Development Policy

Week 2: Growth Theory and Empirics

Lecture 4: Growth Accounting

James Riedel

Growth Accounting--Methodology

1. Start with the standard neo-classical production function:

$$Y = A \cdot K^{\alpha} L^{1-\alpha} \qquad 0 < \alpha < 1$$

2. Totally differentiate (1)

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha \cdot \frac{\Delta K}{K} + (1-\alpha) \cdot \frac{\Delta L}{L} \qquad \Delta K_t = I_t - \delta \cdot K_{t-1}$$

$$\frac{\Delta y}{y} = \frac{\Delta Y}{Y} - \frac{\Delta L}{L} = \frac{\Delta A}{A} + \alpha \left[\frac{\Delta K}{K} - \frac{\Delta L}{L} \right] = \mu + \alpha \cdot \frac{\Delta k}{k}$$

3. Solve for $\Delta A / A$ (TFPG) as the residual

$$\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - \left[\alpha \frac{\Delta K}{K} - (1-\alpha) \frac{\Delta L}{L} \right] = \frac{\Delta y}{y} - \alpha \frac{\Delta k}{k}$$

Growth Accounting--Results

Table 1: Selected Growth Accounting Results for Individual Countries

	α	GDP Growth	Capital	Labor	TFP
OECD 1947-73					
France	0.40	5.40%	41%	4%	55%
Germany	0.39	6.61%	41%	3%	56%
Italy	0.39	5.30%	34%	2%	64%
Japan	0.39	9.50%	35%	23%	42%
United Kingdom	0.38	3.70%	47%	1%	52%
United States	0.40	4.00%	43%	24%	33%
OECD 1960-90					
France	.42	3.50%	58%	1%	41%
Germany	.40	3.20%	59%	-8%	49%
Italy	.38	4.10%	49%	3%	48%
Japan	.42	6.81%	57%	14%	29%
United Kingdom	.39	2.49%	52%	-4%	52%
United States	.41	3.10%	45%	42%	13%
Latin America 1940-1980					
Argentina	0.54	3.60%	43%	26%	31%
Brazil	0.45	6.40%	51%	20%	29%
Chile	0.52	3.80%	34%	26%	40%
Mexico	0.69	6.30%	40%	23%	37%
Venezuela	0.55	5.20%	57%	34%	9%
East Asia 1966-90					
Hong Kong	0.37	7.30%	42%	28%	30%
Singapore	0.53	8.50%	73%	32%	-5%
South Korea	0.32	10.32%	46%	42%	12%
Taiwan	0.29	9.10%	40%	40%	20%

OECD figures from Christenson, Cummings, and Jorgenson (1980) and Dougherty (1991)
Latin American figures from Elias (1990).
East Asia figures from Young (1994).

Growth Accounting results for China

Author(s)	Period	dY/Y	dK/K	dL/L	dH/H	TFIG	TFPG	β	δ
Borensztein/Ostry (1996)	1979-94	9.2	9.9	2.7	nc	5.4	3.8	Na	na
Hu and Khan (1997)	1979-94	9.3	7.7	2.7	nc	5.5	3.9	45	3.6
Woo (1998)	1979-93	8.1	9.8	2.7	nc	6.3	1.8	50	5.0
Woo (1998)	1985-93	7.5	11.0	2.5	nc	5.9	1.6	50	5.0
Young (2000)	1978-98	8.1	7.7	4.5	1.0	6.6	1.5	50	6.0
Wang and Yao (2001)	1978-99	9.7	9.4	2.7	2.7	7.4	2.3	50	5.0
Zhang (2003)	1980-98	9.9	9.4	2.8	nc	6.2	3.7	40	na

Stylized Facts for China

$\Delta Y / Y$		$\alpha(\Delta K / K)$		$(1-\alpha)(\Delta L / L)$		TFPG
9%	=	4.5% $(0.5 * 9\%)$	+	2% $(0.5 * 4\%)$	+	2.5%
100%	=	50%	+	22%	+	28%

Accounting for TFPG in China

Most studies attribute TFPG to the 'usual suspects':

➤ Under-deflation of nominal GDP (1- 1.5%)

➤ Labor reallocation from the rural to urban sector (1%)

➤ Increasing educational attainment of the labor force (1%)

Conclusion:

➤ TPFG is due to one-off factors and therefore is not sustainable

➤There has been no technological change!

➤Seeing is not believing!!

Has China relied too much on investment and not enough on technical change (TPFG) to drive growth? Answer

1. How does technology change occur in a latecomer developing country?
   (1) by investing in imported machinery and equipment
   (2) by attracting foreign-direct investment
   (3) by adopting international best-practices of management
   The effect of technology change is disguised as the effect of investment

2. What causes the reallocation of labor from agriculture to industry?
   Answer: Investments that create jobs in industry for rural workers
   In surplus labor economy, the growth of employment is endogenous (i.e. depends of investment), not exogenous, as assumed in the model

3. Growth accounting methodology by using net investment (gross investment minus depreciation) under estimates the effect of investment. Depreciation is mainly due to obsolescence, not wear and tear, and therefore is not a social cost and should not be deducted from gross investment.

Growth Accounting in Taiwan: Gross vs. Net Investment

	g	$\Delta K/K$	g_{L*}	a	a/g	λ
Young (1995, p. 661)						
1966–70	16.8	20.7	7.8	3.1	0.184	0.558
1970–80	12.1	14.5	10.0	0.1	0.008	0.556
1980–90	7.1	7.9	1.2	2.8	0.389	0.613
1966–90	10.8	13.1	5.9	1.7	0.157	0.579
Own Calculations						
1966–70	17.3	20.0	12.7	1.4	0.079	0.558
1970–80	12.1	14.6	8.9	0.6	0.055	0.556
1980–90	7.1	7.7	2.6	2.5	0.356	0.613
1966–90	9.5	12.5	5.4	1.1	0.117	0.579
Own Calculations		I/K				μ
1966–70	17.3	30.0	12.7	0.3	0.015	0.75
1970–80	12.1	24.6	8.9	-0.7	-0.059	0.75
1980–90	7.1	17.7	2.6	0.7	0.102	0.75
1966–90	9.5	22.5	5.4	-0.3	-0.036	0.74