Economics 172
Issues in African Economic Development

Professor Ted Miguel
Department of Economics
University of California, Berkeley

Economics 172
Issues in African Economic Development

Lecture 3 – January 23, 2007

Lecture 3: Economics 172 Information

- Lecturer: Prof. Ted Miguel

  Email: emiguel@econ.berkeley.edu

  Office hours: Mondays 9-11:30am, Evans 647

- Reading packets are in Copy Central. The course syllabus is on my website at:

http://www.econ.berkeley.edu/~emiguel/undergrad_syllabus.pdf

Introduction to the Solow Growth Model

- The goal is to explain income per capita, *y*
- The "inputs" into economic production are:
  - The "capital" stock per capita, *k*

    This should be broadly interpreted to include both physical capital stocks (factories, machinery, tractors, and infrastructure) and human capital stocks (education, skills, health)
  - The "technology" of production, *A*

    This should also be broadly interpreted to include production processes, the organization of society, government institutions, geography, and social characteristics that affect productivity

Modeling economic production

- Economic production is often modeled using the following functional form:

$$y = f(A, k) = Ak^{\alpha}, \text{ where } 0 < \alpha < 1$$

- There is a single production good (called "output")
- Production is increasing in both capital per person (k) and in technology A

- There are decreasing marginal returns to k. Thus returns to capital investment should be highest in poorer countries, everything else equal (ceteris paribus)

Modeling capital accumulation

- The change in the capital stock from last period to this period is denoted by $\dot{k}$ ("kay-dot")

Modeling capital accumulation

- The change in the capital stock from last period to this period is denoted by $\dot{k}$ ("kay-dot")

- Assume that this is a closed economy (so no international flows), and all saving goes into investment.
- Abstract away from firms' investment decisions, and assume that a fraction *s, 0 < s < 1,* of output is saved
- Assume that some fraction *d* of capital is lost or worn out ("depreciation") in each period of time. This yields:

Modeling capital accumulation

- The change in the capital stock from last period to this period is denoted by $\dot{k}$ ("kay-dot")

- Assume that this is a closed economy (so no international flows), and all saving goes into investment.
- Abstract away from firms' investment decisions, and assume that a fraction *s, 0 < s < 1,* of output is saved
- Assume that some fraction *d* of capital is lost or worn out ("depreciation") in each period of time. This yields:

$$\dot{k} = sy - dk = sAk^{\alpha} - dk$$

Solving for steady-state per capita income

- We want to explain steady-state / equilibrium per capita income in terms of the given "exogenous" variables: the savings rate (s), technology (A), the curvature of the production function (α), and capital depreciation (d).
- Steady state capital per capita (k^*) and income per capita (y^*) are the "endogenous" variables determined within the model that we seek to explain

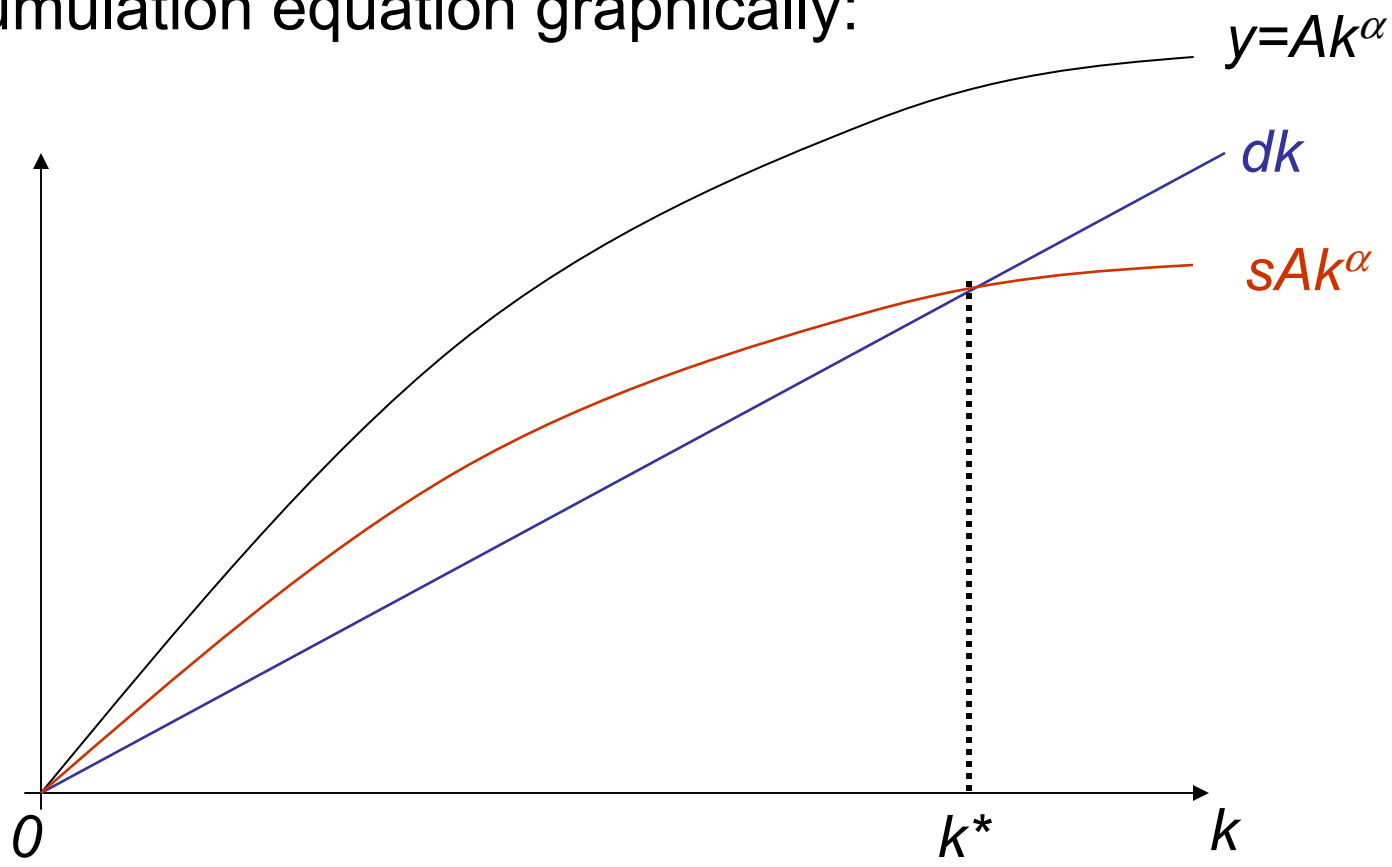
Solving for steady-state per capita income

