6-2-09

GROWTH ACCOUNTING

1957 SOLOW

(1) $Y = B\ k^{\alpha}\ L^{1-\alpha}$

B POSITIVE CONSTANT

B = NEUTRAL TECH. PROGRESS.

TAKING GROWTH RATES OF (1)

$$\hat{Y} = \hat{B} + \alpha\hat{k} + (1-\alpha)\hat{L}$$

GROWTH RATE OF B = TOTAL FACTOR PRODUCTIVITY GROWTH = TFP GROWTH

(B = TOTAL FACTOR PRODUCTIVITY)

DATA:

$\hat{Y}$: OBSERVED / EASY

$\hat{L}$: RAW LABOR : OBSERVED / EASY

$\hat{k}$: OBSERVED / HARD TO CALCULATE

α = CAN BE ESTIMATED USING

P.C & PROFIT MAX ⇒

$$\alpha = \frac{w_L}{pY} = \text{CAPITAL SHARE}$$

$$\Rightarrow \hat{Y} = \hat{B} + \underbrace{\alpha\hat{K} + (1-\alpha)\hat{L}}_{\downarrow}$$

$\hat{Y}$ ↓ CAN BE CALCULATED

$\hat{B}$?? ↓ SOLOW RESIDUAL

SOLOW PROPOSED TO CALCULATE $\hat{B}$ AS A RESIDUAL:

$$\hat{B} = \hat{Y} - [\alpha\hat{K} + (1-\alpha)\hat{L}]$$

SOLOW RESIDUAL = TFP GROWTH = GROWTH OF OUTPUT THAT CAN'T BE EXPLAINED BY INPUT GROWTH

ANOTHER PRESENTATION OF SAME THING: IN PERCENTAGES

$$\frac{\hat{B}}{\hat{Y}} = \frac{\hat{Y}}{\hat{Y}} - \underbrace{\frac{[\alpha\hat{K} + (1-\alpha)]\hat{L}}{\hat{Y}}}_{\%\text{ OF OUTPUT GROWTH EXPLAINED BY GROWTH OF INPUTS}}$$

$\frac{\hat{B}}{\hat{Y}}$: % OF OUTPUT GROWTH EXPLAINED BY TFP GROWTH

6-4-09

- GROWTH ACCOUNTING
  - JONES
  - AGHION-HOWITT
  - KRUGMAN / STIGLITZ
  - YOUNG

- SOLOW MODEL WITH HUMAN CAPITAL

GROWTH ACCOUNTING

LAST CLASS

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

TAKING GROWTH RATES

$$\hat{Y} = \hat{B} + \alpha \hat{K} + (1-\alpha)\hat{L}$$

$$\Rightarrow \hat{B} = \hat{Y} - [\alpha \hat{K} + (1-\alpha)\hat{L}]$$

$\hat{B}$ → TFP GROWTH OR SOLOW RESIDUAL

ALTERNATIVE PRESENTATION:

$$\frac{\hat{B}}{\hat{Y}} + \frac{\alpha \hat{K} + (1-\alpha)\hat{L}}{\hat{Y}} = 1$$

AGHION - HOWITT

FOCUS ON PER CAPITA / PER WORKER MAGNITUDES INSTEAD

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

DIVIDING BY L

$$\frac{Y}{L} = \frac{B K^{\alpha} L^{1-\alpha}}{L} = B\left(\frac{K}{L}\right)^{\alpha}$$

$$\Rightarrow \boxed{y = B k^{\alpha}}$$

TAKING GROWTH RATES

$$\hat{y} = \hat{B} + \alpha \hat{k}$$

- $\hat{y}$: OUTPUT PER WORKER / CAPITA GROWTH
- $\hat{B}$: TFP GROWTH
- $\alpha \hat{k}$: CAPITAL DEEPENING OR GROWTH OF CAPITAL PER WORKER · CAPITAL SHARE

$$\Rightarrow \boxed{\hat{B} = \hat{y} - \alpha \hat{k}}$$

↓ SOLOW RESIDUAL

ALSO $$\frac{\hat{y}}{\hat{y}} = 1 = \frac{\hat{B}}{\hat{y}} + \alpha \frac{\hat{k}}{\hat{y}}$$

THESE ESTIMATES ARE GIVEN IN TABLE 5.1

TABLE 5.1 , ASSUMES $\alpha = 0.3$
(ESTIMATED α's ARE VERY CLOSE TO THE ASSUMED NUMBER)

COUNTRY	$\hat{\gamma}$	$\hat{B}$	$\alpha\hat{\lambda}$	$\frac{\hat{B}}{\hat{\gamma}}$	$\frac{\alpha\hat{\lambda}}{\hat{\gamma}}$

USA : 1960-2000

$\frac{\hat{B}}{\hat{\gamma}}$ = TFP SHARE = 0.58

ISSUE OF HUMAN CAPITAL
(NEEDS TO BE TAKEN INTO ACCOUNT FOR ACCURATE MEASURING OF $\hat{B}$)

INCLUDING H-K $\Rightarrow$ ESTIMATES OF $\hat{B}$ ↓ -

AS AN EXAMPLE :

$\left.\frac{\hat{B}}{\hat{\gamma}}\right|_{\text{TAKING H-K INTO ACCOUNT}} = 0.50$

