

Development Economics

Slides 3

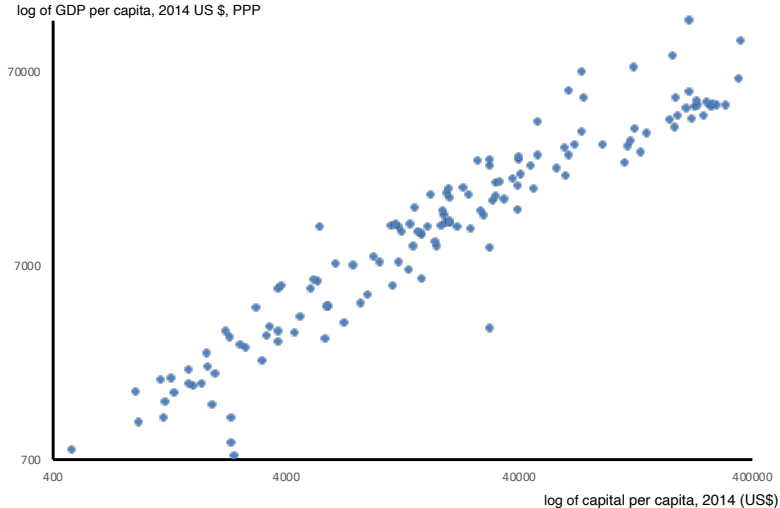
Debraj Ray, NYU

Capital

- **Physical capital:** a fundamental correlate of per-capita income.

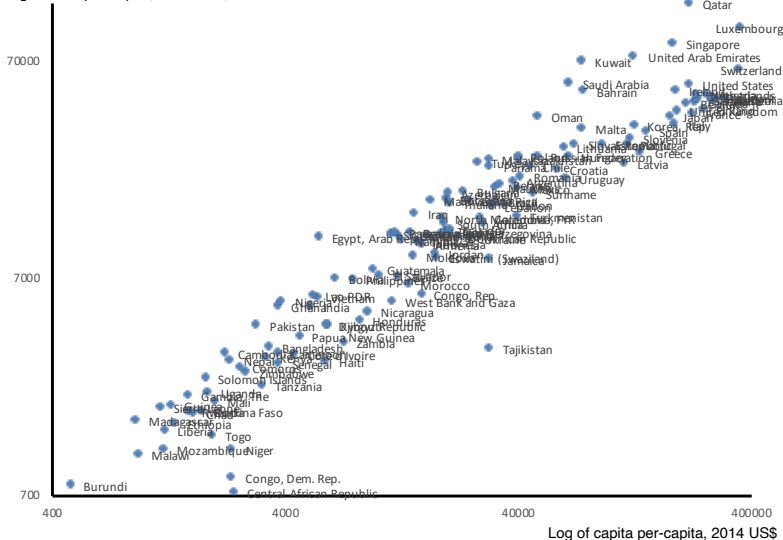
Capital

- **Physical capital:** a fundamental correlate of per-capita income.



■ Physical capital: a fundamental correlate of per-capita income.

log of GDP per capita, 2014 US\$, PPP



- If this correlation is so strong, isn't **capital accumulation** the answer?
- Savings ability and motives
- How savings translate into output
- That takes us to the **theory of economic growth**.

The Production Function

■ Production function:

$$Y = F(K, L)$$

- K and L : a long list of inputs, but think of them as two numbers for now.

The Production Function

■ Production function:

$$Y = F(K, L)$$

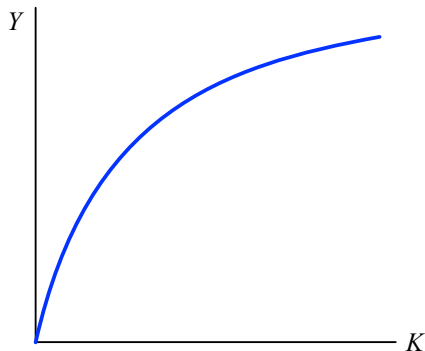
- K and L : a long list of inputs, but think of them as two numbers for now.

■ Returns to scale:

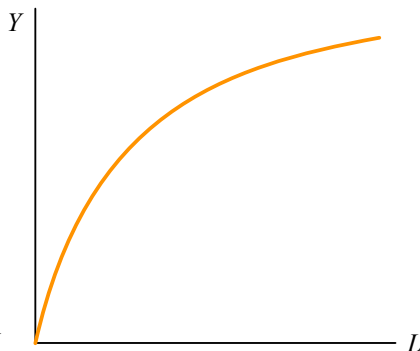
- Constant returns to scale: $F(\lambda K, \lambda L) = \lambda F(K, L)$ for all $\lambda > 0$.
- Increasing returns to scale: $F(\lambda K, \lambda L) > \lambda F(K, L)$ for all $\lambda > 1$.
- Decreasing returns to scale: $F(\lambda K, \lambda L) < \lambda F(K, L)$ for all $\lambda > 1$.

The Production Function

■ Diminishing returns to individual inputs:



Drawn for some fixed value of L



Drawn for some fixed value of K

- Typical example is **Cobb-Douglas production function**

$$Y = AK^a L^b$$

- Explain $0 < a < 1, 0 < b < 1$.

- Typical example is **Cobb-Douglas production function**

$$Y = AK^aL^b$$

- Explain $0 < a < 1, 0 < b < 1$.