- We want to explain steady-state / equilibrium per capita income in terms of the given "exogenous" variables: the savings rate (*s*), technology (*A*), the curvature of the production function (α), and capital depreciation (*d*).
- Steady state capital per capita (k^*) and income per capita (y^*) are the "endogenous" variables determined within the model that we seek to explain
- The steady state is where there is the same stable amount of capital per capita across periods: $\dot{k} = 0$ or equivalently where $sAk^{\alpha} = dk$. Solving→

$$k^* = \left(\frac{sA}{d} \right)^{\frac{1}{1-\alpha}}$$

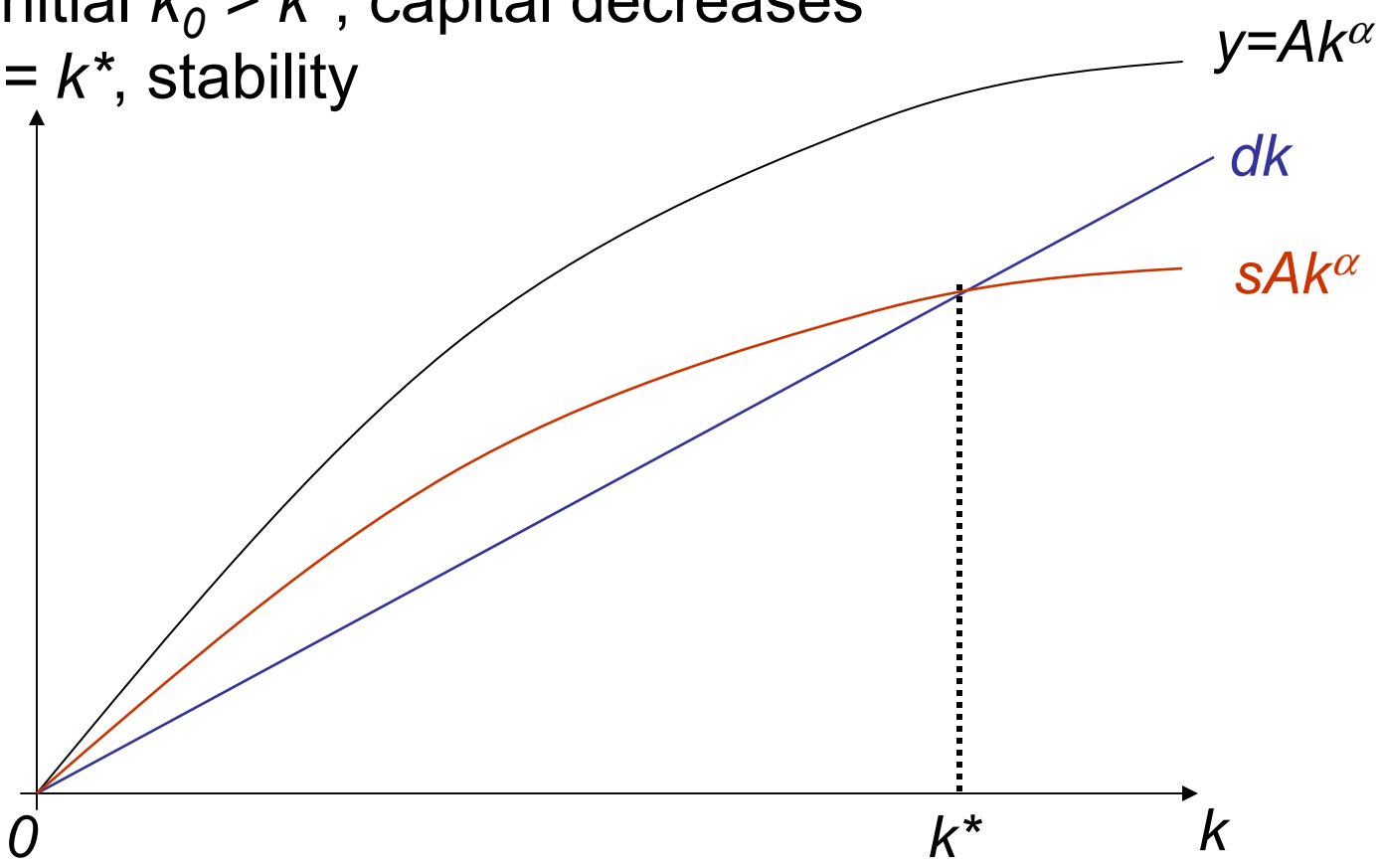
Graphical solutions to the Solow model

- Imagine plotting the two components of the capital accumulation equation graphically:



