CHAPTER 2

LITERATURE REVIEW

Both theoretical and empirical studies have documented the importance of TFP for long run growth (Solow 1956, Cass 1965, Koopmans 1965, Diamond 1965). In 1970, after a survey which concentrate on some basic theoretical hypotheses and empirical evidence reported, M. Ishaq Nadiri (1970)[2] found that although there are many ways of measuring TFP, but the 2 indices most often used in empirical research are Kendrick's arithmetic measure (1961) and R. Solow geometric index (1957).

Kendrick approaches measurement of dA/A using a distribution equation. He implicitly assumes a homogenous production function and the Euler condition to obtain the following measure:

$$dA/A = \frac{Q_1/Q_0}{(wL_1 + rK_1) / wL_0 + rK_0)} - 1 \qquad \text{---------------------------a}$$

where w and r are the wage rate and the rate of return on capital, respectively.

Solow's measure is based on the Cobb-Douglas production function with constant returns to scale, autonomous and neutral technological change, i.e.

$$dA/A = dQ/Q - (\alpha dL/L + \beta dK/K) \qquad \text{---------------------------b}$$

$$\beta = (1-\alpha)$$

where α and β are the shares of labor and capital and dQ, dL and dK are the time derivatives of Q, L and K.

As mentioned earlier, the production indices are deduced either from an explicitly defined production function or from a distribution theory where the production function is implicit. Thus, the accurate specification of the form and estimation of the parameters

[2] Some Approaches to the Theory and Measurement of TFP: A Survey (1970)

of the production function, such as α and β in b are crucial to the measurement of these indices. Any misspecification or errors in estimating the parameters of the aggregate production function – errors in measuring the variables, errors due to omission of relevant inputs – will spill over to the measure of TFP. If these sources of bias are successfully removed, the remaining portion of dQ/Q unexplained by the combined rate of growth of all the factors of production is the measure of 'true' TFP.

The unusually rapid and prolonged growth of both output and exports in the newly industrializing countries (NICs) of East Asian has led many economists to believe that productivity growth in these economies, particularly in their manufacturing sectors, has been extraordinarily high. This view has, in turn, led to a growing belief in the 'dynamic' (i.e. TFP) gains from an outward orientation. This view, however, fails to take into account the equally unusual rapid growth of both capital and labor in these economies.

In 1994, using the Summers & Heston and OECD data sets, Alwyn Young[3] uses simple back of the envelope calculations to show that, as regards productivity growth in the aggregate economy and in manufacturing in particular, the East Asian NICs are not, in general, substantial outliers.

The principal lessons to be drawn from the NICs are likely to be those concerning the potential gains from factor accumulation and the sectoral reallocation of resources, i.e. 'static' neoclassical gains which have fueled the dynamic growth of these economies for more than 20 years.

[3] Lessons From the East Asian NICs: A Contrarian View (1994)

After one year, Alwyn Young (1995)[4] documents the fundamental role played by factor accumulation in explaining the extraordinary postwar growth of Hong Kong, Singapore, South Korea and Taiwan. Participation rates, educational levels and investment rates (excepting Hong Kong) have risen rapidly in all 4 economies. In addition, in most cases, there has been a large intersectoral transfer of labor into manufacturing, which has helped fuel growth in that sector. Once one accounts for the dramatic rise in factor inputs, one arrives at estimated TFP growth rates that are closely approximated by the historical performance of many of the OECD and Latin American economies.

He considered the translogarithmic value added production function:

$$Q = \exp [\, \alpha_0 + \alpha_K \ln K + \alpha_L \ln L + \alpha_t t + 1/2 B_{KK}(\ln K)^2 + B_{KL}(\ln K)(\ln L) + B_{Kt} \ln K \,.\, t + 1/2 B_{LL}(\ln L)^2 + B_{Lt} \ln L \,.\, t + ½ B_{tt} t^2]$$

where K, L and t denote capital, labor and time.

Under the assumption of constant returns to scale, the parameters α_i and B_{JK} satisfy the restriction :

$$\alpha_K + \alpha_L = 1$$

$$B_{KK} + B_{KL} = B_{LL} + B_{KL} = B_{Kt} + B_{Lt} = 0$$

Therefore,

$$\text{Ln} [Q(t)/Q(t-1)] = \alpha_K \ln [K(t)/K(t-1)] + \alpha_L \ln [L(t)/L(t-1)] + TFPt\text{-}1,t$$

$$\alpha_i = [\alpha_i(t) + \alpha_i(t-1)]/2$$

Where α_i denote the elasticity of output with respect to each input or equivalently, assuming perfect competition, the share of each input in total factor payments.

