

Growth accounting framework applied to Hong Kong - A technical note

While economic growth can fluctuate from year to year due to a host of cyclical factors, it is generally agreed that economic growth in the long run is driven by the flows and stocks of various factors of production (e.g. labour, building stock, stock of machinery and equipment, etc.), as well as growth in *Total Factor Productivity* (TFP). Common contributory factors to the TFP growth include technological advancement and quality upgrading of the workforce due to higher educational attainment.

The method of growth accounting can be dated back to the years of Solow (1957)^a. It has been applied, with further innovations, to explain the relatively rapid and sustained growth in the 4 Asian Newly Industrialised Economies (NIEs) in the past several decades up to the early 1990s (notable examples in works by Young in 1994^b and 1995^c). The framework has since been used by many international organisations in evaluating the macroeconomic growth performance from the supply side perspective^d.

A basic version of the framework is to analyse overall economic growth as a two-input, Cobb-Douglas, production function:

$$Y = A \times L^{(1-\alpha)} \times K^{\alpha} \quad (i)$$

where

Y is real GDP, adjusted for cyclical fluctuations

L is the labour force in full employment

K is the capital stock

$(1 - \alpha)$ is the elasticity of output with respect to labour^e

α is the elasticity of output with respect to capital^f

A is the total factor productivity (TFP)

^a *Technical Change and the Aggregate Production Function*, Solow, The Review of Economics and Statistics, (1957)

^b *Lessons from the East Asian NICs: A Contrarian View*, Young, European Economic Review 38:964-73 (1994)

^c *The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience*, Young, Quarterly Journal of Economics 110:641-80 (1995)

^d A relatively recent example is in *Projection of Long-term Total Factor Productivity Growth for 12 Asian Economies*, Jungsoo Park, ADB Economics Working Paper Series No. 227 (October 2010)

^e Assuming labour earns its marginal product, $(1 - \alpha)$ can be measured using national account data on the share of compensation of employees in aggregate income.

^f Similarly, assuming capital earns its marginal product, α can be measured using national account data on the share of income received by owners of capital in return for the use of capital.

In essence, after smoothing out cyclical fluctuations in the real GDP series, economic growth from the supply side can be attributed to three factors: (1) Labour force growth (i.e. growth in L); (2) growth in capital stock (i.e. growth in K); and (3) TFP growth (i.e. growth in A).

An alternative way of presenting this growth accounting framework, which is the version used in the Report of the Working Group on Long-Term Fiscal Planning (the **Report**) in March 2014, is to analyse labour productivity growth (i.e. growth in Y/L) in terms of the drivers from capital deepening (i.e. growth in K/L) and TFP growth :-

$$\left(\frac{Y}{L}\right) = A \times \left(\frac{K}{L}\right)^{\alpha} \quad (\text{ii})$$

$$\left(\frac{\dot{Y}}{L}\right) = \dot{A} + \alpha \times \left(\frac{\dot{K}}{L}\right) \quad (\text{ii})'$$

Economic growth can thus be expressed in terms of three components: (1) TFP growth ($\dot{A}$); (2) Capital intensification ($\frac{\dot{K}}{L}$); and (3) labour force growth ($\dot{L}$):-

$$Y = \left(\frac{Y}{L}\right) \times L$$

Applying (ii) gives $Y = A \times \left(\frac{K}{L}\right)^{\alpha} \times L \quad (\text{iii})$

$$\dot{Y} = \dot{A} + \alpha \times \left(\frac{\dot{K}}{L}\right) + \dot{L} \quad (\text{iii})'$$

The application of (iii)' on Hong Kong is in **Table 1**.

Table 1 **Decomposition of Hong Kong's GDP growth in the past 3 decades**

Period	Contributions to labour productivity growth due to:		Labour productivity growth*	Labour force growth	GDP growth*
	Capital deepening	TFP growth [^]			
	(a)	(b)	(c) = (a) + (b) [#]	(d)	(e) = (c) + (d) [#]
1980 – 1996 (17 years)	1.7 % pt. p.a.	2.4 % pt. p.a.	4.0 % p.a.	2.2 % p.a.	6.3 % p.a.
1997 – 2013 (17 years)	0.7 % pt. p.a.	1.8 % pt. p.a.	2.5 % p.a.	1.2 % p.a.	3.7 % p.a.

Notes: (^) Capital stock is based on in-house estimates – for details of the methodology, please see the “**Further technical issues**” below. Total factor productivity (TFP) is taken as the residual after netting out the effect of capital deepening in the GDP growth accounting framework.

(*) GDP growth here refers to growth in the real GDP series after smoothing out cyclical fluctuations. Labour productivity is derived using the same series.

(#) Due to rounding, the sums of the components in the table may not add up to the totals.

Further technical issues

The elasticity of output with respect to capital (α)

Assuming the markets are competitive and there are no externalities, return to capital equals the marginal product of capital. As such, the parameter α refers to the share of income received by owners of capital in return for the use of capital, and can be proxied by the ratio of Gross Operating Surplus to Nominal GDP^g in each of the years. This ratio hovered at the average of 50% over the period 1980-2012.