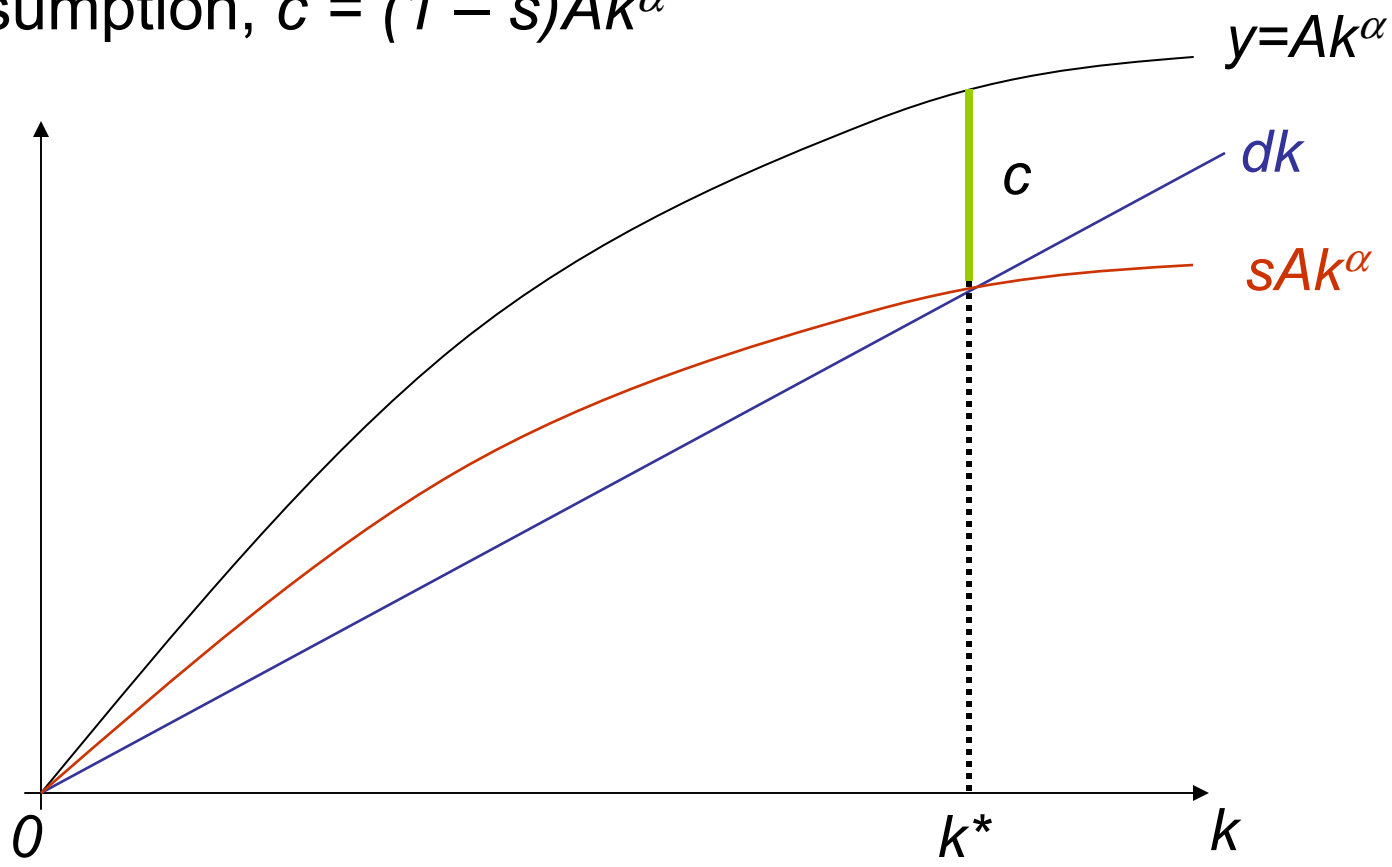
Graphical solutions to the Solow model

- For initial $k_0 < k^*$, the increase in capital is positive
- For initial $k_0 > k^*$, capital decreases
