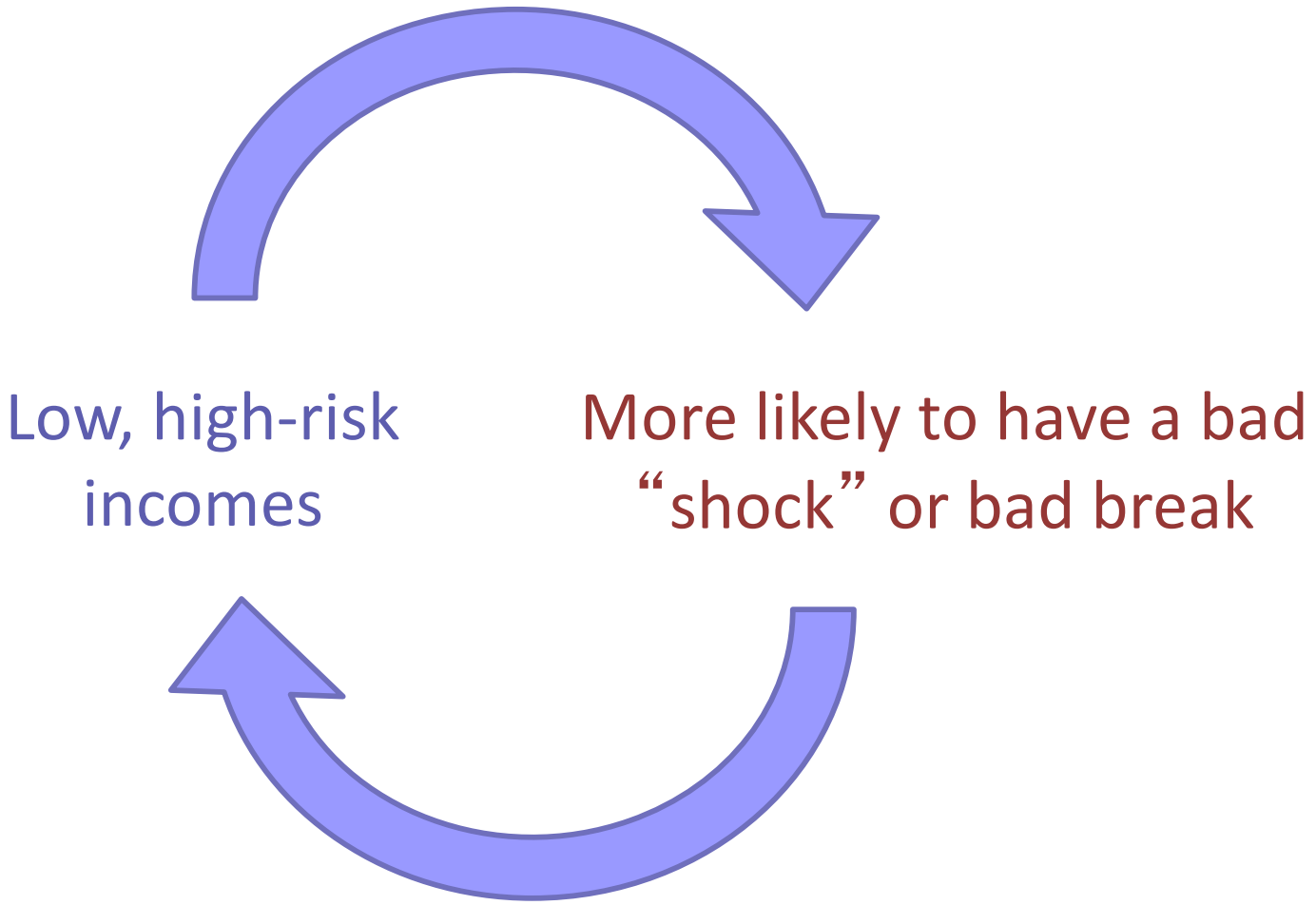
- So far we have modeled each nation as having a single equilibrium determined by the fundamentals

- Could there be multiple equilibria?

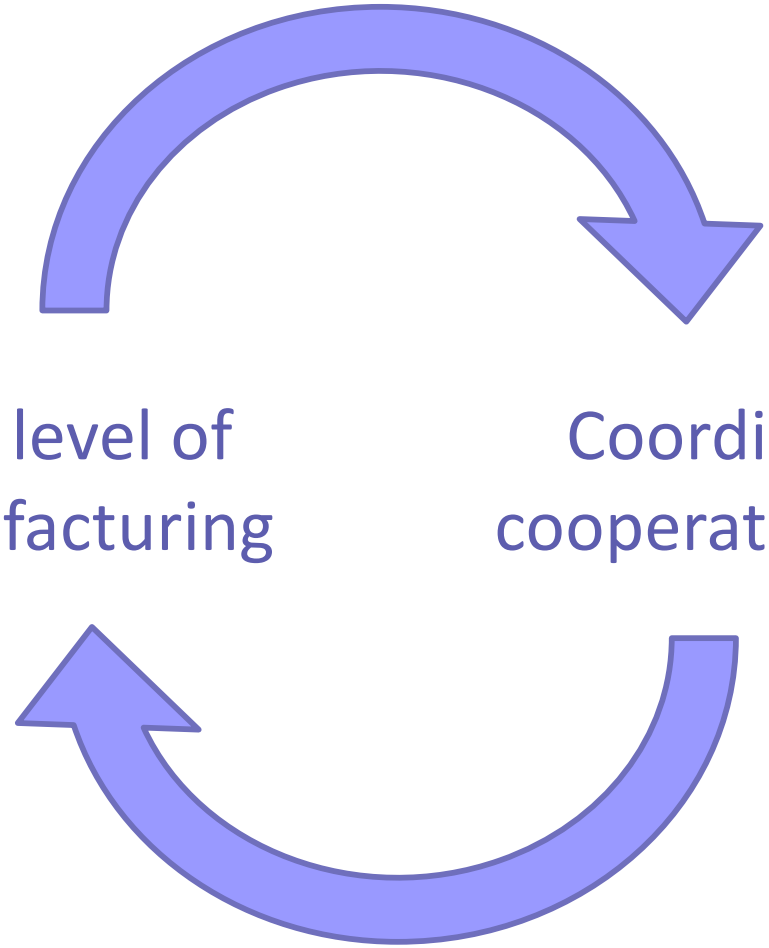
Poverty traps



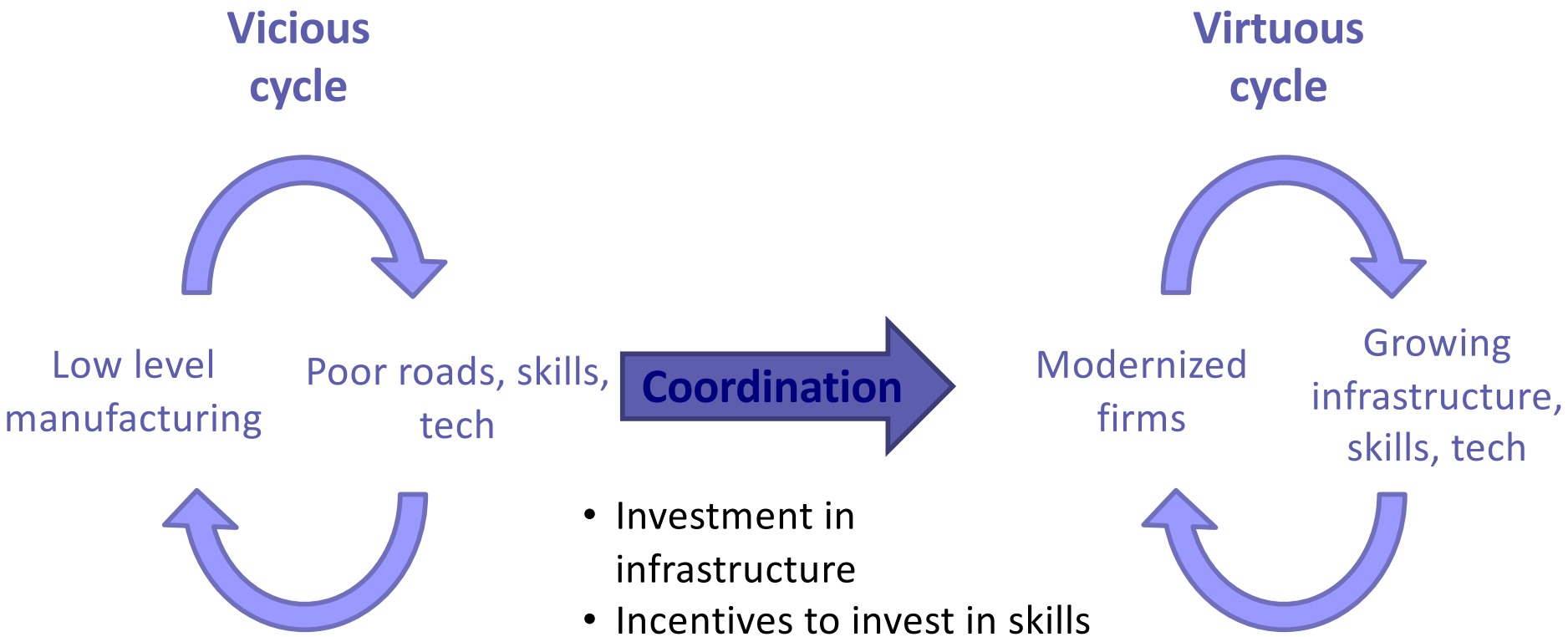
Risk and bad “shocks”



Macro-level: Coordination problems

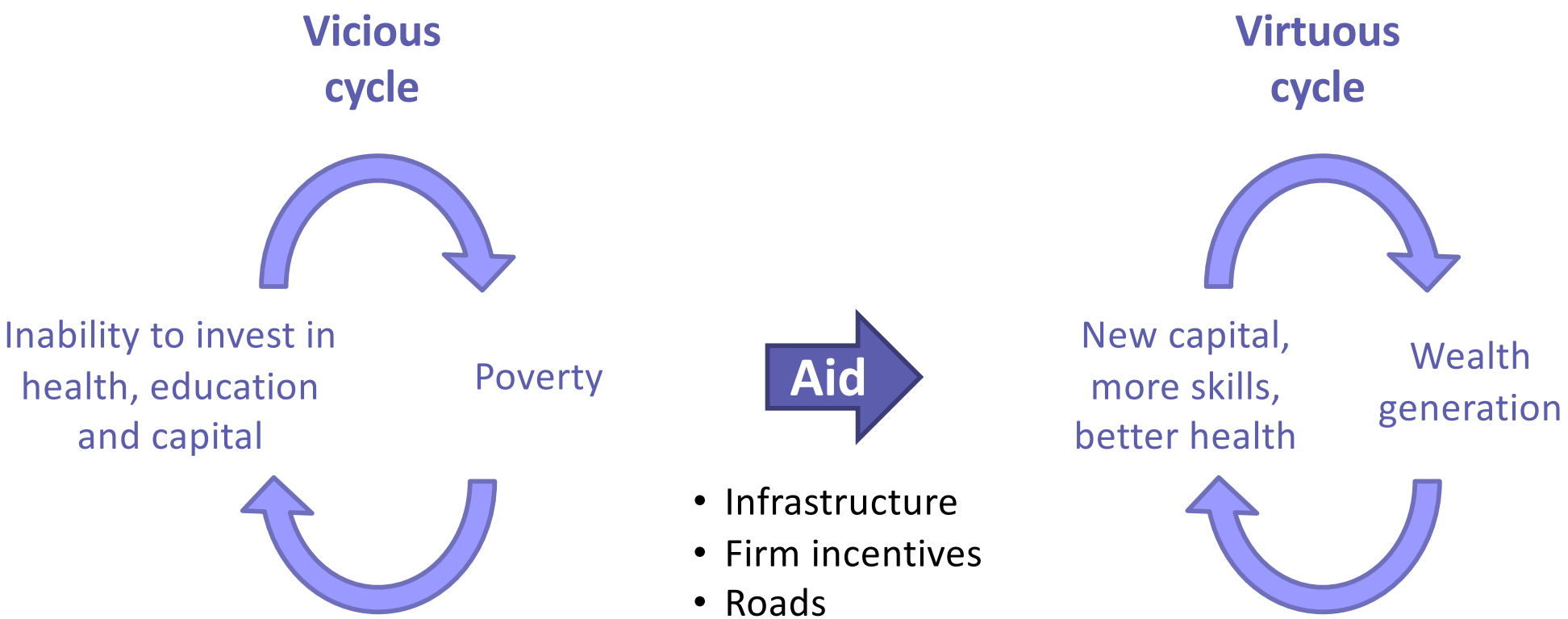


Aid and public policy as a "big push"



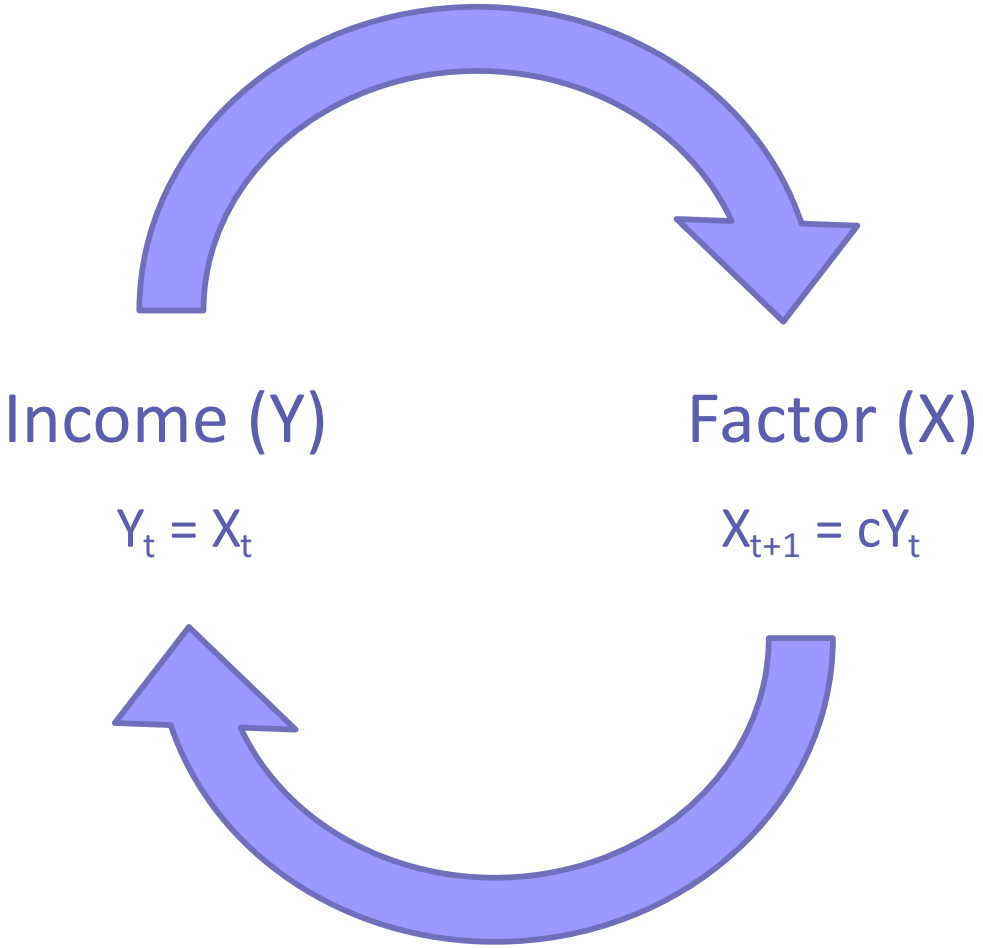
- Investment in infrastructure
- Incentives to invest in skills
- Publicly funded R&D

Simple and compelling rational for aid:
A one-time transfer can push you out of a poverty trap