The capital stock series (K)

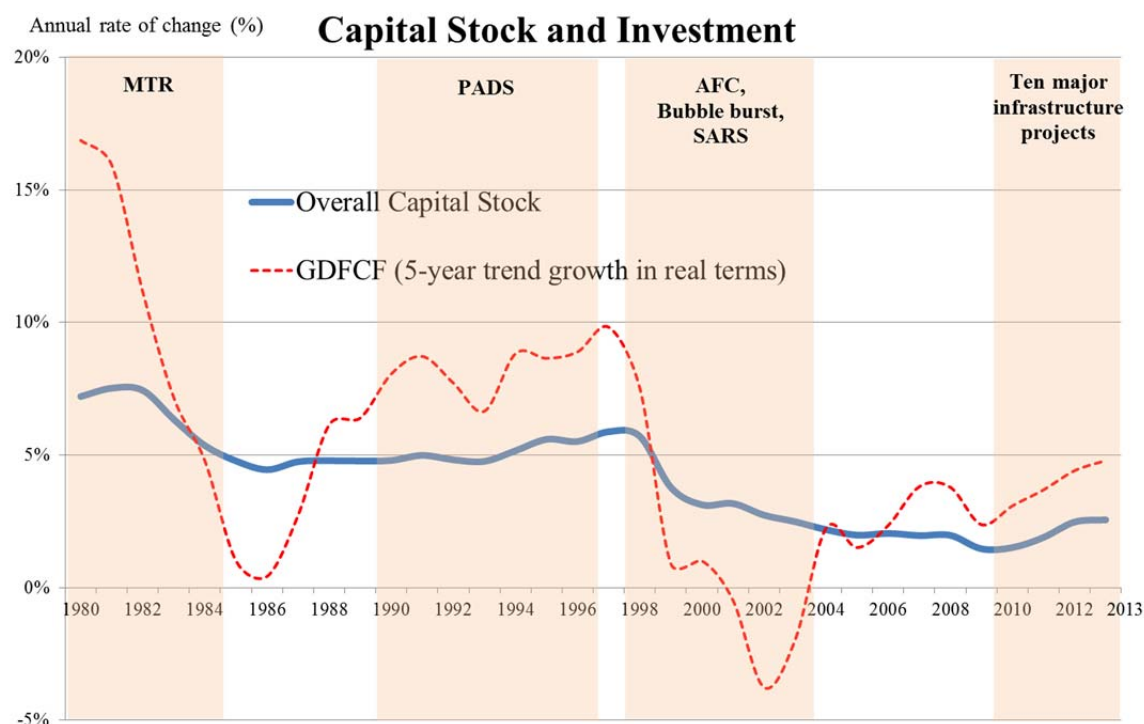
The capital stock is estimated by using the Perpetual Inventory Method (PIM), based on the quarterly expenditure figures on machinery, equipment and intellectual property products (M&E), and building and construction (B&C) from the national account as sourced from C&SD^h. The quarterly depreciation rate is assumed at 5% for machinery, equipment and intellectual property products and 0.5% for building and construction.

Chart 1 plots the movements of the capital stock series from 1980 onwards, alongside the trend rates of change in investment expenditure. The investment boom in the 1980s and the early 1990s led to a period of relatively more rapid increase in the capital stock. Yet the abrupt turn after the outbreak of the Asian Financial Crisis and the ensuing property market bubble burst in late 1997 resulted in a prolonged setback in aggregate investment up until only recently, and in turn a successive slowdown in capital stock in the post-97 era.

^g To be exact, the Nominal GDP as used for computation of the ratio refers to the sum of Gross Operating Surplus and Compensation of Employees from the national account data.

^h By assuming the depreciation rates and making reference to the trend growth in investment expenditures in the decade that follow, the initial points of capital stocks of private B&C, public B&C and overall M&E are derived by multiplying a factor of around 60, 50 and 15 to the corresponding investment levels at 1966Q1.

Chart 1 Hong Kong's capital stock as estimated from the quarterly figures of investment expenditure



Capital deepening (the increase in the K/L ratio)

Based on the capital stock series, the average annual rates of change in the capital-to-labour ratio (i.e. the K/L ratio) over 1980 – 2013 are computed as follows:-

Table 2 Capital intensification in the past 3 decades

Period	Capital stock (K)	Labour Force (L)	Capital-to-labour ratio (K/L ratio)
	(a)	(b)	(c) = (a) - (b) [#]
1980 – 1996 (17 years)	5.5 % p.a.	2.2 % p.a.	3.2 % p.a.
1997 – 2013 (17 years)	2.8 % p.a.	1.2 % p.a.	1.5 % p.a.

Note: (#) Due to rounding, the differences between (a) and (b) in the table may not exactly equal to (c) as listed in the table.