- At $k = k^*$, stability



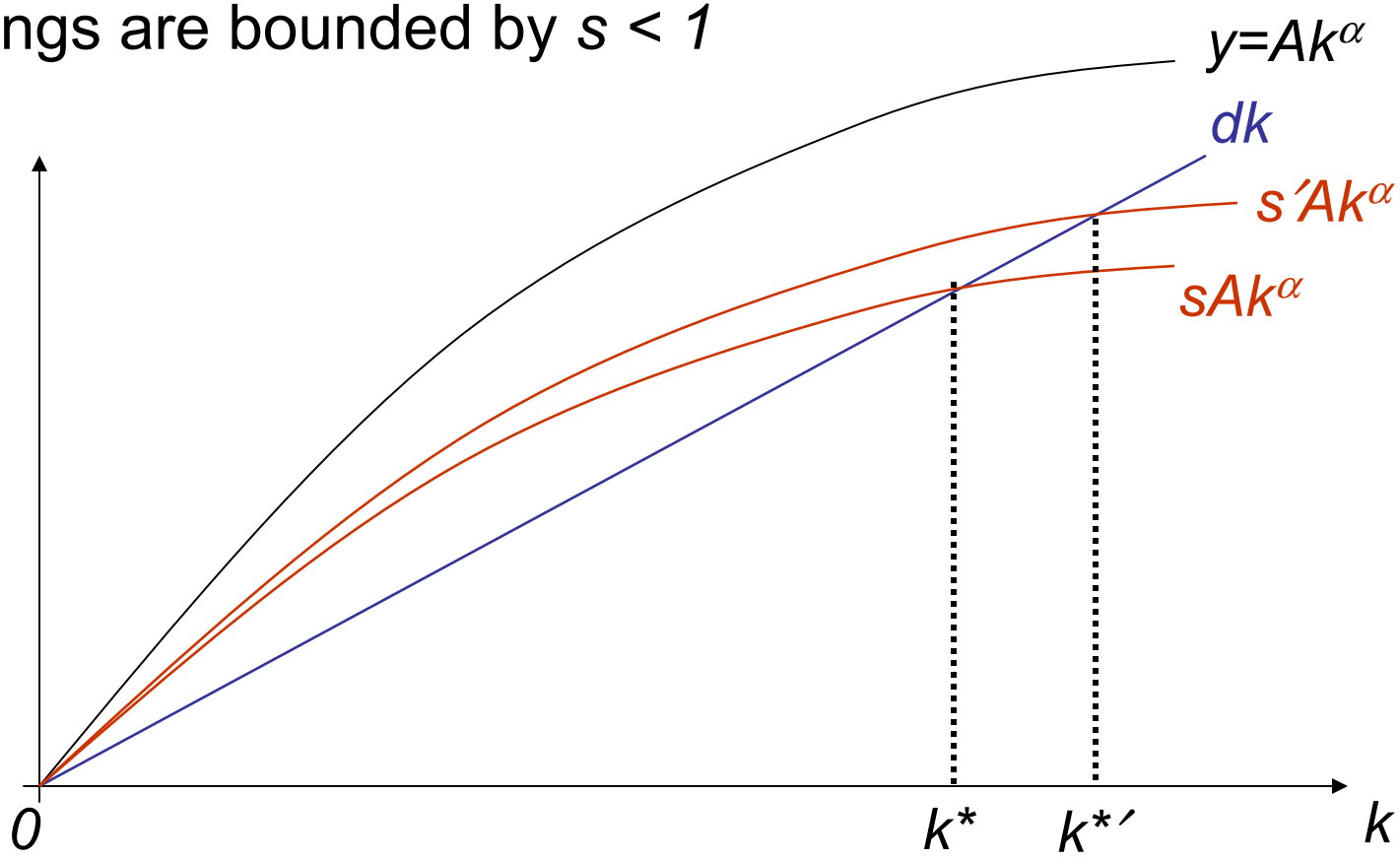
Graphical solutions to the Solow model

- The difference between output and savings is consumption, $c = (1 - s)Ak^{\alpha}$