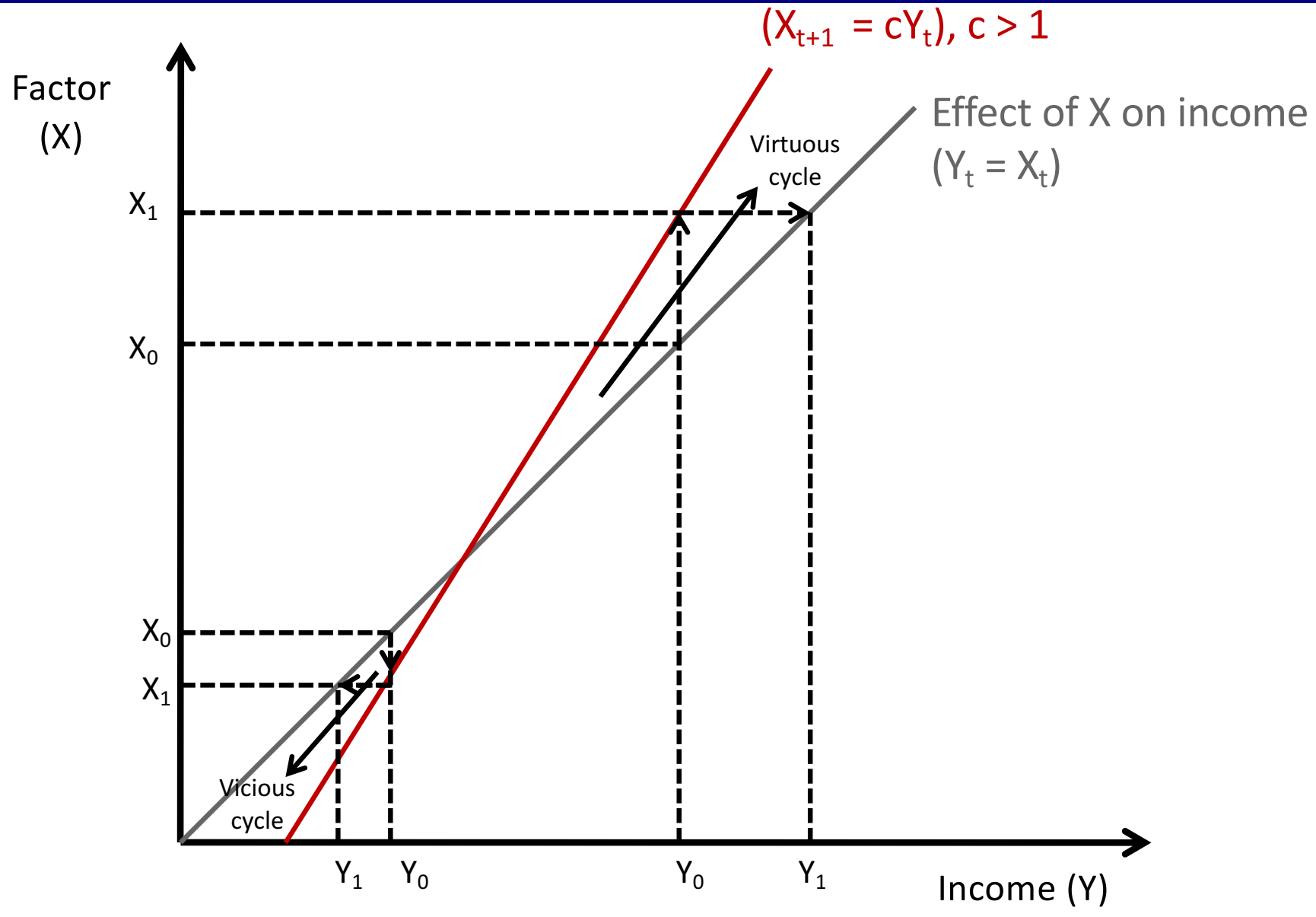


A simple model of poverty traps

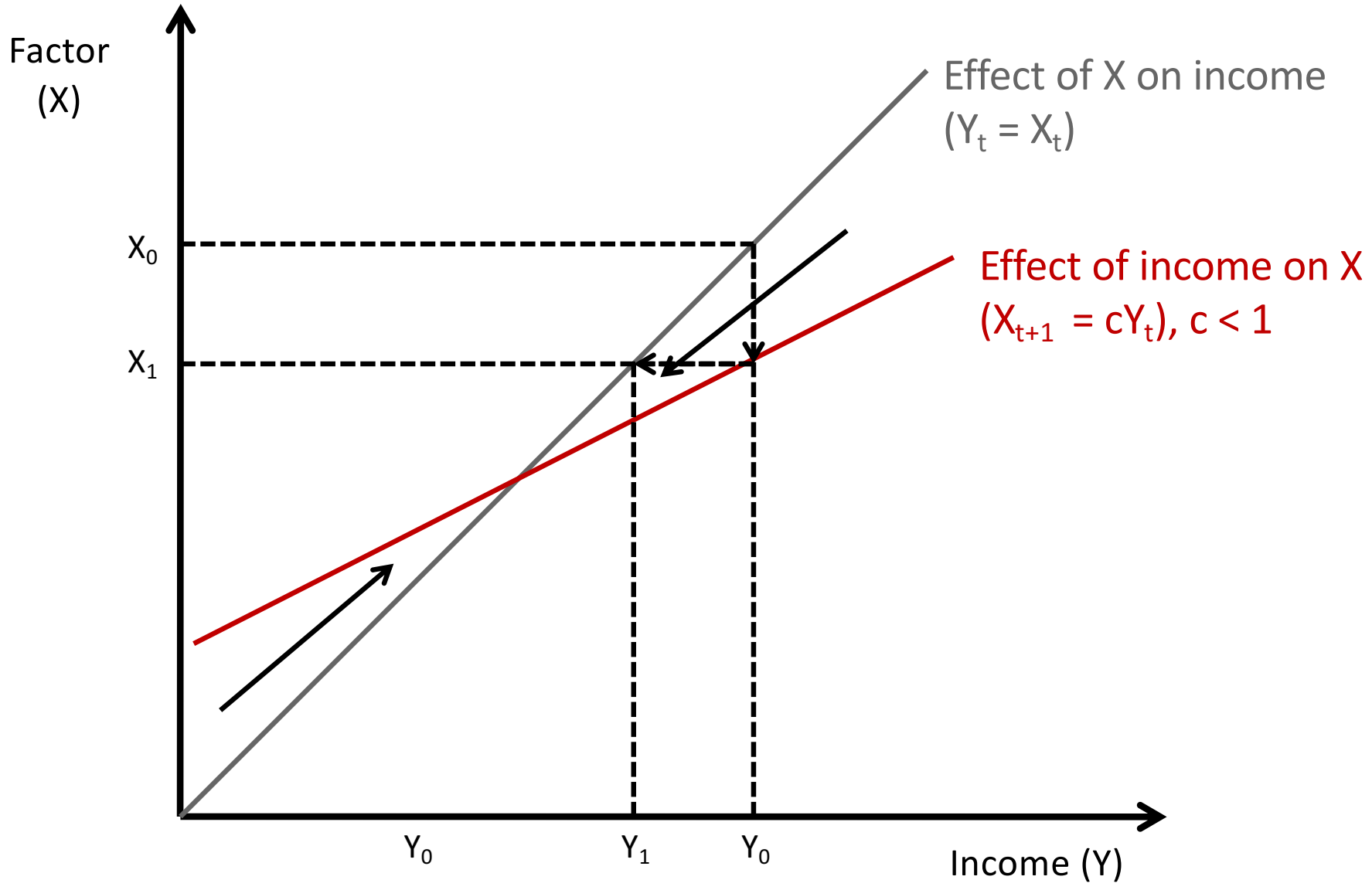
Magic number is "c"



No equilibrium



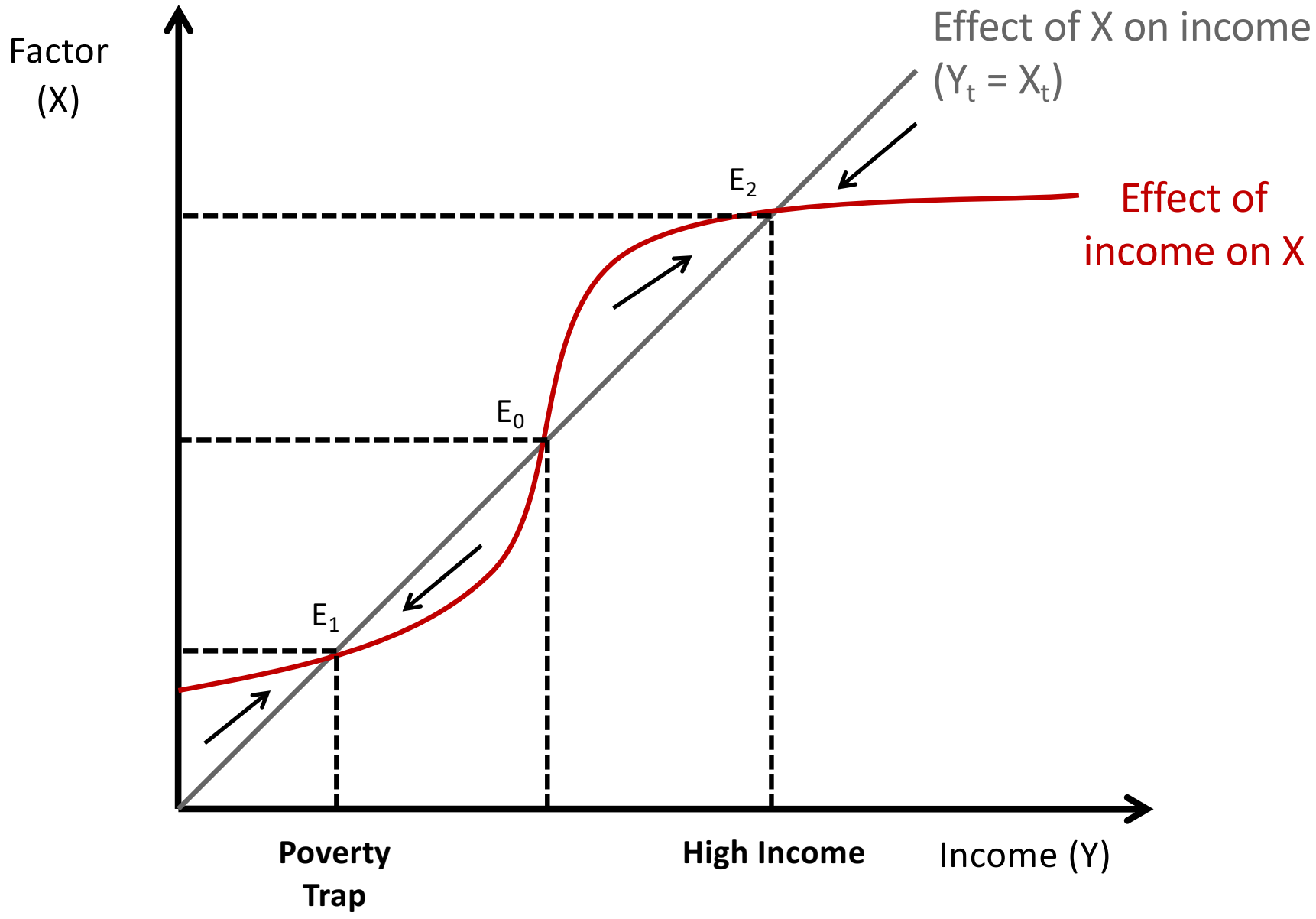
Stable equilibrium



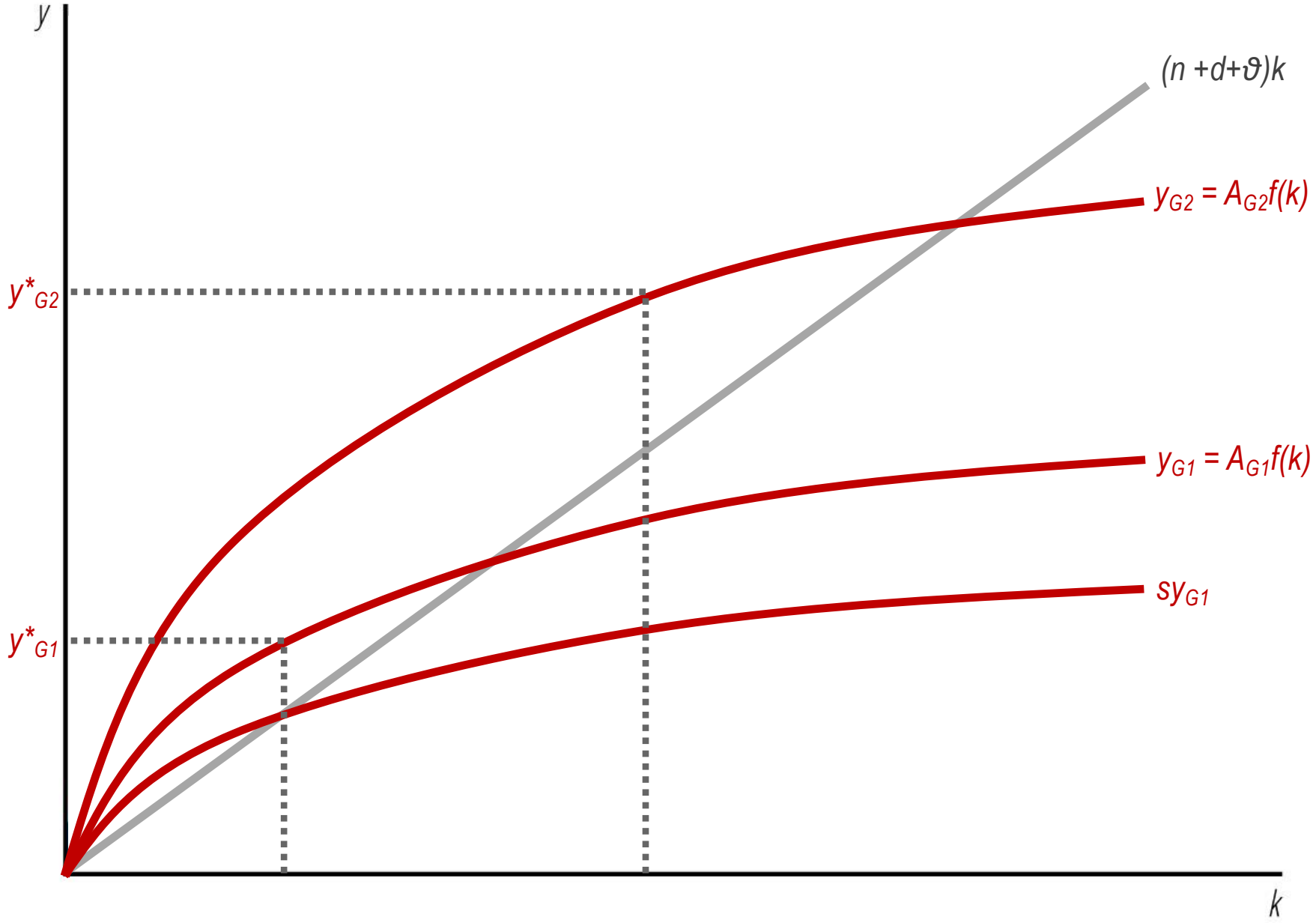
It’s all about increasing or decreasing returns to factors (c)

- X increases more than proportionally to income (increasing returns to X)
  - Unstable equilibrium
  - Virtuous or vicious cycle
  - Divergence
- X increases less than proportional to income (diminishing returns to X)
  - Single, stable equilibrium
  - Convergence, based on fundamentals
  - e.g. Solow model