YOUNG TABLE I

ADJUSTED BY CHANGES IN LABOR FORCE SIZE AND EDUCATION LEVEL

GDP p.c. GROWTH, TFP GROWTH

H-K	(1966-91)	$\hat{y} = 5.7\%$	$\hat{B} = 2.3\%$
SIN	(1966-90)	$\hat{y} = 6.8\%$	$\hat{B} = 0.2\%$
S-K	"	$\hat{y} = 6.8\%$	$\hat{B} = 1.7\%$
TAIWAN	"	$\hat{y} = 6.7\%$	$\hat{B} = 2.1\%$

REMARK: GDP PER WORKER WILL GROW SLOWER BECAUSE ↑ LABOR PARTICIPATION

TABLE I:

N = NUMERATOR
D = DENOMINATOR

$$\widehat{GDP\ PER\ CAPITA} = \left(\frac{Y}{POP}\right) \Rightarrow \begin{matrix} \hat{Y} = N \\ \hat{POP} = D \end{matrix} \Big] \text{N-D}$$

$$\left(\widehat{GDP\ PER\ WORKER}\right) = \left(\frac{Y}{L}\right) \Rightarrow \begin{matrix} \hat{Y} = N \\ \hat{L} = D \end{matrix} \Big] \text{N-D}$$

TABLE II

ROLE OF ρ H-K LEVELS

TABLE IX

H-K

$\hat{Y}$, $\hat{K}$, $\alpha\hat{K}$, $\hat{L}$, $(1-\alpha)\hat{L}$, $\hat{B}$

$\hat{B}$ = TFP GROWTH = 2.3%

TABLE VI

$\hat{B}$ = 0.2%

YOUNG : H-K / SINGAPORE

SIMILARITIES : TRADING PORTS
BRITISH COLONIES

H-K: MAINLAND CHINA
SIN: MALAYSIA / INDONESIA

} PRE-WAR

POST WAR

DOMESTIC INDUSTRIES / EXPORTS

TEXT → CLOTHING → PLASTICS →
ELECTRONICS.

80'S : SERVICES.

DIFFERENCES

H-K MORE EDUCATED POP.
LAISSEZ FAIRE GOV $\frac{I}{GDP} \approx 20\%$

SIN
- INTERVENTIONIST GOV.
FORCED SAVINGS, ETC

$\frac{I}{GDP} \approx 9\%$ (1960)

$\approx 43\%$ (1994)

- INDUSTRIAL TARGETING

SOME PROBLEMS WITH GROWTH ACCOUNTING

ISSUE: TECH. PROGRESS IS OFTEN EMBODIED IN NEW K-GOODS

⇒ IT IS HARD TO SEPARATE K-ACCUMULATION FROM INNOVATION / TECH. CHANGE.

QUESTION:

↑ Y WHY? ↗ MORE K OR ↘ BETTER K ?

IDEA OF QUALITY ADJUSTED PRICES OF K-GOODS

THIS AFFECTS HOW ↑ IN PRODUCTIVITY ARE ALLOCATED ACROSS SECTORS.

BUT

AGGREGATE EFFECT WASHES OUT.

BIGGEST PROBLEM FOR GROWTH ACCOUNTING EXERCISES

IS:
NATIONAL ACCOUNTS IN MANY CASES SISTEMATICALLY OVERESTIMATE ↑ k

EXAMPLE OF E.ASIA GROWTH

HSIEH (2000): THE RESULTS OF YOUNG ARE INACCURATE IN SOME CASES

BECAUSE OF SERIOUS OVER REPORTING OF R -

USES ALTERNATIVE METHOD AND RESULTS FOR SING & TAIWAN ARE VERY DIFFERENT

H-K & S-KOREA RESULTS VERY SIMILAR -

EX: SINGAPORE

SLOW METHOD: $\hat{B} = 0.2\ \%$

ALTERNATIVE METHOD: $\hat{B} = 2.2\ \%$

SOLOW WITH TECH. CHANGE

$$y^*(t) = \left[\frac{s}{\delta+n+g}\right]^{\frac{\alpha}{1-\alpha}} A(t)$$

NOT A RICH ENOUGH MODEL TO LOOK AT COUNTRIES WITH DIFFERENT LEVELS OF EDUCATION/SKILL-

WE ARE LOOKING FOR A NEW VERSION OF THE MODEL THAT WILL INCORPORATE THIS.

SO HIGHER LEVEL OF SKILL / HUMAN CAPITAL $\Rightarrow$ HIGHER PATH FOR $y(t)$ AT BGP.

RESULT:

$$y^*(t) = \left[\frac{s}{\delta+n+g}\right]^{\frac{\alpha}{1-\alpha}} h \cdot A(t)$$

↑ H-K LEVEL

THE GROWTH RATE OF $y(t)$ AT BGP WILL NOT BE AFFECTED:

AT BGP $\hat{y} = g^{=\hat{A}}$

MODEL:

SOLOW WITH H-K / SKILL

LET $h = e^{\psi u}$

ψ: CONSTANT POSITIVE

u = [redacted] % OF TIME DEVOTED TO H-K ACCUMULATION

IF NO TIME DEVOTED TO H-K ACCUMULATION ALL LABOR IS UNSKILLED:

$u = 0 \Rightarrow \boxed{h} = e^0 = \boxed{1}$