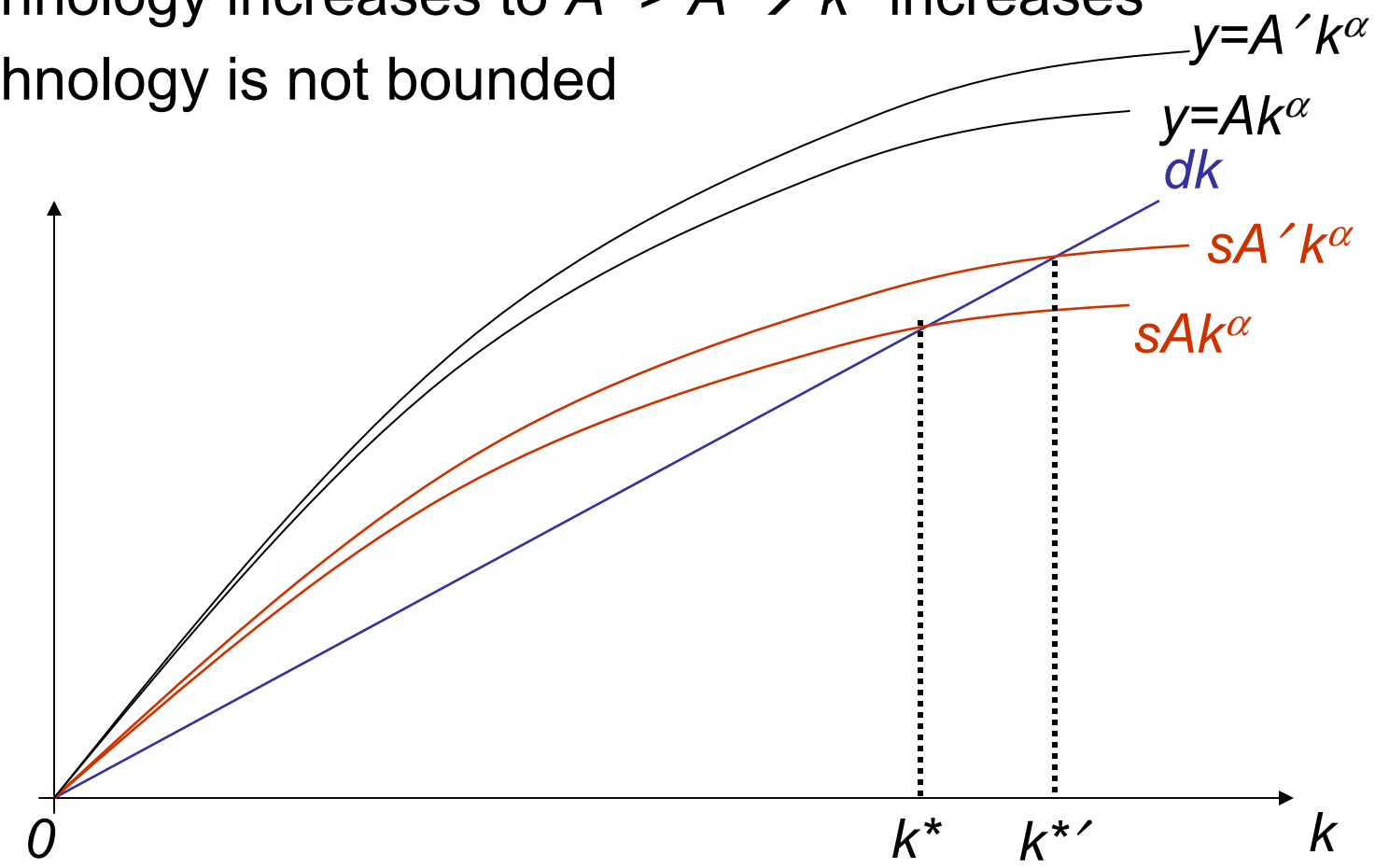
Comparative statics: *s*

- The level of savings increases to $s' > s \rightarrow k^*$ increases
- Savings are bounded by $s < 1$