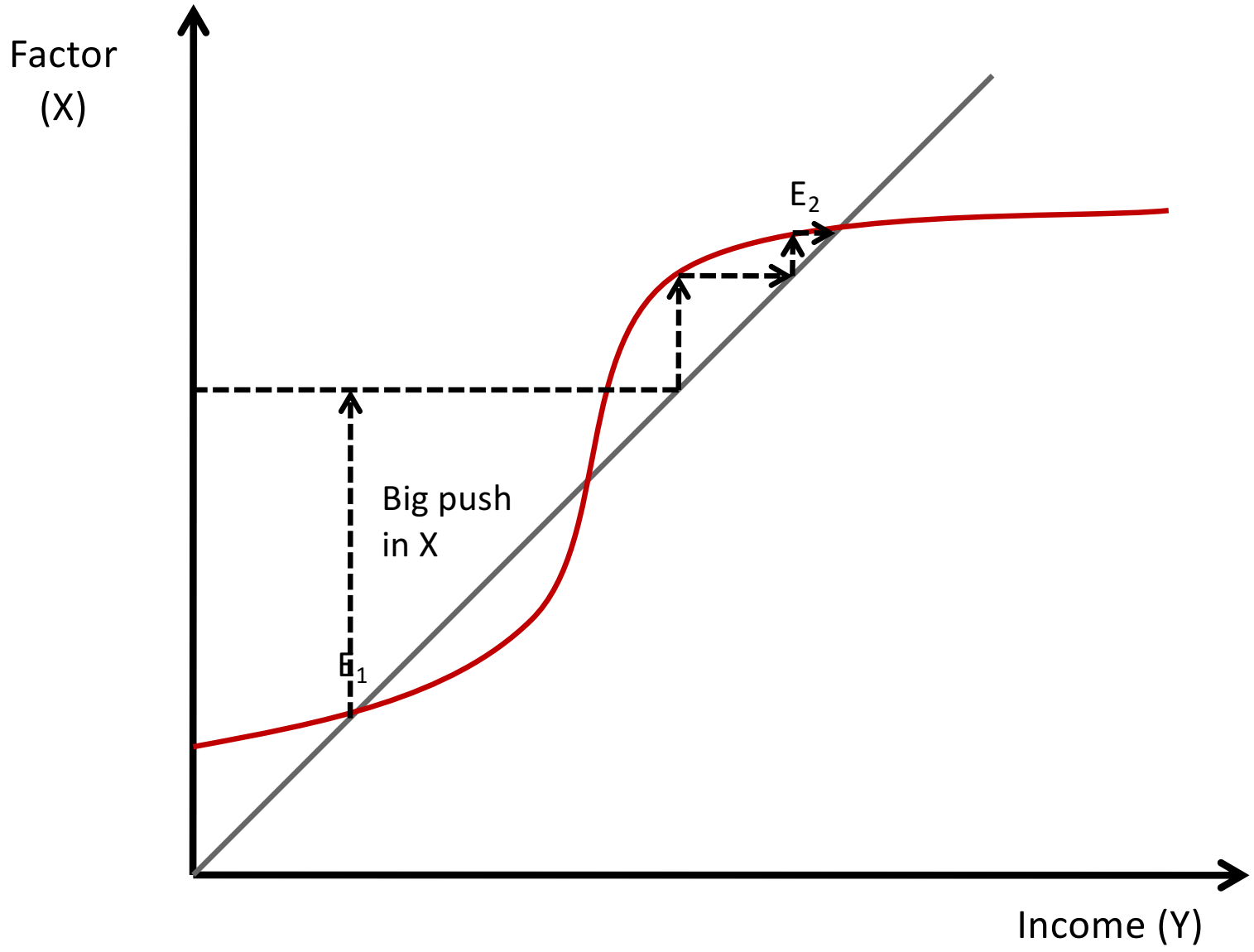
Multiple equilibria



The Solow model had a single, stable equilibrium



What aid can do when there are multiple equilibria



The "big push" story

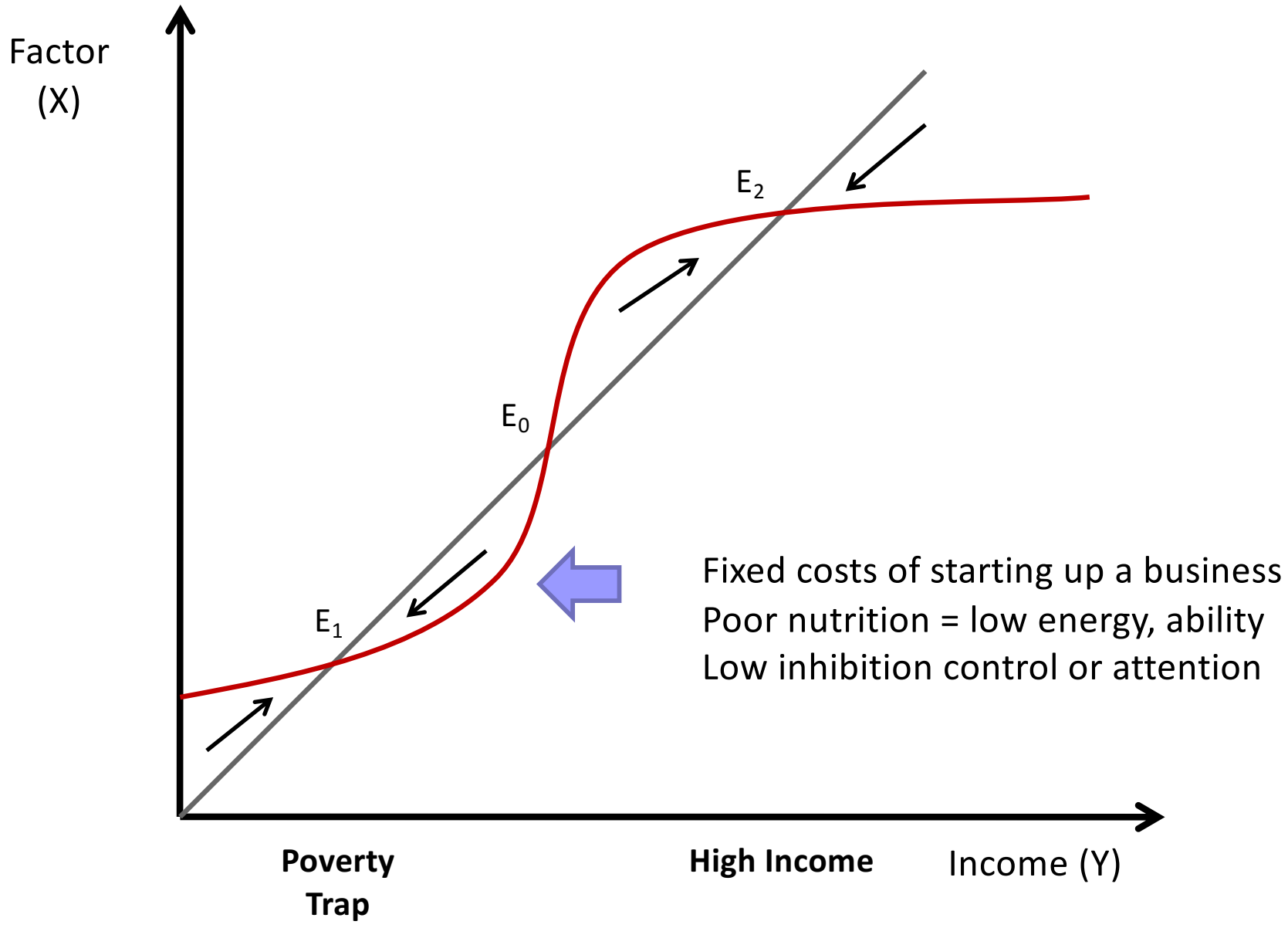
- Poverty is a bad equilibrium
- Some large change in fundamentals helps you break out
  - Soviets: Forced savings and investment
  - Jeff Sachs: Aid, Trade
  - Max Weber: Protestantism, rational bureaucracies
  - Tilly, Herbst: War and state development
  - David Brooks: Culture

Not just a macro-level story

Why might poor people face S-shaped income today/tomorrow curves?

Multiple equilibria at the micro (household) level

Banerjee and Duflo



Very different policy implications

Multiple equilbria

- The poverty trap (multiple equilibria) goes with a "transformational" perspective on development

Solow model / unique equilibrium

- The "fundamentals" approach (single equilibrium) goes with a more "marginal" perspective

Another poverty trap: information externalities in industrial specialization

- For all but the most sophisticated economies , industrial success entails concentration in a relatively narrow range of high-productivity activities.
- The specific product lines that eventually prove to be hits are typically highly uncertain and unpredictable.

The information externality

1. There is uncertainty about what products can be produced efficiently in a country.
   - Unknown cost structure and comparative advantage.
2. Experimentation and adaptation is costly and risky.
3. Once the advantage is discovered, imitators rush in.

The "trap"

- Why would a firm make the costly and risky investment if everyone else will come in and reap the benefits?
- How do we overcome this knowledge externality in rich country innovation?
  - Patents and intellectual property.
  - Research incentives and grants.
  - University funding.
- It's coordination and good governance are key … So it's back to institutions

What's the evidence on poverty traps at the micro level?

Micro level

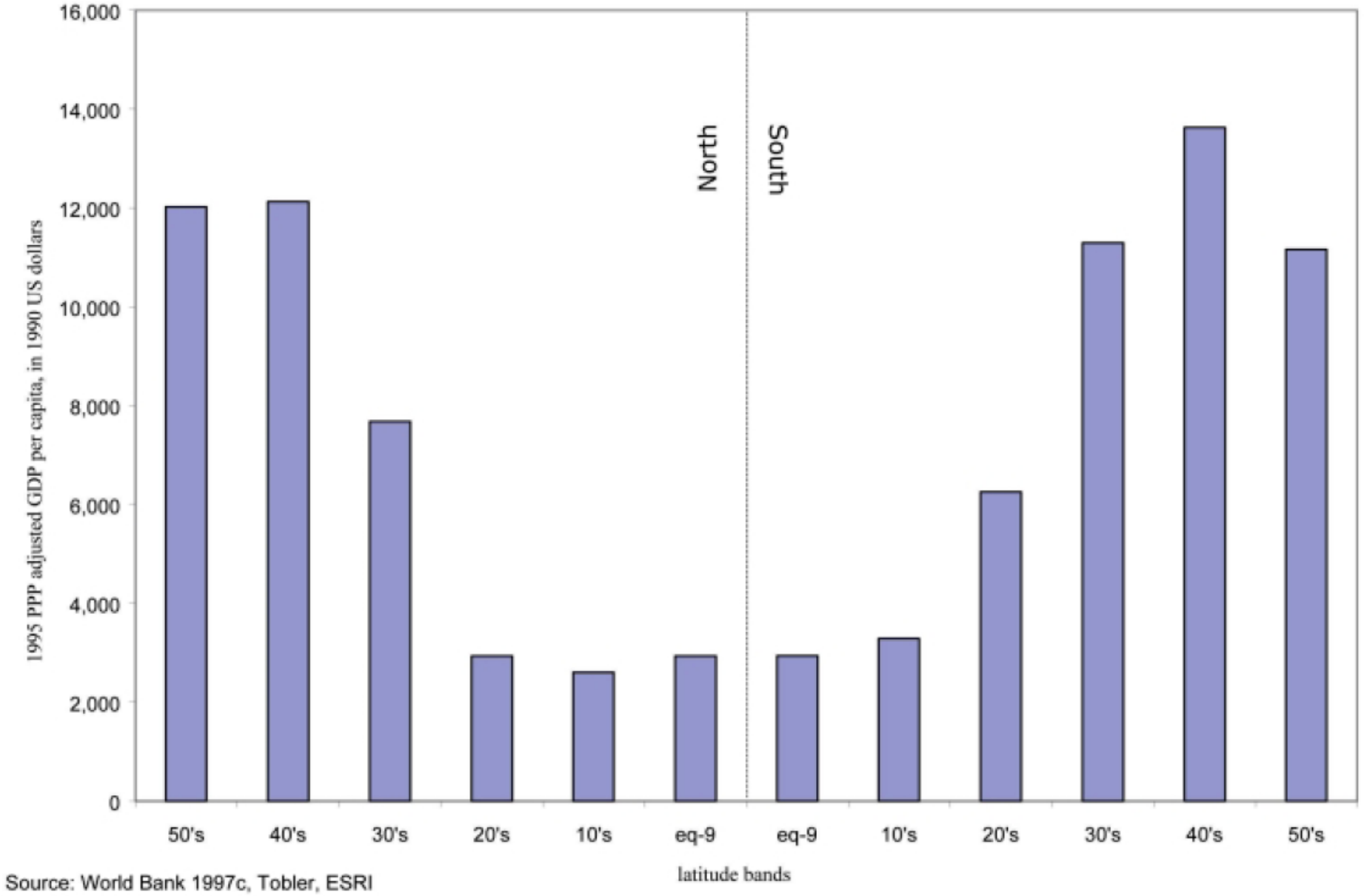
- Mixed evidence of poverty traps for the poorest
  - Absence of one factor (e.g. health) can hold you back even if you have other factors (e.g. skills and capital)
  - Fixed start-up costs matter (e.g., micro-credit/enterprise)
  - Food poverty trap unlikely (see Banerjee and Duflo – for most calories are cheap),
  - But health *shock* poverty trap seems possible.
- But unclear whether a "big push" does necessarily lead to a virtuous cycle of growth
- Change is more incremental

What's the evidence on poverty traps at the macro level (and the big push)?

Macro (country) level

- Pretty weak (says Easterly 2008)
- Poorest countries change all the time (few stay in "traps")
- Initially poor countries no more likely to have zero or lower growth than middle income ones
- Big increases in aid do not seem to result in big jumps in growth

So what (un)makes institutions: heat and lethargy? GDP per capita by latitude



Source: World Bank 1997c, Tobler, ESRI

Sachs, Jeffrey. 2000. "Tropical Underdevelopment." CID Working Paper No. 57.

A long (and dubious) tradition in philosophy and science of linking temperature with temperament

"In countries like India, Pakistan, Indonesia, Nigeria and Ghana I have always felt enervated by the slightest physical or mental exertions, whereas in the UK, France, Germany or the US I have always felt reinforced and stimulated by the temperate climate… And I know that all tropical peoples visiting temperate countries have had a similar experience."

-Bangladeshi diplomat

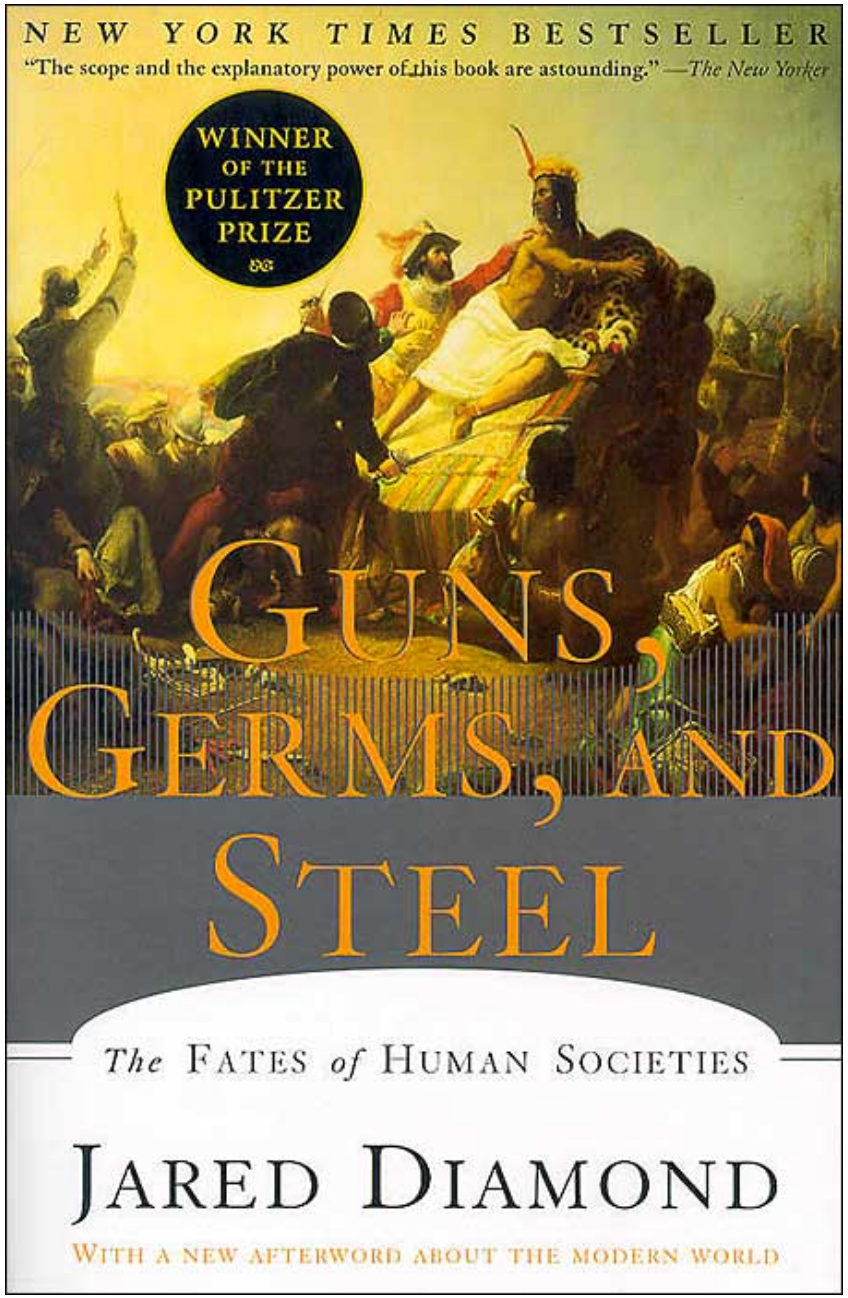
Quoted in Landes (1999), p.15

Climatic determinism
The importance of an enervating climate

- Famous proponent: Yale's Ellsworth Huntington
  - Taught geography 1907–1915
- Intermixed with racial theories of development
  - Ellsworth was President of the American Eugenics Society, 1934–1938

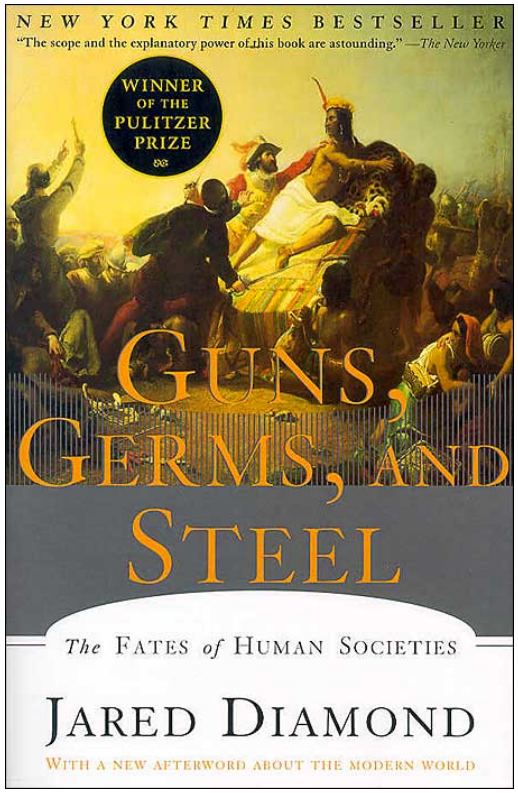
We can probably do better

- The effects of ‘endowments’
- Disease environment
  - Direct effects (on labor productivity)
  - Indirect effects (on institutions and technology)
- Geography and trade
- Climate and agricultural productivity
- Natural resource wealth

