# Growth and Productivity

- Long run economic growth is obviously rather important and economics should have a lot to say about it

There are five stylized facts

1. Large differences in growth rates and levels of per capita income persist across countries and over time
2. In the long run economies exhibit a balanced growth path -Q per capita and K per capita roughly same positive growth over time
3. real rate of return to capital roughly constant long run and real wages grow at rate close to growth Q per head. So K/Q no trend over time and K/Q and K/Q stay roughly constant
4. High investment rates in capital and human capital (education) closely related to high living standards
5. Low population associated with high living standard

- Steady state growth or balanced growth path in the long run: growth output and employ constant and share of saving constant
- Need technological progress to explain growth in output per capita
- **Solow** -constant returns to scale production function and diminishing MP for all factors
$$Y = f(K, L)$$
- Harrod neutral technological progress -disembodied labour augmenting
- Technology essentially 'manna from heaven'

$$\begin{aligned} Y &= AK^{\beta_1}L^{\beta_2} \\ \beta_1 + \beta_2 &= 1 \end{aligned}$$

$$\log Y = \beta_0 + \beta_1 \log + K + \beta_2 \log L + u$$

Note that we can also use the framework to look at factor demands and productivity. Consider:
$$Y = AK^{\alpha}L^{\beta}$$

to operationalise this we normally take logs and estimate

$$\log Y = \log A + \alpha \log K + \beta \log L$$

using lower case for logs we can rewrite as

$$y = \alpha_0 + \alpha_1 k + \beta l$$

assuming constant returns to scale $\alpha_1 + \beta = 1$ so

$$\begin{aligned} y &= \alpha_0 + \alpha_1 k + (1 - \alpha_1) l \\ y &= \alpha_0 + \alpha_1 k + l - \alpha_1 l \end{aligned}$$

so

$$\begin{aligned} y - l &= \alpha_0 + \alpha_1 k - \alpha_1 l \\ y - l &= \alpha_0 + \alpha_1 (k - l) \end{aligned}$$

this is sometimes used to overcome problems of multicollinearity. If we don't assume constant returns to scale then:

$$\begin{aligned} y - l &= \alpha_0 + \alpha_1 k + \beta l - l \\ y - l &= \alpha_0 + \alpha_1 k + (\beta - 1) l \end{aligned}$$

which can be reparametarised for estimation as

$$y - l = \alpha_0 + \alpha_1 k + \alpha_2 l$$

Economy grows at the natural rate set by exogenous labour force growth and technical progress

- **Growth accounting:** Dennison/Maddison following Solow
- $$\text{Output growth} = a \text{ capitalgrowth} + b \text{ labourgrowth} + \text{a residual}$$

  with $a$ being the share of profits and $b$ the share of wages
- So source of growth are simply contributions from factor inputs and Total Factor Productivity (the residual)
- Even when extended studies have found the residual does a lot of work.
- Growth without technological progress suggests that output and employment grow at same level, i.e. labour productivity does not grow, but this is not what is observed so need to consider what drive growth productivity and divergent growth rates across countries
- **Convergence/Catch up:**
- Solow developed model to look at dynamics of individual country, but used for cross country studies.

- Implication of model with TP is that countries with low levels of capital will grow more quickly than those with high, so expect poorer countries to catch up with richer ones over time.
- Actually poorer will need to increase savings rate (lower popn growth) relative to rich -absolute convergence. Is also conditional convergence, which depends on being away from steady state, if steady state characteristics are similar
- Can catch up through education
- some evidence of convergence this if look at advanced economies
- but also examples of developing countries that have failed to catch up
- also Friedmans criticism/fallacy-Argentina in early part of century and now and sample selection bias

  Still considerable debate -use of panel data
- For Solow model changes in growth of output per capita in long run steady state come from changes in the rate of exogenous technological progress only

- **New growth theory** is a variant/development of N-C model which allows long run divergence in growth rates and income levels associated with factor accumulation
- provides mechanisms to overcome diminishing returns to capital which allows policy or preference changes to impact on the long run steady state
- Knowledge spillovers: knowledge translates into skill and influences labour productivity
- Human capital accumulation: Lucas sees human capital as an externality that augments TFP growth
- Research and Development -innovations and blueprints -if excludable imperfect market
- Models mainly developed by Romer and Lucas
- Romer 1 adds $\beta$ to conventional exponent as induced technical improvement , increasing returns to scale

$$Y = AK^{\alpha+\beta}L^{1-\alpha}$$

- Romer 2: Introduces D a set of designs resulting from R&D, constant returns to scale to growth of K and D together, but problems of measuring R&D are well known. Labour produces output and designs (intermediate)

$$Y = K^{1-\alpha} L^{\alpha} D^{\alpha}$$

- **Schumpetarian:** creative destruction and innovation -good discussion in Carlin & Soskice
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- **Efficiency of use of factors and persistent failure of markets and governments to eliminate inefficiency**
- rent seeking: policy distortions and inefficiency -resources switched into competition for economic rents.
- importance of interest groups Olsen
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- **Role of Institutions**
- tend to use formal models of bargains betweem firms and unions
- usually effect level rather than growth productivity
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- Critics of new growth theory find it
- rich in theoretical detail
- limited in empirical support
- conceptually flawed/lacking
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**Serious conceptual problems with aggregate production functions:**

- Capital controversy: theoretical inconsistencies in N-C production function and distribution.
- Individual firms unlikely to have the same production function. C-D is in logs so means should be geometric.

- Production function is only one equation of a simultaneous system: marginal productivity conditions, need to be aggregated as well.
- Existence of external economies of scale: whole > sum of parts
- Firms/industries can have widely different outputs and techniques of production: $\alpha$ and $\beta$ unlikely to be distributed independently of $K$ and $L$. High values of $K$ are likely to have high $\alpha$ and high $L$ high $\beta$. These may change over time. Increases in output will be greater if increase labour in a labour intensive industry, but where it goes depends on factor prices and these may vary in non-competitive industries. Cannot be a purely technical relationship.

**Serious practical problems**

- Aggregating labour inputs: use person hours, but how to treat skills/quality . In practice approximate by aggregate monetary value of inputs, deflated by a labour input price index, or use unweighted measures of flows (total person hours) or stock (total no. employees). Also use of gross output and value added measures.
- Aggregating capital inputs causes greatest problems: Often use value of the capital stock (replacement cost in some base year gross or net of depreciation) in practice, but there are many problems (variations in quality, scrapping, using stock rather than flow). Sometimes assume all revenues go to labour ad capital (no profits) so $PQ = wL + mK$ but this can lead to serious problems of interpretation. Problems in getting a price of capital when needed.

- Orthodox critics argue for more use of 'special cases' rather than technocratic approach -justify by parables -Temple
- More radical argue need to consider the social relations of production/ social determinants
- Hodgson: move back to classical: example of 1974
- SSA School in the US -see HarvieCJE 1996 on UK coal industry