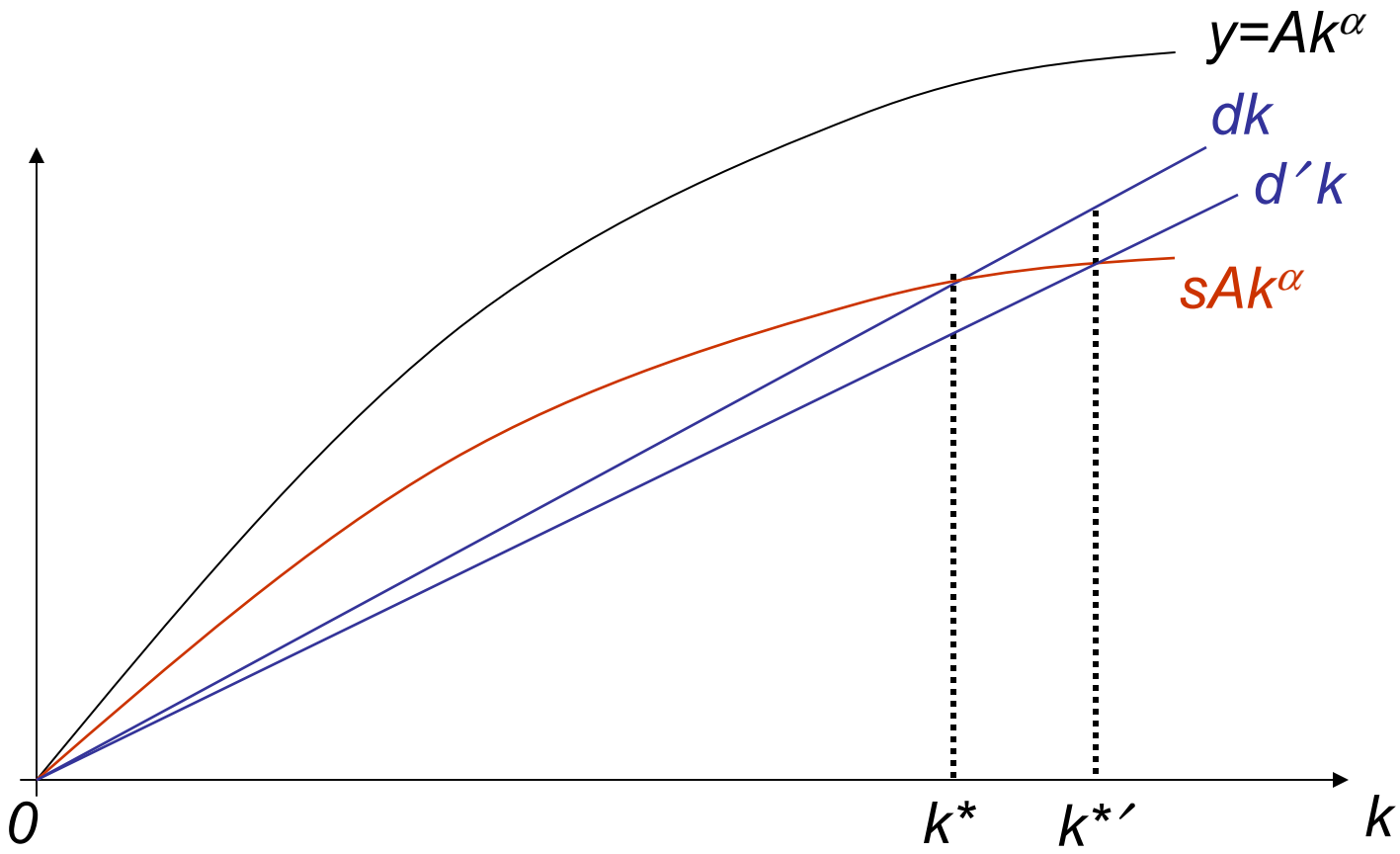
Comparative statics: *A*

- Technology increases to $A' > A \rightarrow k^*$ increases
- Technology is not bounded