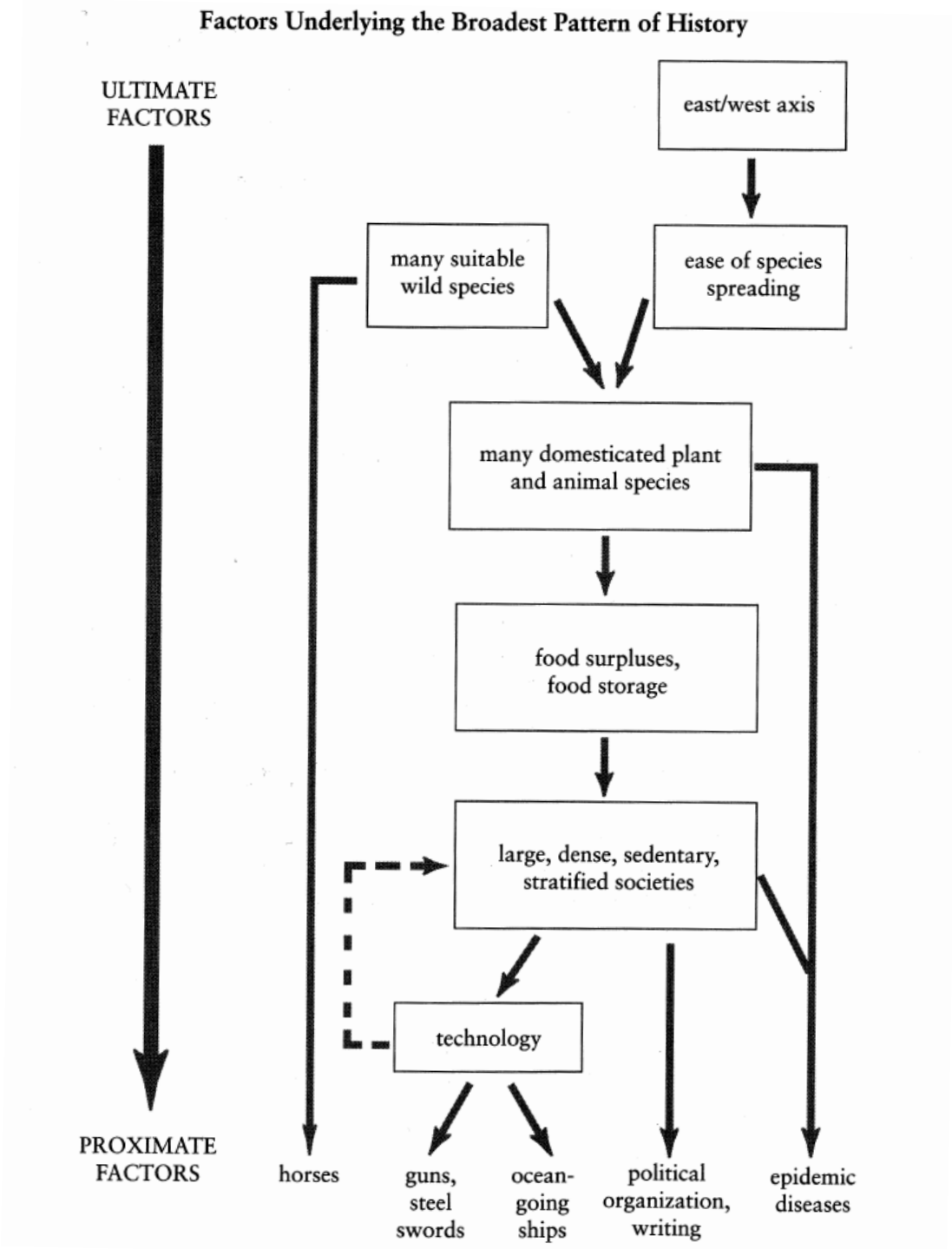


By the 1600s and 1700s, why was Europe economically and technologically ahead?

Why were places like the Americas and Africa behind?


NEW YORK TIMES BESTSELLER
"The scope and the explanatory power of this book are astounding." —The New Yorker
WINNER OF THE PULITZER PRIZE
GUNS, GERMS, AND STEEL
The FATES of HUMAN SOCIETIES
JARED DIAMOND
WITH A NEW AFTERWORD ABOUT THE MODERN WORLD

(p.87)


Factors Underlying the Broadest Pattern of History
ULTIMATE FACTORS
PROXIMATE FACTORS
east/west axis
ease of species spreading
many suitable wild species
many domesticated plant and animal species
food surpluses, food storage
large, dense, sedentary, stratified societies
technology
horses
guns, steel swords
ocean-going ships
political organization, writing
epidemic diseases

The diffusion of endowments and technology

Diamond: An east-west orientation facilitated a broad diffusion of technologies across a shared ecological space

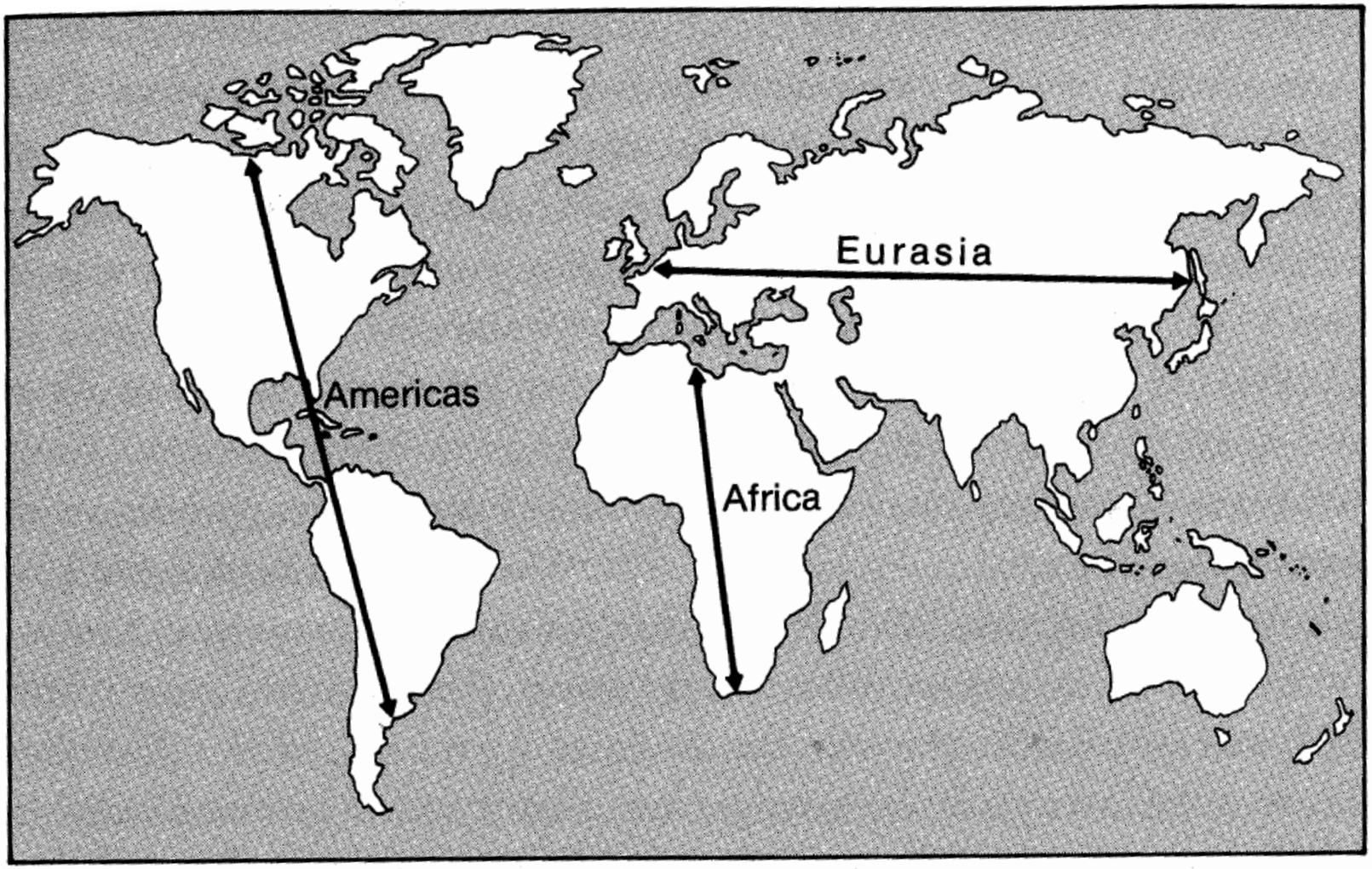
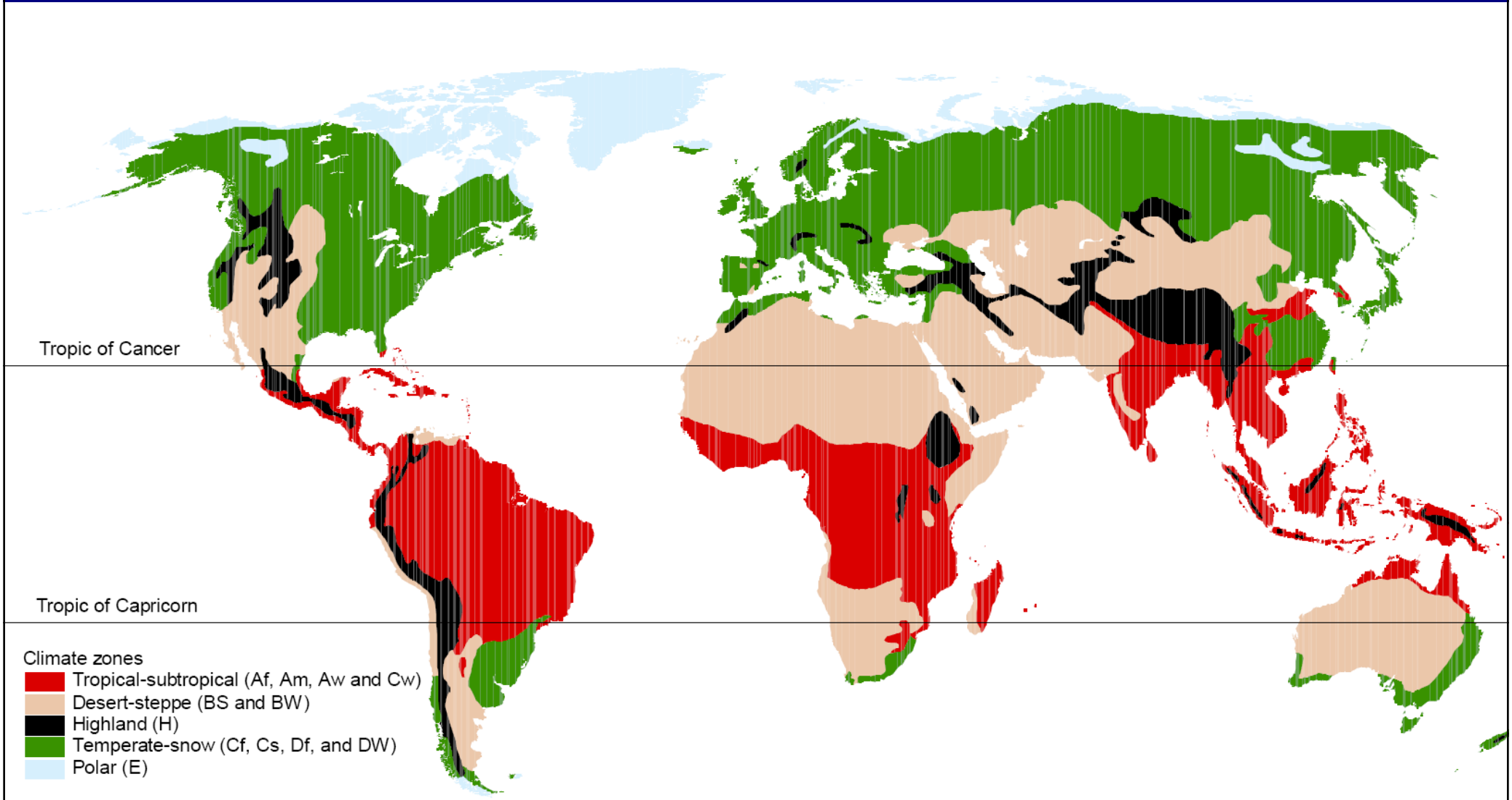


Figure 10.1. Major axes of the continents.

Diamond, Jared. 1999. "Guns, Germs and Steel".

Climate zones

The technologies of pre-industrial civilization were largely agricultural (and ecologically specific) ones.



Sachs, Jeffrey. 2000. "Tropical Underdevelopment." CID Working Paper No. 57.

Africa: Low endowment of domesticable animals

TABLE 9.2 Mammalian Candidates for Domestication

	Continent			
	Eurasia	Sub-Saharan Africa	The Americas	Australia
Candidates	72	51	24	1
Domesticated species	13	0	1	0
Percentage of candidates domesticated	18%	0%	4%	0%

A "candidate" is defined as a species of terrestrial, herbivorous or omnivorous, wild mammal weighing on the average over 100 pounds.

Diamond, Jared. 1999. "Guns, Germs and Steel".

Low endowment of nutritious grains

TABLE 8.1 World Distribution of Large-Seeded Grass Species

Area		*Number of Species*
West Asia, Europe, North Africa		33
Mediterranean zone	32	
England	1	
East Asia		6
Sub-Saharan Africa		4
Americas		11
North America	4	
Mesoamerica	5	
South America	2	
Northern Australia		2
	Total:	56

Diamond, Jared. 1999. "Guns, Germs and Steel".

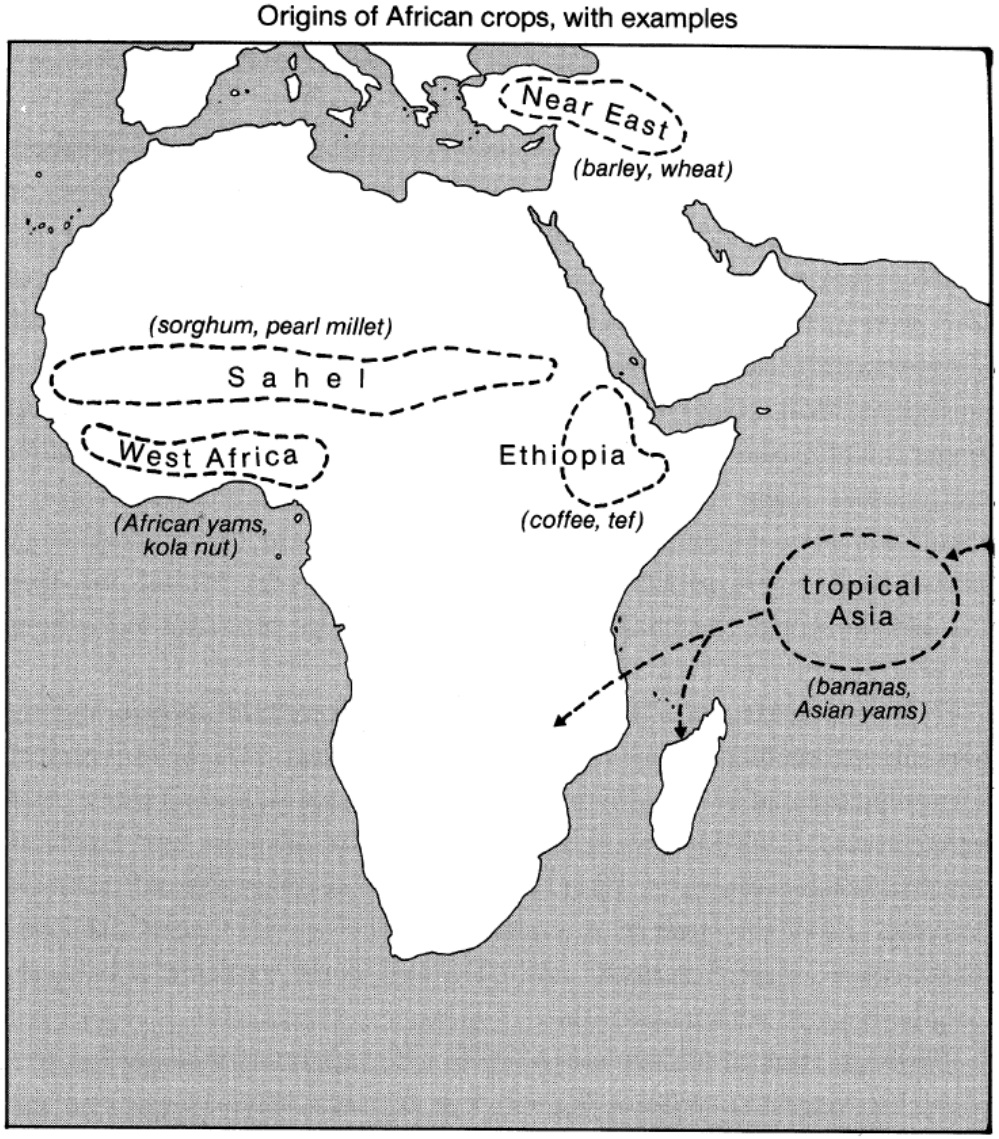
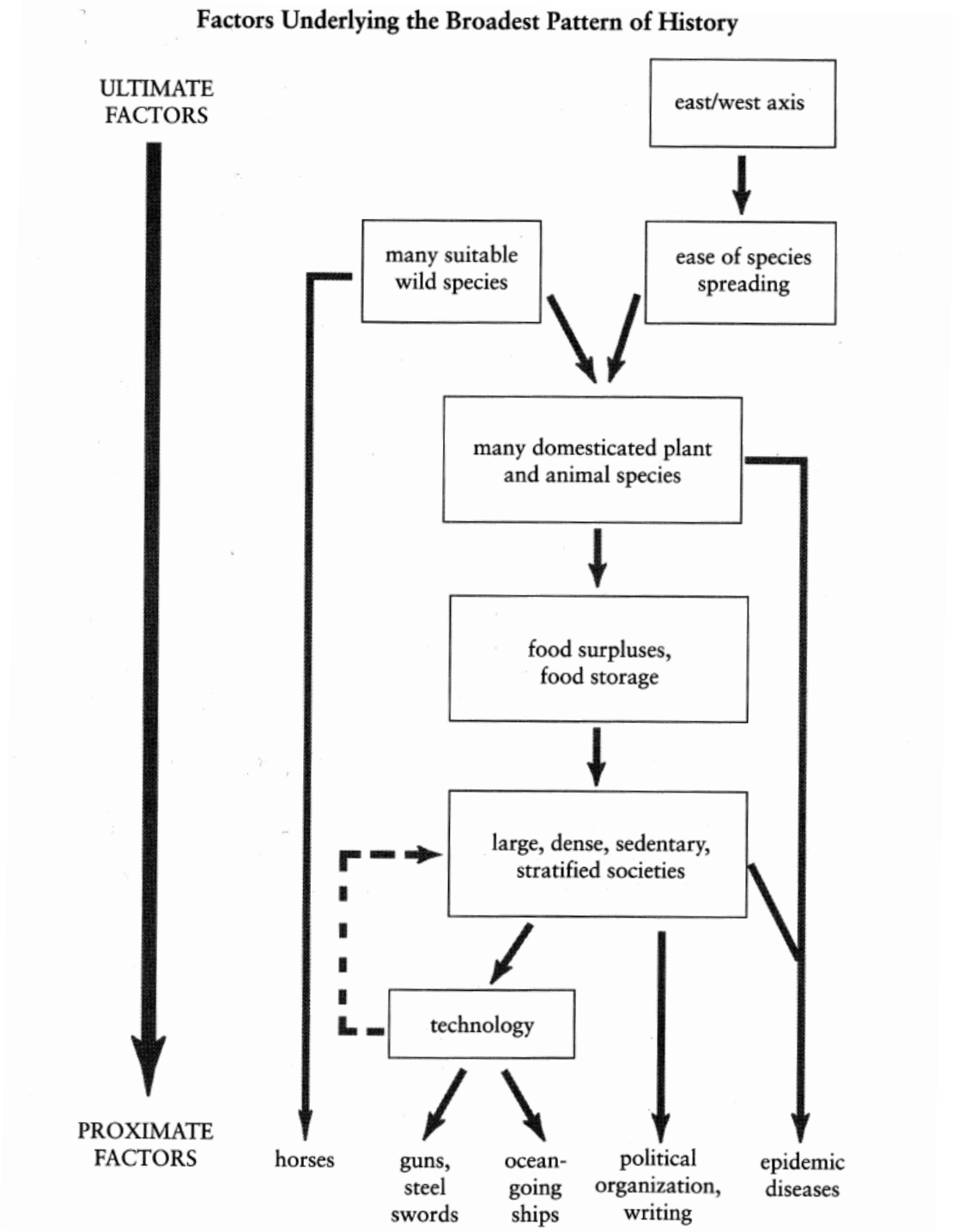