- **Returns to scale with Cobb-Douglas**

- $a + b = 1$ (**constant returns to scale**, our leading case)
- $a + b < 1$ (decreasing returns to scale)
- $a + b > 1$ (increasing returns to scale)

The Production Function in Per-Capita Form

- Start with Cobb-Douglas case $Y = AK^aL^b$. Divide through by L to get

$$\frac{Y}{L} = A \frac{K^a}{L^{1-b}} = A \left(\frac{K}{L} \right)^a \Rightarrow y = Ak^a,$$

where $y = Y/L$ and $k = K/L$ — provided that $a + b = 1$.

The Production Function in Per-Capita Form

- Start with Cobb-Douglas case $Y = AK^aL^b$. Divide through by L to get

$$\frac{Y}{L} = A \frac{K^a}{L^{1-b}} = A \left(\frac{K}{L} \right)^a \Rightarrow y = Ak^a,$$

where $y = Y/L$ and $k = K/L$ – provided that $a + b = 1$.

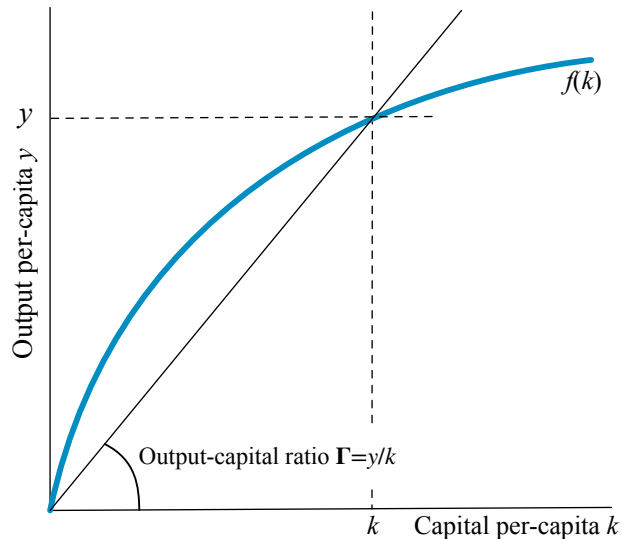
- General case: $Y = F(K, L)$. CRS: $F(\lambda K, \lambda L) = \lambda F(K, L)$.

- Setting $\lambda = 1/L$ in this equation, we get

$$F\left(\frac{K}{L}, 1\right) = \frac{1}{L}F(K, L) = \frac{Y}{L}, \text{ or } y = f(k),$$

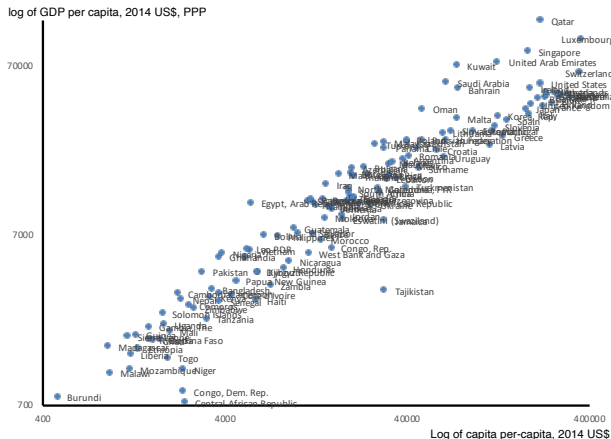
where $y = Y/L$, $k = K/L$ and $f(k) = F(k, 1)$.

The Production Function in Per-Capita Form



The Production Function in Per-Capita Form

- **Recall:** $y = f(k)$ and in the Cobb-Douglas case, $y = Ak^a$.
- **Observation:** Take logs in the Cobb-Douglas case, get $\ln y = \ln A + a \ln k$:
- Linear: earlier scatter plot pretty impressively in line:



Caveats to Keep in Mind

- Lots of residual variations around linearity in that scatter plot:

Caveats to Keep in Mind

- Lots of residual variations around linearity in that scatter plot:
- Productivity variations:

$$Y = AK^aL^b \text{ or } Y = AK^a(eL)^b$$

Caveats to Keep in Mind

- Lots of residual variations around linearity in that scatter plot:
- Productivity variations:

$$Y = AK^a L^b \text{ or } Y = AK^a (eL)^b$$

- A (total factor productivity) and e (labor productivity) vary across countries.

limited flow of technology.

high fixed costs: infrastructure, roundaboutness in production.

allocative inefficiency: imperfect capital markets, political patronage.

Caveats to Keep in Mind

- Lots of residual variations around linearity in that scatter plot:
- **Limited human capital:** $Y = F(K, \text{labor of different qualities})$

Caveats to Keep in Mind

- Lots of residual variations around linearity in that scatter plot:
- **Limited human capital:** $Y = F(K, \text{labor of different qualities})$
- Can interpret e on last page as “education per person.”

Caveats to Keep in Mind

- **Lots of residual variations around linearity in that scatter plot:**
 - **Limited human capital:** $Y = F(K, \text{labor of different qualities})$
 - Can interpret e on last page as “education per person.”
- **Alternatively:** $Y = AK^aU^bH^c$
 - where U is unskilled labor and H is “human capital”.
 - **imperfect substitution** across labor types.

Caveats to Keep in Mind

- And last but not least:
- **Physical capital is endogenous**

Caveats to Keep in Mind

- And last but not least:
- **Physical capital is endogenous**
 - Where does this huge range of physical capital come from?
 - Need to demonstrate why the pace of accumulation is slow.
 - Combine production function with “behavioral model”.
 - Leads to a theory of **economic growth**.