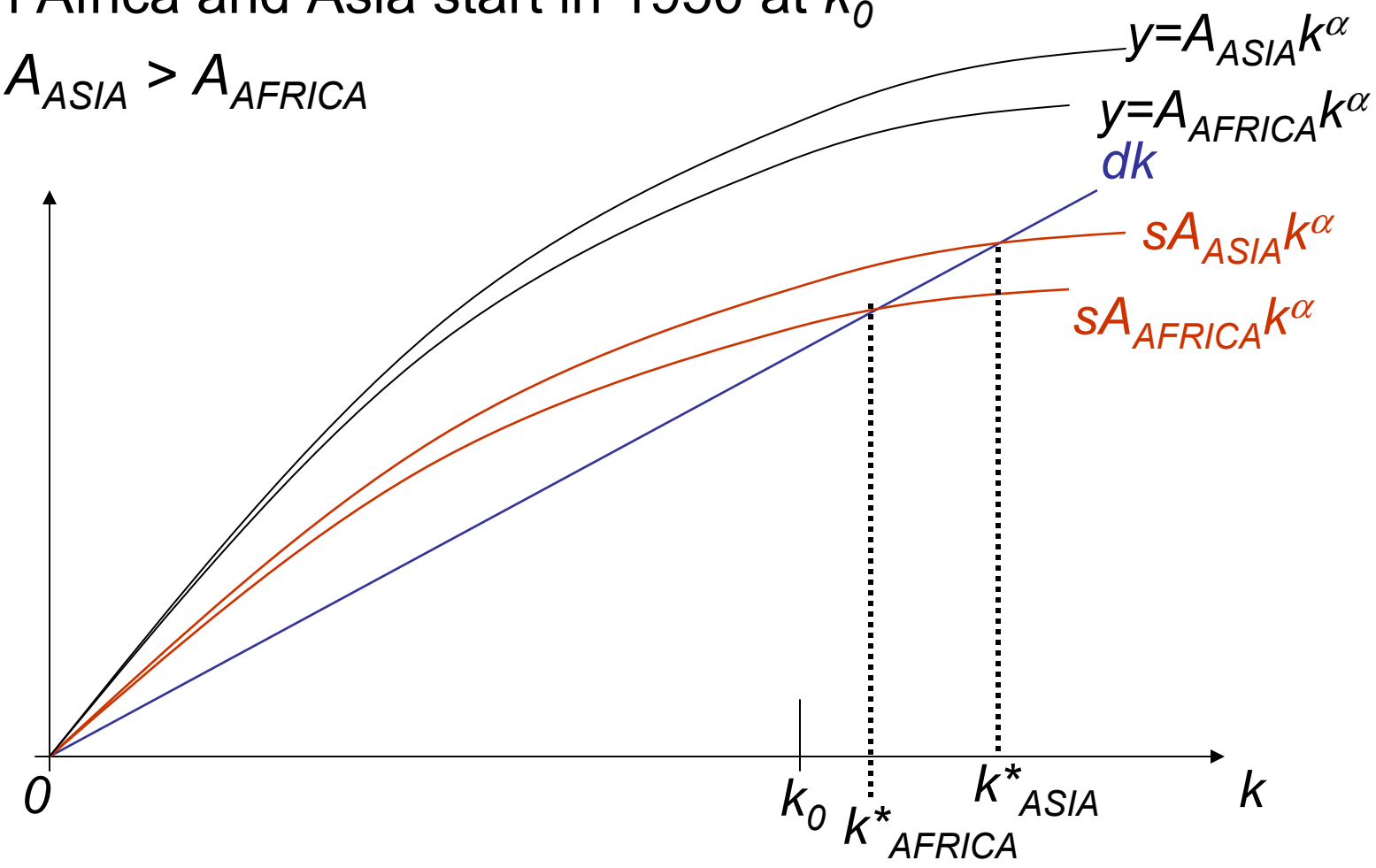
Comparative statics: *d*

- Lower depreciation $d' < d$ boosts steady state k^*



An illustrative case: Africa versus Asia

- Both Africa and Asia start in 1950 at k_0
- But $A_{ASIA} > A_{AFRICA}$



Sources of long-run economic growth

- High investment rates – in physical or human capital – do not yield long run growth: you can only save up to *s=1*, and at that point you are consuming nothing (which is very bad for human welfare)

- Technological improvements are the key source of long-run economic growth (Easterly 2001). They make a given set of production inputs go farther

Evidence on sources of growth

- If *A* were equal across regions / countries, and all differences were driven by baseline capital intensity, then we would see: systematically higher returns to investment in poor countries (like those in Sub-Saharan Africa), most capital flowing from rich to poor countries, and poor countries growing faster than rich countries.
- But we do not see these patterns

Evidence on sources of growth

- If *A* were equal across regions / countries, and all differences were driven by baseline capital intensity, then we would see: systematically higher returns to investment in poor countries (like those in Sub-Saharan Africa), most capital flowing from rich to poor countries, and poor countries growing faster than rich countries.