Figure 19.3. The areas of origin of crops grown traditionally in Africa (that is, before the arrival of crops carried by colonizing Europeans), with examples of two crops from each area.

Consequence:

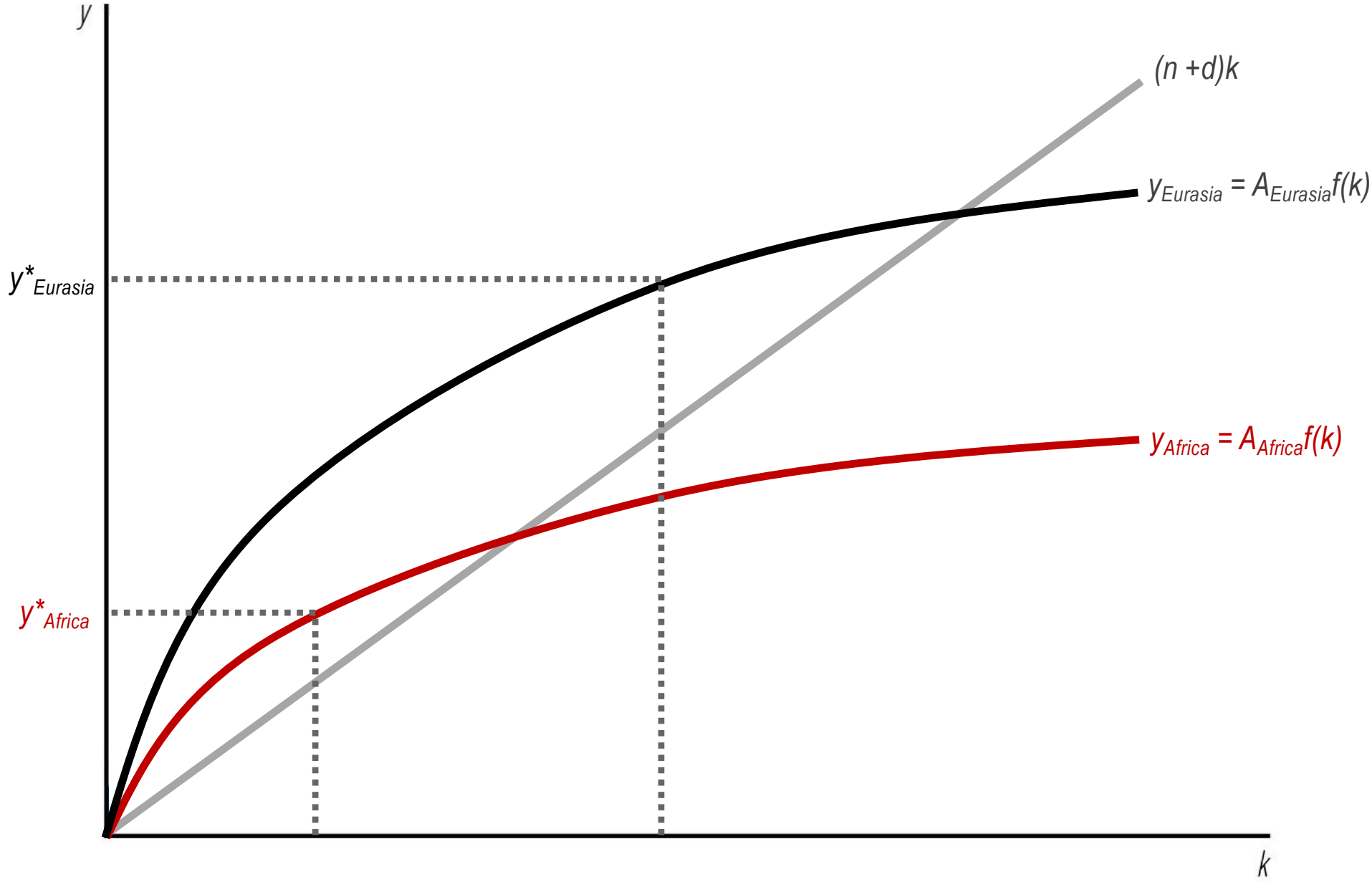
By 1700s, temperate-zone technologies more productive than tropical-zone ones.

(health, agriculture, energy, military….)



Explaining income differences in 1500

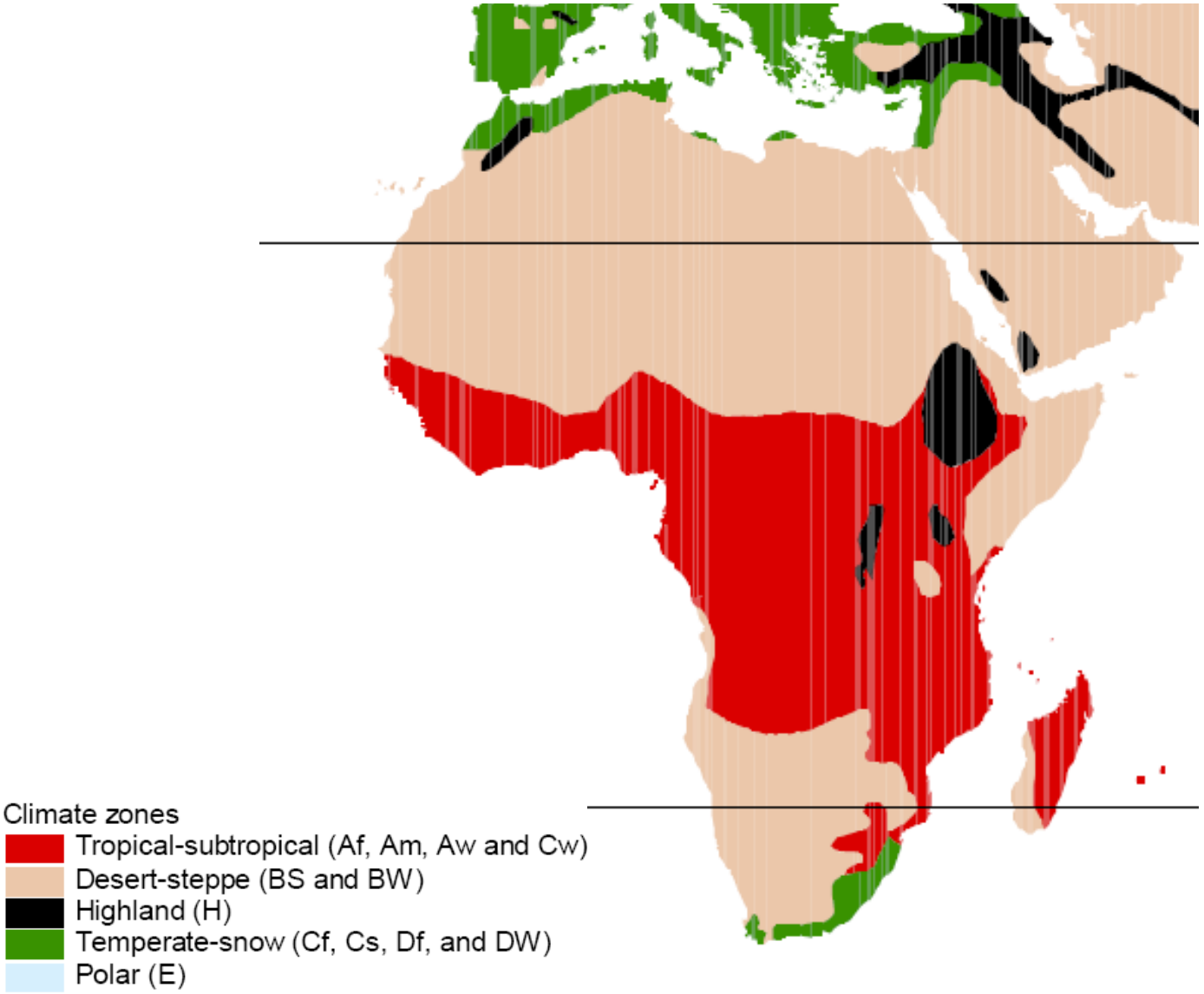
Is Diamond's model is fundamentally about different "technology"?



Depends what you mean by technology: the disease environment

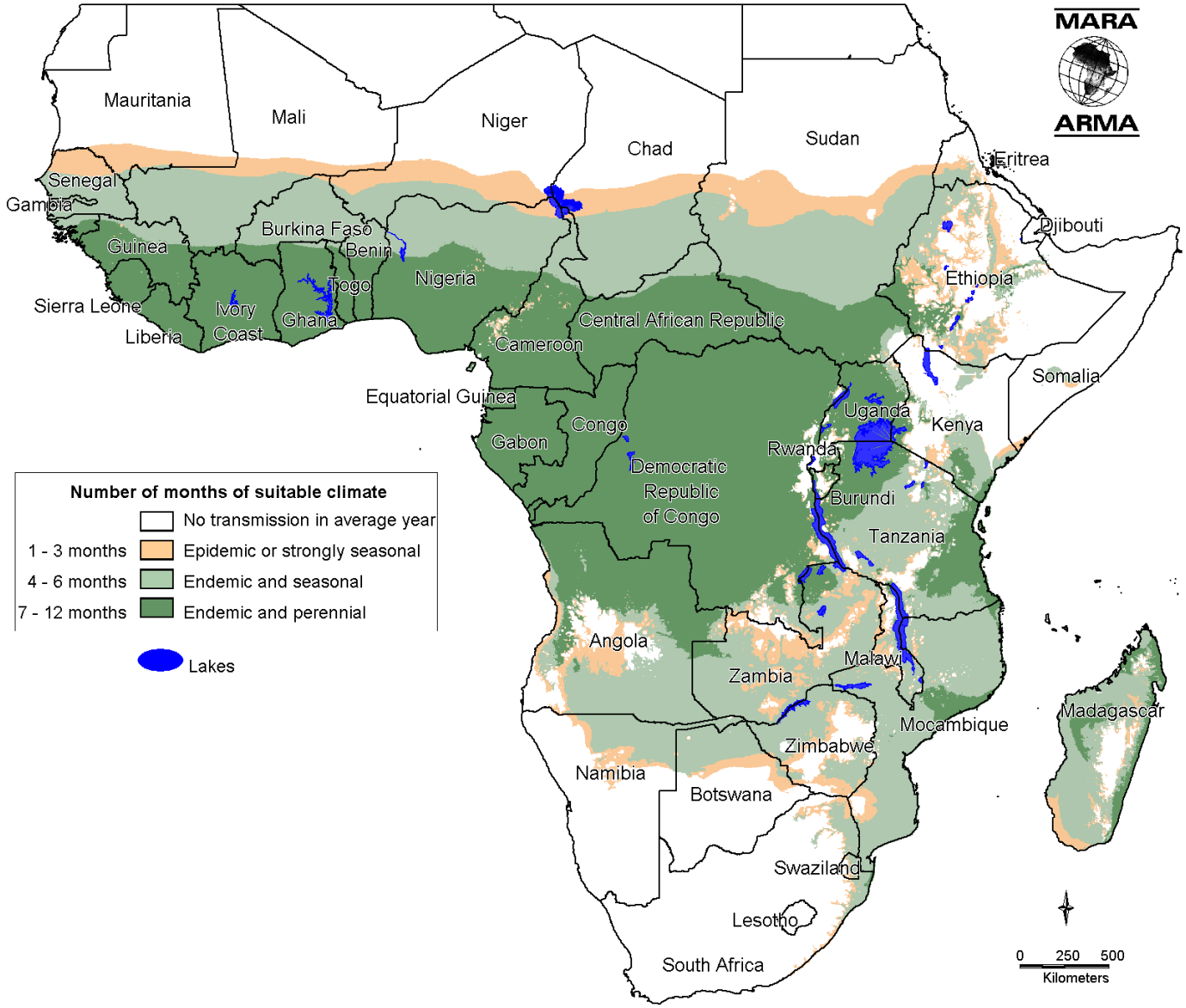
The cradle of humanity is also the cradle of human disease and parasites.

Climatic zones may matter for more reasons than the diffusion of technology



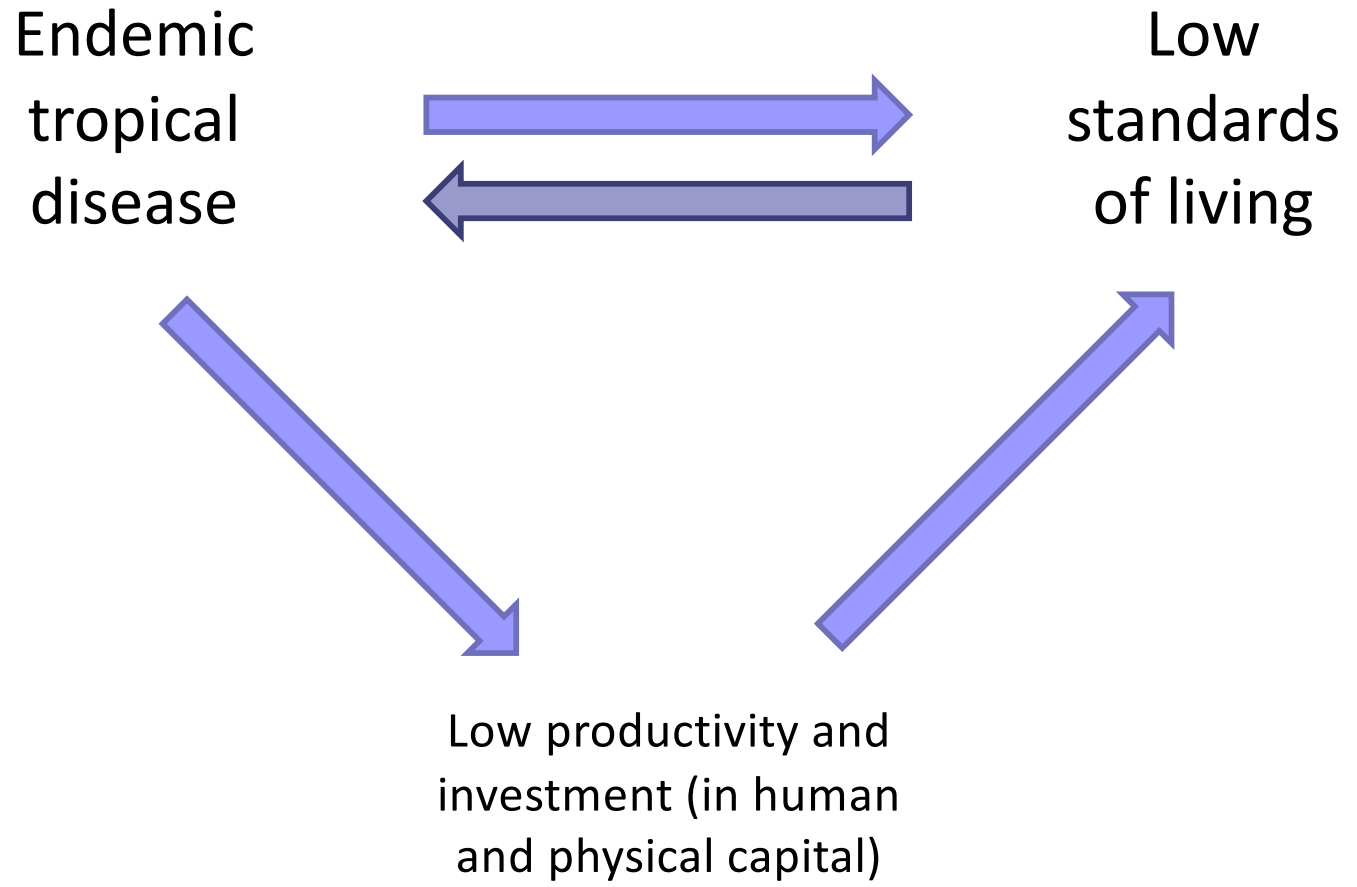
Sachs, Jeffrey. 2000. "Tropical Underdevelopment." CID Working Paper No. 57.

Duration of the Malaria Transmission Season

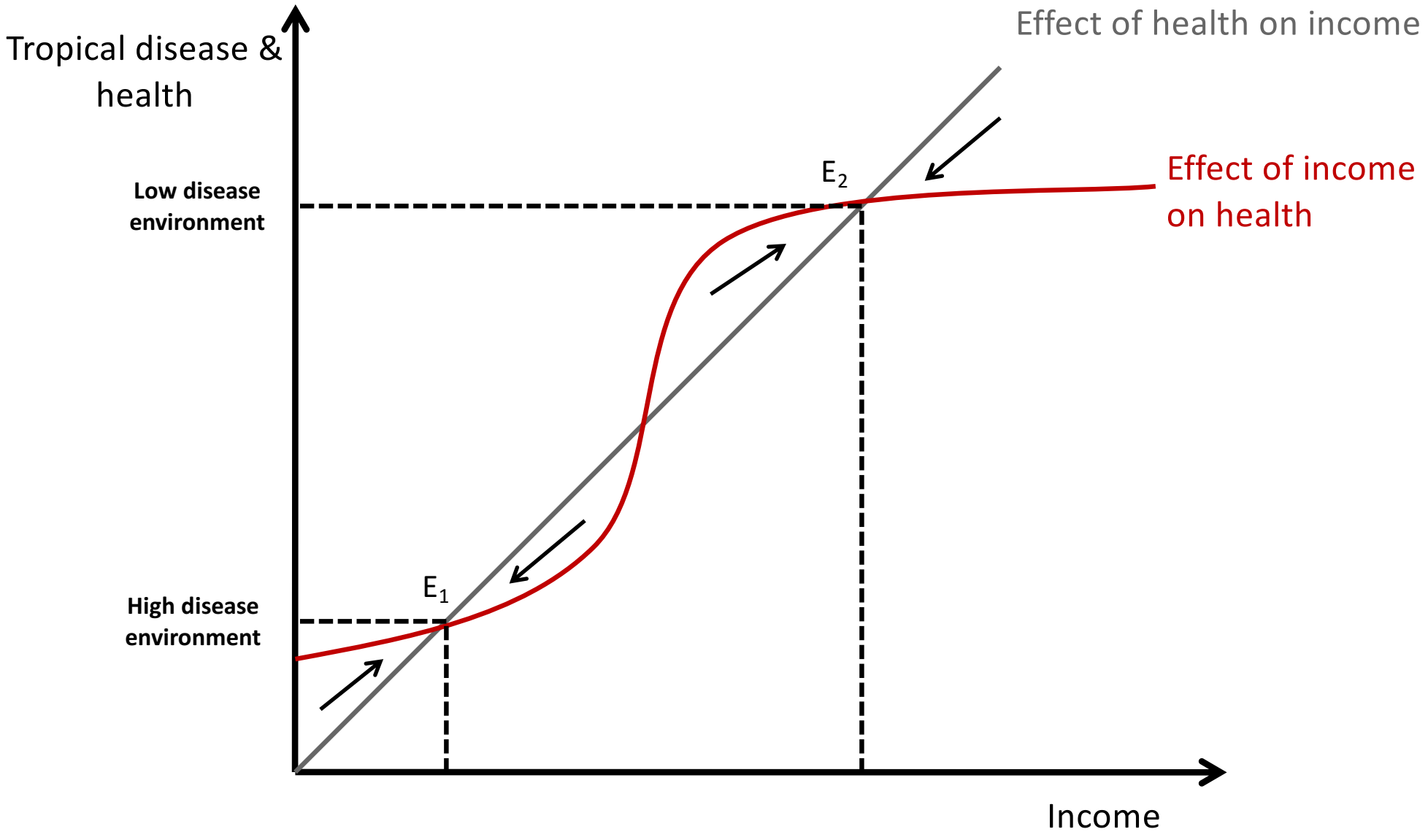


This map is a product of the MARA/ARMA collaboration (http://www.mara.org.za). July 2001, Medical Research Council, PO Box 17120, Congella, 4013, Durban, South Africa
CORE FUNDERS of MARA/ARMA: International Development Research Centre, Canada (IDRC); The Wellcome Trust UK; South African Medical Research Council (MRC); Swiss Tropical Institute, Multilateral Initiative on Malaria (MIM) / Special Programme for Research & Training in Tropical Diseases (TDR), Roll Back Malaria (RBM).
Malaria seasonality model: Tanser, F et al. 2001. Paper in preparation.
Topographical data: African Data Sampler, WRI, http://www.igc.org/wri/sdis/maps/ads/ads_idx.htm.

One hypothesis: from disease directly to underdevelopment (e.g. Sachs)



Is this a case of multiple equilibria?



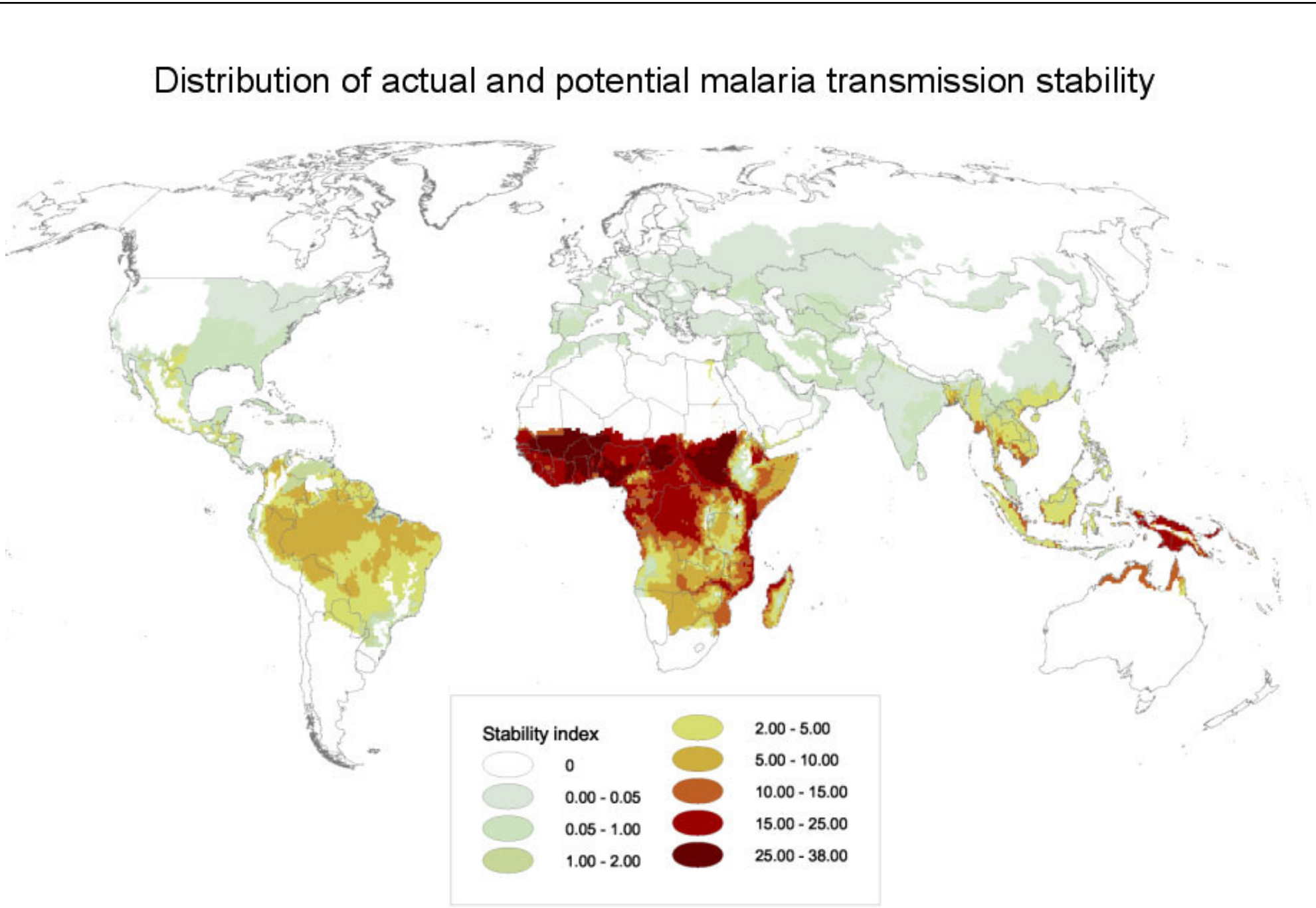


Figure 1 from Anthony Kiszewski, Andrew Mellinger, Andrew Spielman, Pia Malaney, Sonia Erlich Sachs, and Jeffrey Sachs. **A Global Index Representing The Stability of Malaria Transmission**. Am J Trop Med Hyg 2004 70:486-498.

What are the policy implications if disease directly diminishes development potential?

- Bolsters the case for spending in:
  - AIDS and malaria treatment
  - Child and maternal health
  - Research on tropical vaccines
- If a poverty trap, aid will ignite growth
  - In the long run, these are investments, not aid

An alternative story:

Geography → Institutions

Acemoglu, Johnson and Robinson
Critical of idea of multiple equilibria

- The gains from reducing sick/disabled days would have a small effect on GDP
- Historical advances in public health and medicine ignite little economic growth
- One possibility: Disease → underdevelopment because it made colonial subjugation easier

They point to another channel: Disease and settler mortality

- Starting in 17thc, Europeans emigrated to certain areas.
- Settlement colonies survived and prospered only where the disease environment was favorable.
  - Temperate zones
  - Highlands
  - Semi-tropics

Boer traders accompanying the Klapprott family on their safari to the Uasin Gishu.

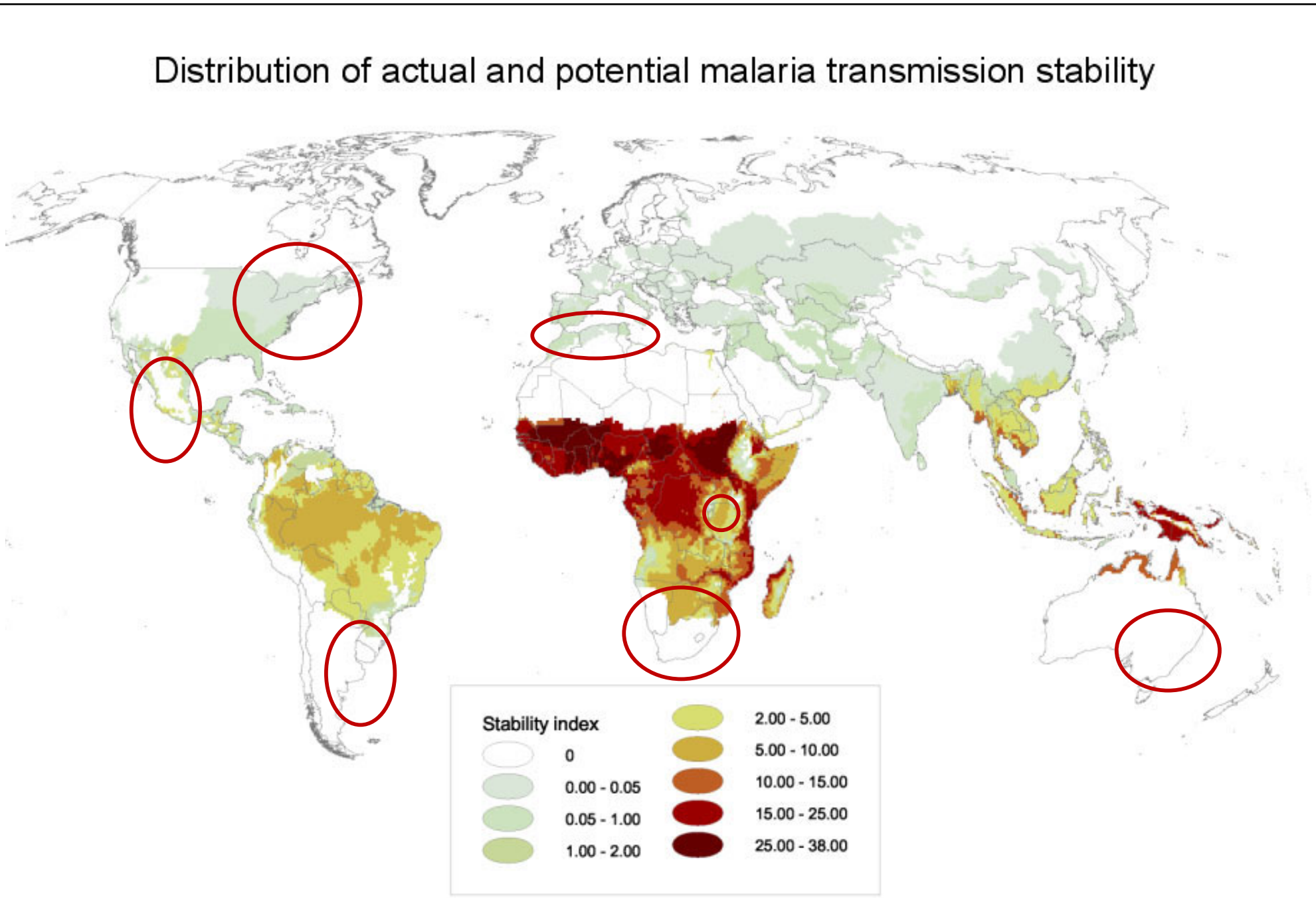
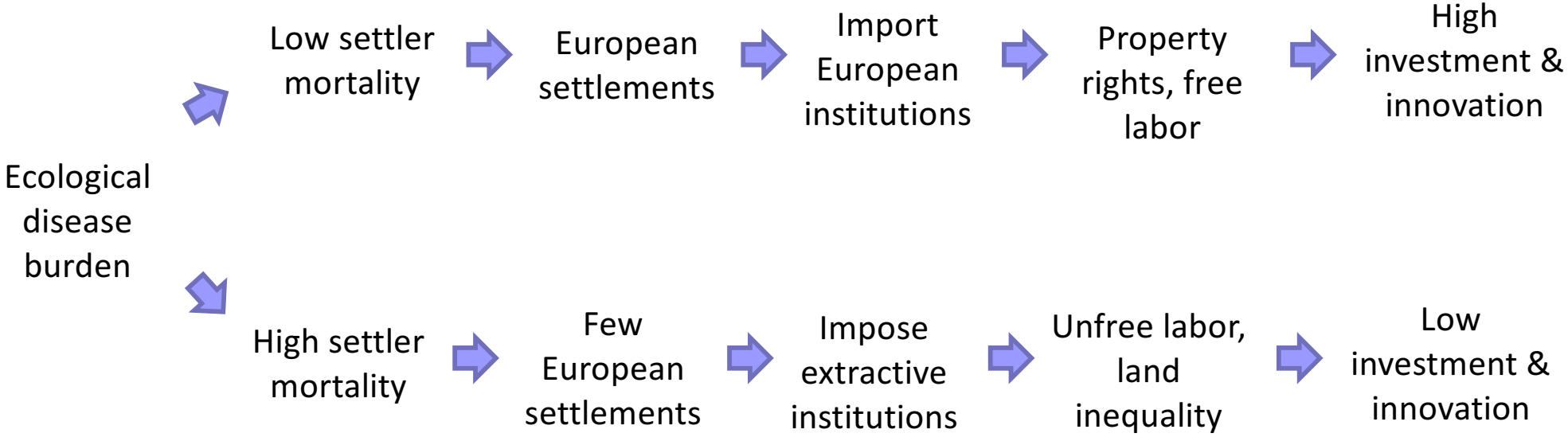