- More evidence: African countries have shown massive increases in education (e.g., school enrollment, literacy) in the past 50 years but average growth has been zero
- Similarly, massive infusions of international capital – often in "foreign aid" – have not produced growth

Investigating underlying determinants of growth

- For next time, please read the Easterly (2001) chapter, the review of linear regression, and the Bloom and Sachs (1998) article

Whiteboard #1

Whiteboard #2

Whiteboard #3

Whiteboard #4

Whiteboard #5

Map of Africa


AZORES
Ponta Delgada
Porto
Coimbra
Lisbon
PORTUGAL
Valladolid
Madrid
Valencia
Cordoba
Sevilla
Gibraltar
Tangier
Rabat
Casablanca
Marrakech
MOROCCO
Barcelona
Palma
Algiers
Oran
Annaba
Constantine
Batna
Rome
Napoli
Bari
Palermo
Tunis
Catania
Valletta
MALTA
Sfax
Gafsa
Medenine
TUNISIA
Tripoli
Banghazi
Misratah
Istanbul
Ankara
Yerevan
Baku
Caspian Sea
Bursa
Izmir
Athens
Adana
TURKEY
Tabriz
Tehran
IRAN
Al Mawsil
Halab
SYRIA
Beirut
Damascus
Baghdad
IRAQ
Esfahan
Bakhtaran
Amman
Jerusalem
Basra
Kuwait
Shiraz
Mediterranean Sea
Alexandria
Port Said
Suez
Cairo
Beni Suef
El-Minya
EGYPT
Aswan
Nile
Red Sea
Medina
Al Manamah
Ad Dawhah
QATAR
Riyadh
Mecca
SAUDI ARABIA
YEMEN
Al Ghaydan
Sanaa
Taizz
Al Mukalla
Canary Islands
Layoune
WESTERN SAHARA
Tropic of Cancer
Timimoun
Reggane
ALGERIA
Djanet
Ouargla
Sabhah
Marzuq
LIBYA
Al Jawf
Aozou
Taoudenni
Atar
MAURITANIA
Tessalit
Nouakchott
Araouane
MALI
Tombouctou
Niger
Gao
NIGER
Bilma
Agades
Faya-Largeau
Port Sudan
Atbarah
Khartoum
Asmara
ERITREA
Mekele
Praia
CAPE VERDE
Dakar
SENEGAL
Banjul
GAMBIA
Kayes
Tambacounda
Bamako
Tahoua
Niamey
Zinder
L. Chad
CHAD
Al Fashir
SUDAN
Djibouti
Berbera
Hargeysa
Bissau
GUINEA BISSAU
GUINEA
Kankan
BURKINA FASO
Ouagadougou
Bobo Dioulasso
Sokoto
Katsina
Kano
Maiduguri
NÔDjamena
Dire Dawa
Addis Ababa
Conakry
Freetown
SIERRA LEONE
Monrovia
LIBERIA
Korhogo
COTE D'IVOIRE
Bouake
Man
Tamale
Kumasi
GHANA
Abidjan
Accra
Lome
BENIN
Parakou
Zaria
Kaduna
Jos
Abuja
Ibadan
Porto Novo
NIGERIA
Moundou
Ndele
CENTRAL AFRICAN REPUBLIC
Bossangoa
Waw
ETHIOPIA
Asela
Goba
Juba
SOMALIA
Port Harcourt
CAMEROON
Douala
Yaounde
Malabo
EQUATORIAL GUINEA
Ebolowa
Bata
Berberati
Bangui
Bangassou
Gulu
UGANDA
KENYA
Mogadishu
Equator
SAO TOME & PRINCIPE
Sao Tome
Libreville
Port Gentil
GABON
CONGO
Mbandaka
Bumba
Kisangani
Kampala
Lake Victoria
Eldoret
Kisumu
Nairobi
Chisimayu
DEM. REP. OF CONGO
Kigali
Bukavu
Bujumbura
Mwanza
Brazzaville
Kinshasa
Pointe-Noire
Matadi
Kananga
Kalemi
Tabora
TANZANIA
Mombasa
Tanga
Dar es Salaam
Luanda
Malange
Kamina
Mbeya
Kasama
Likasi
L. Malawi
Moroni
COMOROS
Antsiranana
Luena
Lubumbashi
Huambo
ATLANTIC
OCEAN
Lubango
ANGOLA
ZAMBIA
Lusaka
Mongu
Chipata
MALAWI
Lilongwe
MOZAMBIQUE
Blantyre
Nampula
Livingstone
Victoria Falls
Harare
ZIMBABWE
NAMIBIA
Tsumeb
Maun
Bulawayo
Beira
Antananarivo
Toamasina
MADAGASCAR
Windhoek
Francistown
BOTSWANA
Walvis Bay
Tropic of Capricorn
Gaborone
Pietersburg
Fianarantsoa
Tulear
Pretoria
Maputo
Mbabane
Tolanaro
0
1000 Miles
0
1000 Km
Luederitz
Keetmanshoop
Johannesburg
SWAZILAND
Welkom
Orange
Kimberley
Maseru
Bloemfontein
LESOTHO
Durban
SOUTH AFRICA
De Aar
Beaufort West
Umtata
Oudtshoorn
East London
Cape Town
Port Elizabeth