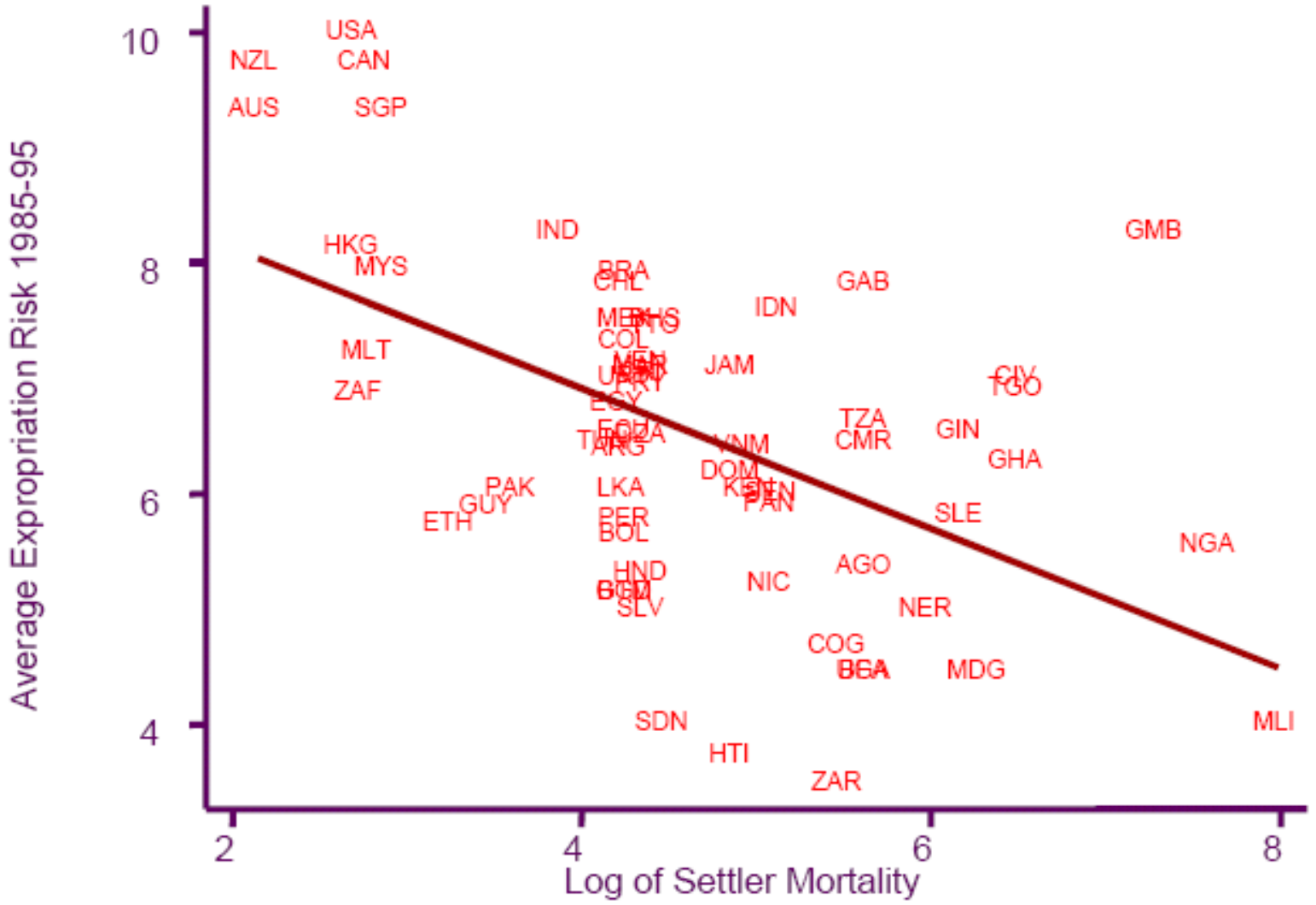
Figure 1 from Anthony Kiszewski, Andrew Mellinger, Andrew Spielman, Pia Malaney, Sonia Erlich Sachs, and Jeffrey Sachs. **A Global Index Representing The Stability of Malaria Transmission**. Am J Trop Med Hyg 2004 70:486-498.

Disease, settler mortality, and institutions

(Acemoglu, Johnson and Robinson)



Path dependence in initial institutions

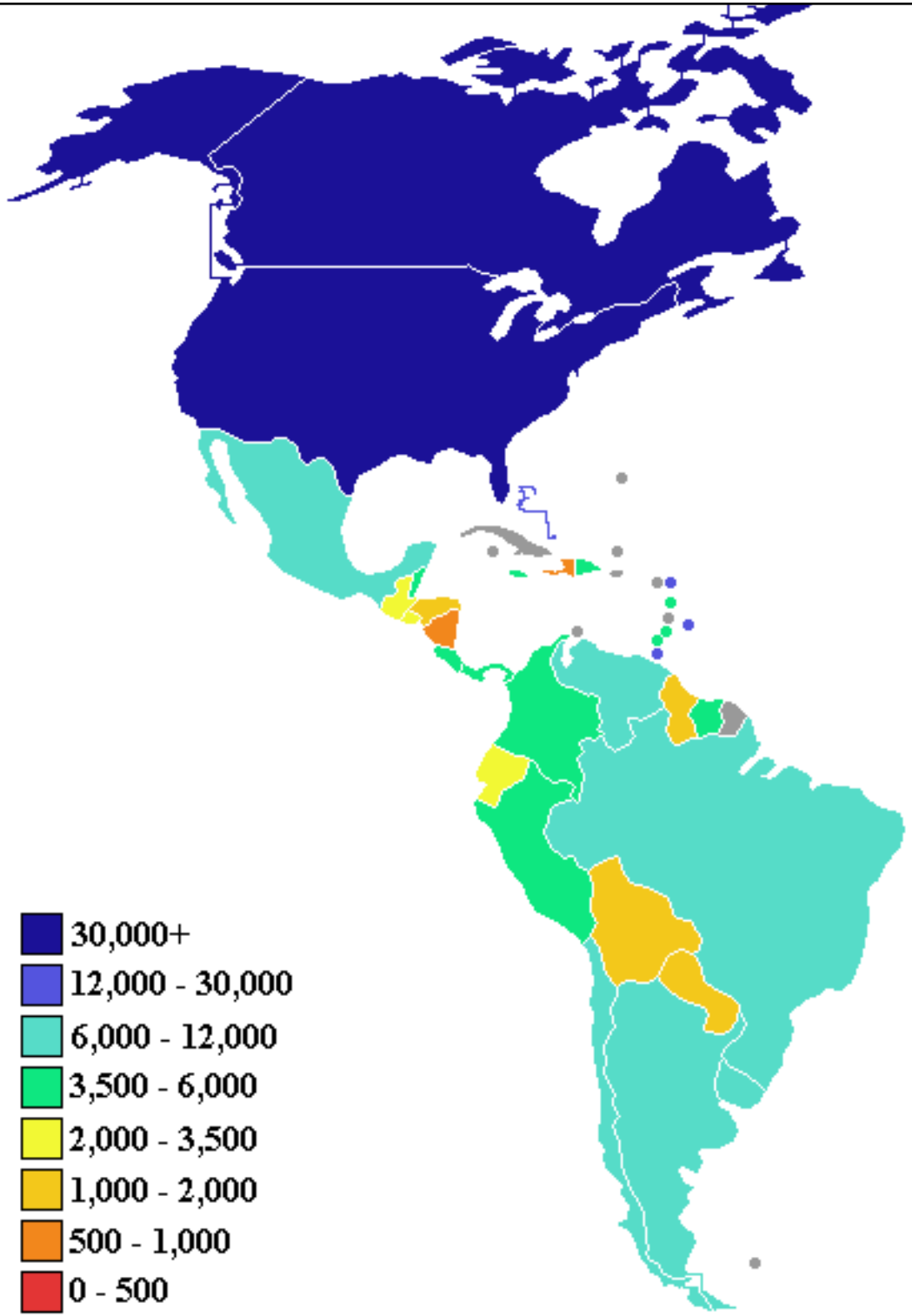


Institutions and income

“Interestingly, we show that once the effect of institutions on economic performance is controlled for, neither distance from the equator nor the dummy for Africa is significant.

These results suggest that Africa is poorer than the rest of the world not because of pure geographic or cultural factors, but because of worse institutions.”

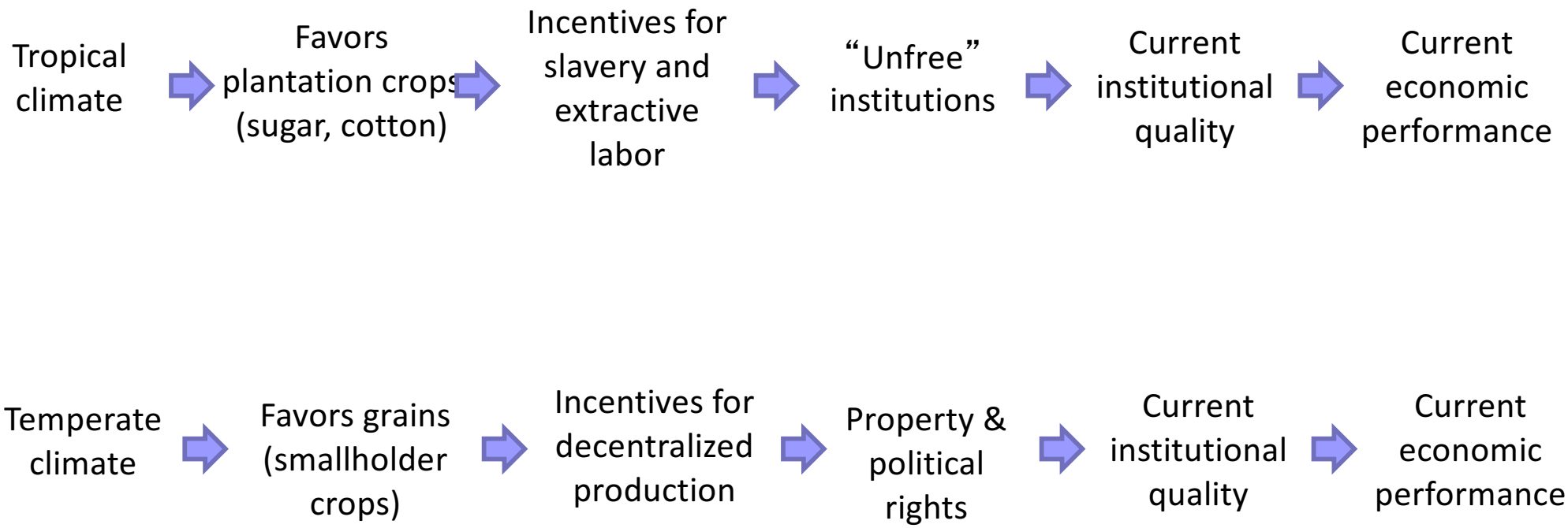
- AJR (2001)



Engerman & Sokoloff:

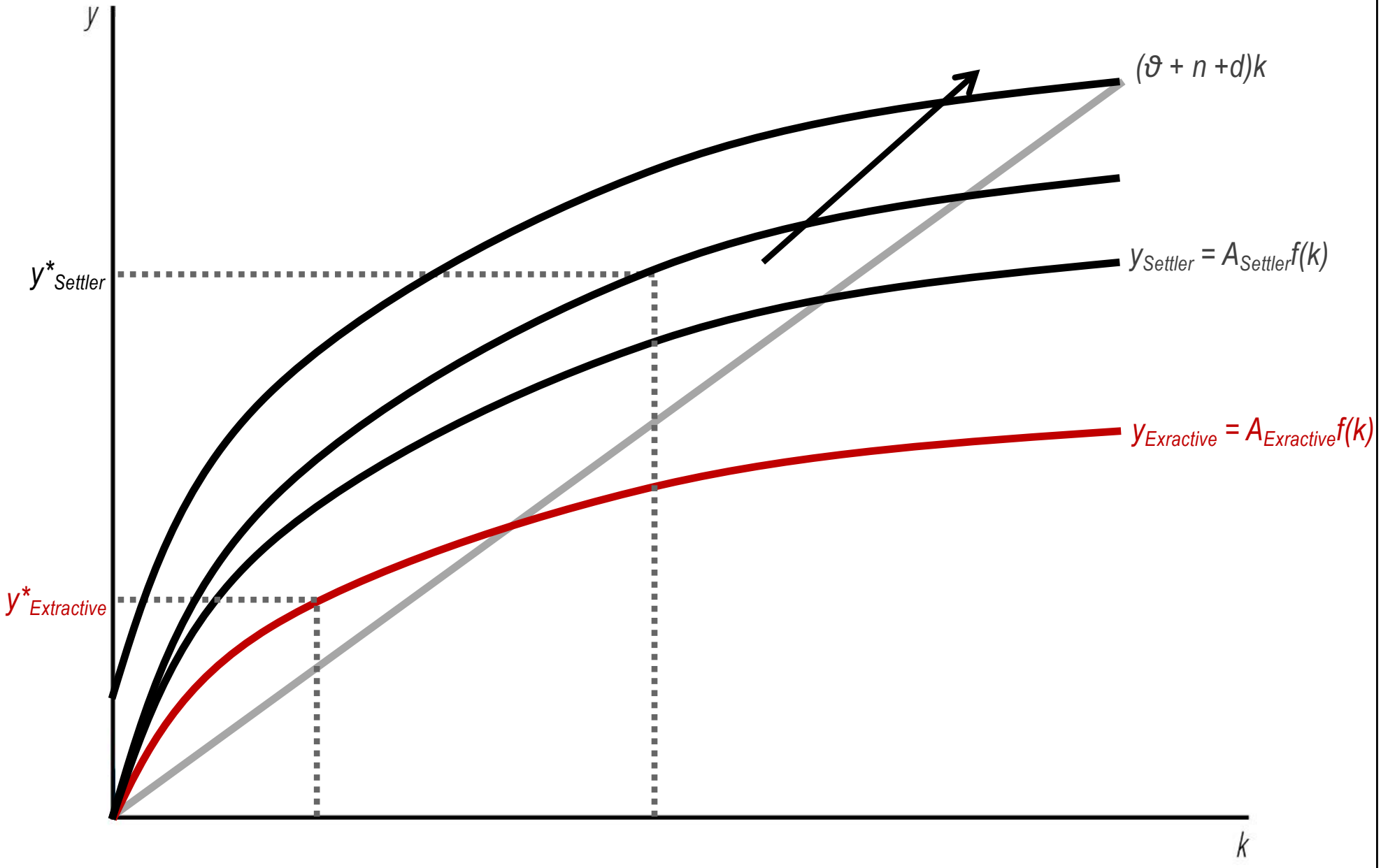
Factor Endowments, Institutions, and Paths of Development

Geography → Institutions
(by another path: endowments)



Explaining income differences in 1500-2000

Free versus unfree institutions



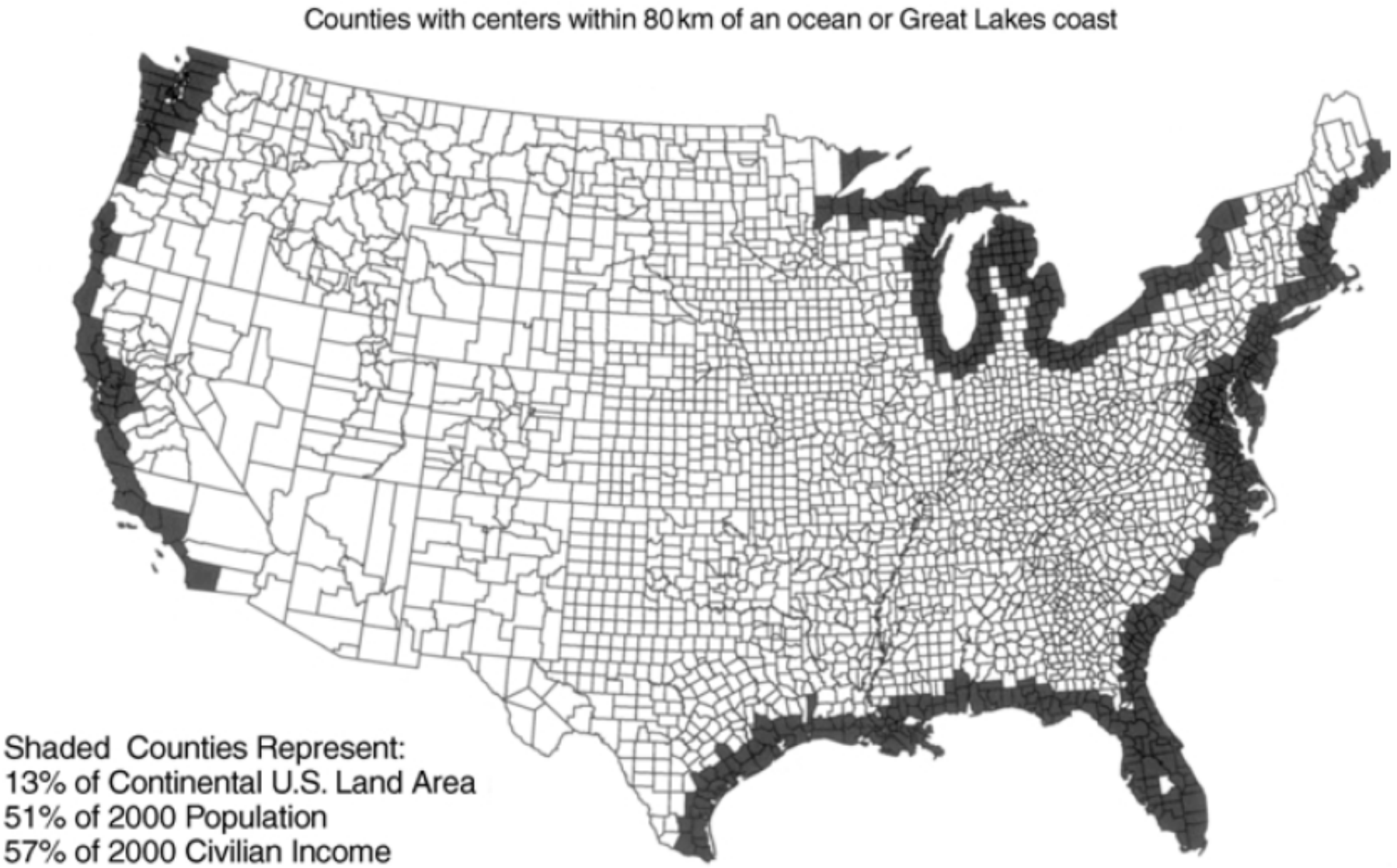
Another view
Geography → Trade → Growth

Coastal access

Navigable rivers

Smooth terrain

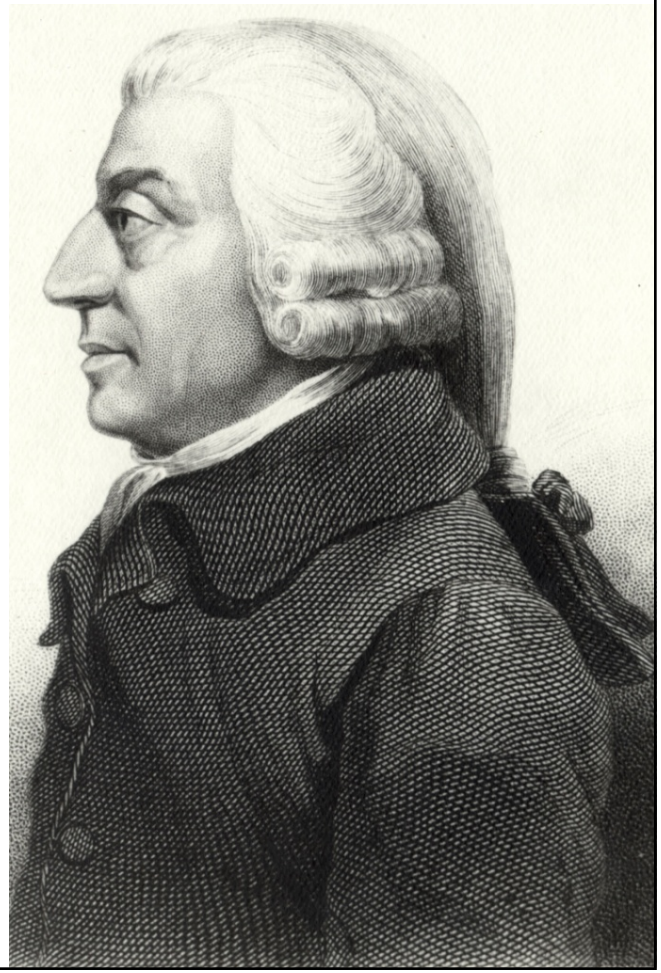
Proximity to markets



Rappaport, Jordan, and Jeffrey Sachs. 2003. "The United States as a Coastal Nation." Journal of Economic Growth 8 (1):5-46.

"As by means of water carriage a more extensive market is opened to every sort of industry than what land carriage alone can afford it, so it is upon the sea-coast, and along the banks of navigable rivers that industry of every kind begins to sub-divide and improve itself, and it is frequently not till a long time after that those improvements extend themselves to the inland part of the country."

-Adam Smith, The Wealth of Nations (1776)



Market integration and growth

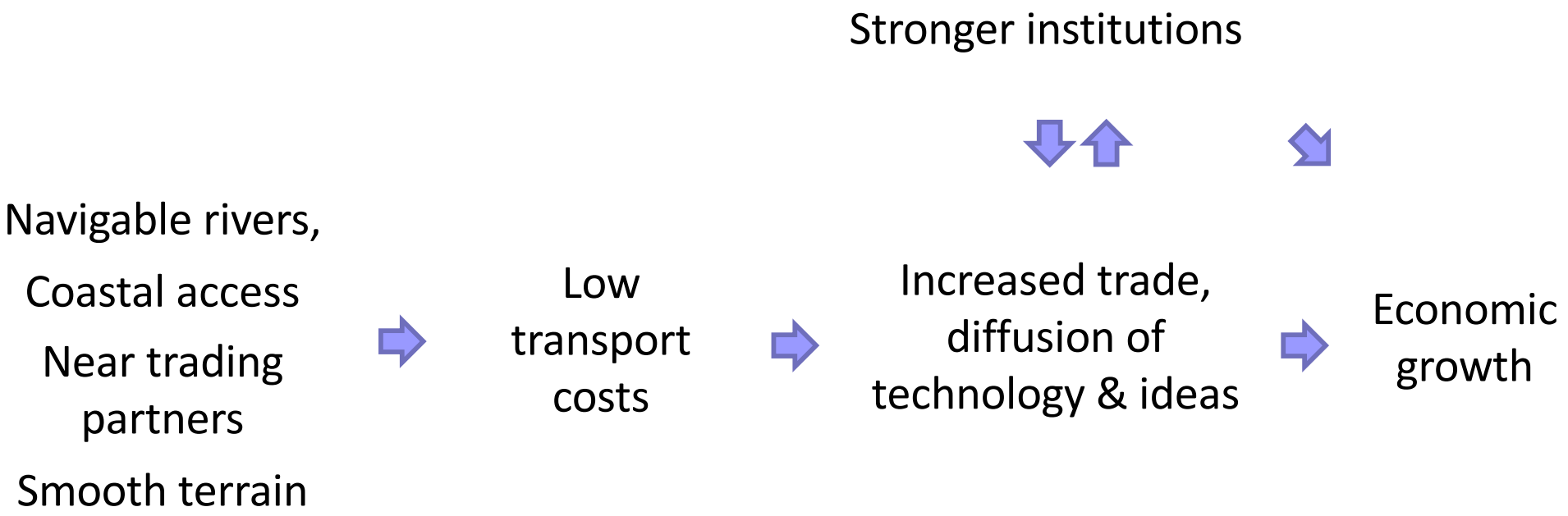
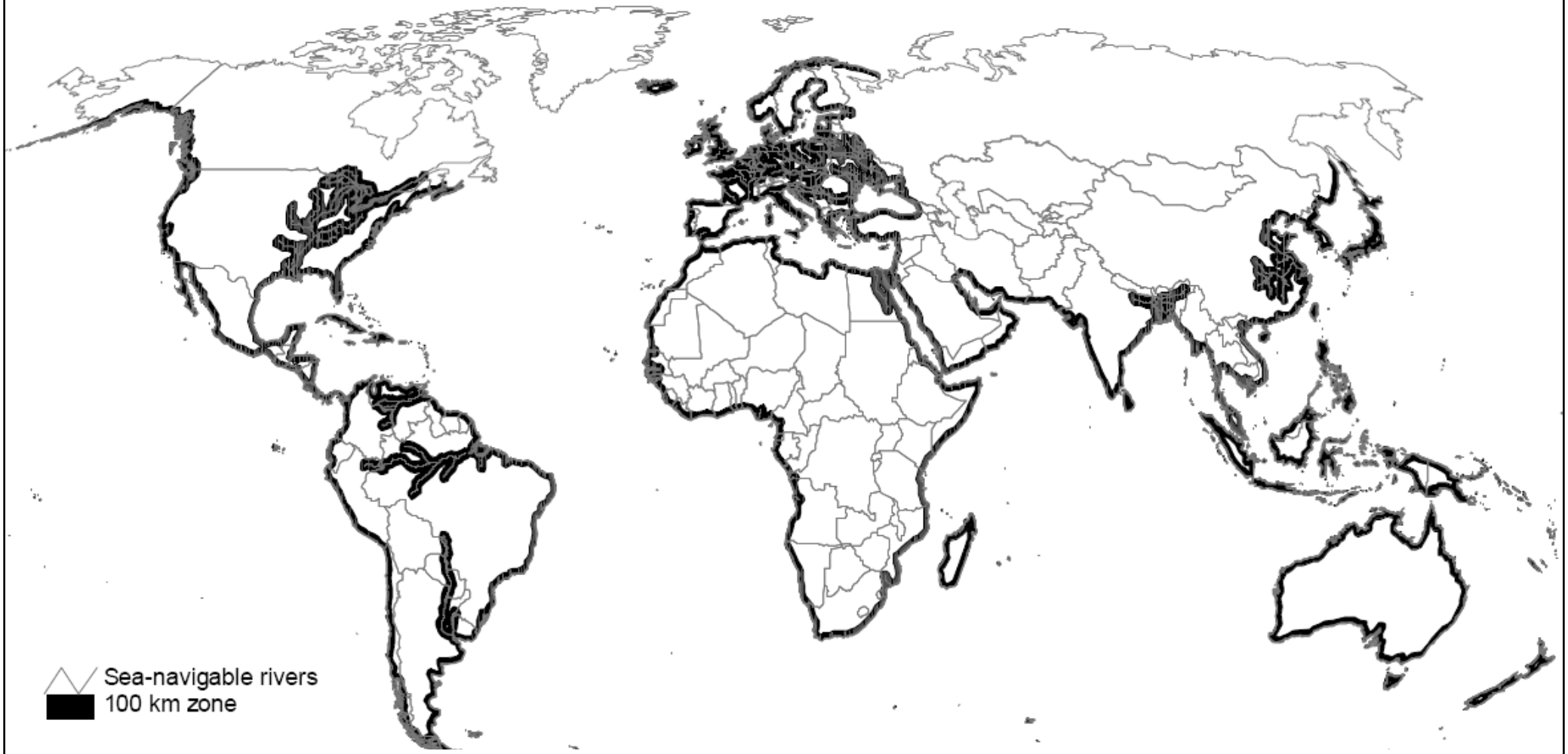


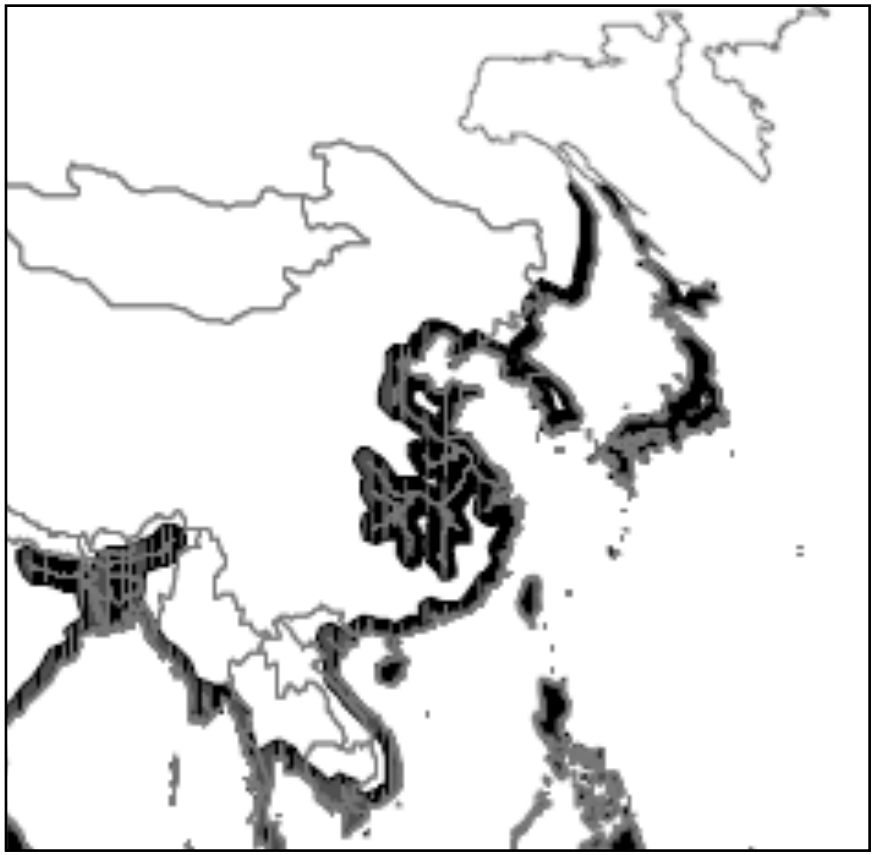
Figure 3. Land within 100 km of an ice-free coast or sea-navigable river



Mellinger, Andrew D., Jeffrey Sachs, and John L. Gallup. 1999. "Climate, Water Navigability, and Economic Development." *CID Working Paper No. 24.*

Europe

China & Japan



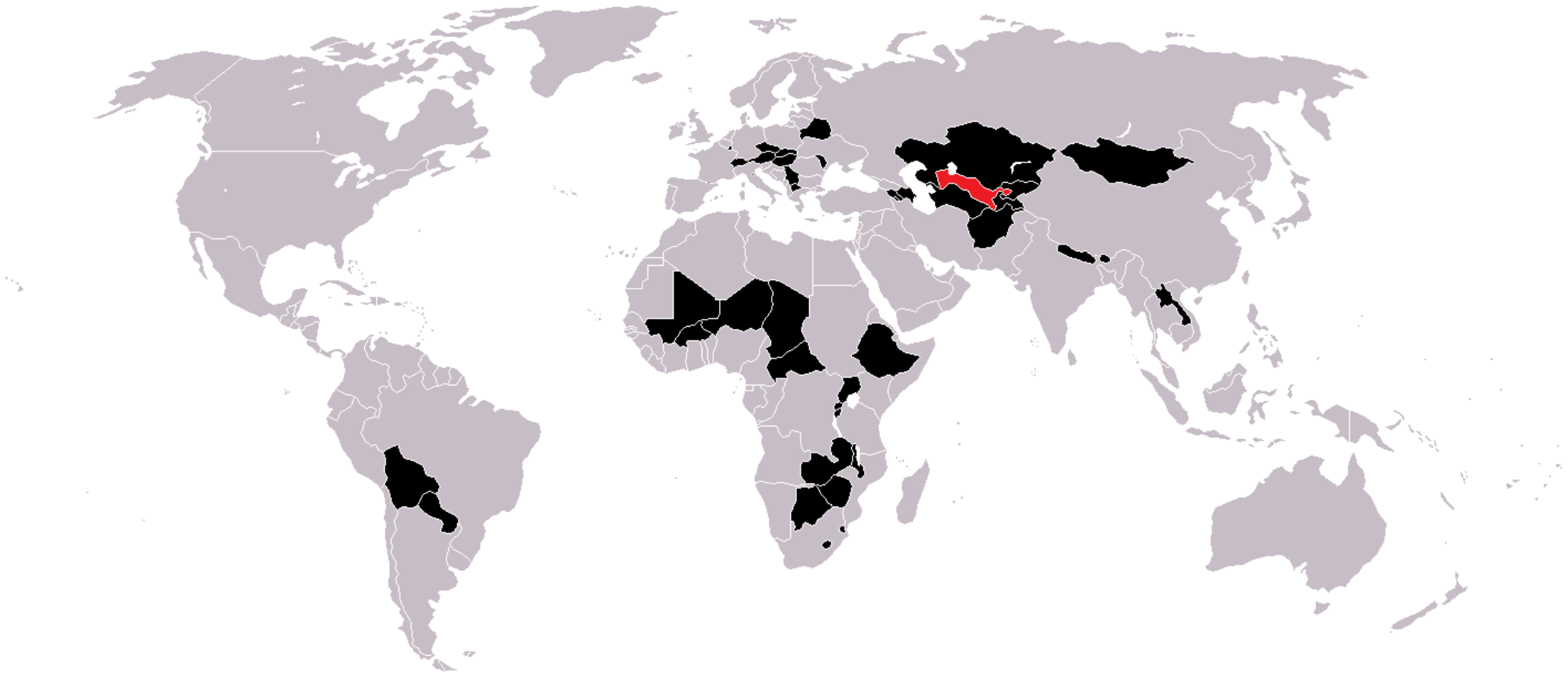
Mellinger, Andrew D., Jeffrey Sachs, and John L. Gallup. 1999. "Climate, Water Navigability, and Economic Development." *CID Working Paper No. 24.*

Mellinger, Andrew D., Jeffrey Sachs, and John L. Gallup. 1999. "Climate, Water Navigability, and Economic Development." *CID Working Paper No. 24.*

World landmass within 100 km of the sea:	17%
World's GDP is produced within 100 km of the sea:	68%
World landmass in temperate climates:	39%
World's GDP is produced within 100 km of the sea:	67%
World landmass: temperate and near the sea:	8%
World's GDP production: temperate and near the sea:	53%

Mellinger, Andrew D., Jeffrey Sachs, and John L. Gallup. 1999. "Climate, Water Navigability, and Economic Development." *CID Working Paper No. 24.*

Landlocked nations




Africa's
Railroads

Consequence of landlockedness

- High transport costs
  - Raise cost of living
  - Reduces trade
  - Raises cost of inputs into production
  - Reduces information flows

Summary: why might geography influence incomes and development?

- *Popular wisdom:* Heat → lethargy
- *Diamond:* Technology advanced unevenly due to ecological barriers
- *Sachs:* Tropical disease burden and agriculture → Lowers productivity & investment
- *AJR:* Disease burden→ Quality of institutions → Growth
- *E&S:* Agricultural endowments → Type of institutions → Growth
- Sachs, others: Geography, Trade, and Growth

Conclusion: what do we do about it?

- One simple view: give aid.
- Another simple view: fix health (Sachs). Evidence mixed, but can't hurt.
- Another: direct institution building. No evidence, little experience.
- But on the micro level we can try all kinds of ideas, and hopefully build them out.