[4] The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience (1995)

According to him, all of the influences noted above – rising participation rates, intersectoral transfers of labor, improving levels of education and expanding investment rates – serve to chip away at the productivity performance of the East Asian newly industrializing countries (NICs), drawing them from the top of mount Olympus down to the plains off Thessaly. While the growth of output and manufacturing exports in the NICs of East Asian is virtually unprecedented, the growth of TFP in these economies is not (**Table 2**).

In particular case, despite the spectacular growth of Singapore over the last thirty years, Young (1995) found that the growth was not due to TFP growth but rather to intensive use of inputs. The annual TFP growth for the entire economy averaged to a mere 0.2% for Singapore during the 1966-1990 period. Even more alarming for Singapore, the same study found her manufacturing sector has experienced a –1% annual growth over the same period. What is going on?

H.M. Leung (1996)[5] attempts to probe this question by focusing on Singapore's manufacturing industry level data. TFP growth (TFPG) is measured from industry level data for Singapore over a time series, and then regress the estimates to a list of variables.

The parametric estimation of TFPG is based on the translog production function:

$$TFPG = \ln[(Y(t)/Y(t-1)] - A_K\ln[(K(t)/K(t-1)] - A_L\ln[L(t)/L(t-1)]$$

where Y = output, K = capital, L = labor

A_K = share of output that are paid to K

A_L = share of output that are paid to L and $A_K + A_L = 1$

[5] Total Factor Productivity Growth in Singapore's Manufacturing Industries (1996)

Table 2
Estimates of TFPG, selected period (%)

Country	World Bank (1993)	Young (1995)	Bosworth & Collins (1996)		Sarel (1995)	Sarel (1996)
	1960-1990	1966-1990	1960 - 1994	1984 - 1994	1975 - 1990	1979 - 1996
Hong Kong	3.647	2.3	n.a.	n.a.	3.8	n.a.
Korea	3.1021	1.7	1.5	2.1	3.1	n.a.
Sinagapore	1.1911	0.2	1.5	3.1	1.9	2.5
Taiwan	3.7604	2.6	2	2.8	3.5	n.a.
Indonesia	1.2543	n.a.	0.8	0.9	n.a.	0.9
Malaysia	**1.0755**	**n.a.**	**0.9**	**1.4**	**n.a.**	**2**
Philippines	n.a.	n.a.	0.4	-0.9	n.a.	-0.9
Thailand	2.496	n.a.	1.8	3.3	n.a.	2

Note: n.a. = not available

Source: World Bank (1993) & IMF (1997)

To estimate TFPG, require data on industry level output, capital and labor, and payment to one factor only, say L, since A_K can then be derived by total output and A_L

The TFPG is estimated to be around 2 to 3% per annum over the last ten years, somewhat higher than previous estimates but remains a small fraction of the actual GDP growth. The variables found to have significant influence on TFPG include foreign ownership, export orientation and remuneration per employee. The result also suggests that Singapore has not gained much from learning-by-doing.

For purposes of cross-country comparisons, given the sensitivity of TFP measures to the data as well as to methods of computation, it is essential to compare the TFPG estimates based on the same time period and using the same method for data adjustments and computation of TFPG. Hence, the result of TFPG measures for countries covered in a World Bank study[6] are used as a basis for comparison (**Table 2**). Of all the Asean economies shown in Table 2, Thailand registered the highest (2.4960%) for the period 1960-1990. All the Asean economies shown have lower TFPG estimates than South Korea, Hong Kong and Taiwan.

In 1996, Lee Saw Hoon and Abdul Wahab Muhamad[7] had examined Malaysia's growth performance at the sectoral, national and international levels and further analyzed in the light of Malaysia's productivity framework (**Figure 1**).

[6] The East Asian Miracle: Economic Growth & Public Policy (1993). The method used by World Bank is covered in Chapter 3 Methodology.

[7] APO Productivity Journal (1996): Sustaining Productivity-Driven Growth in Malaysia

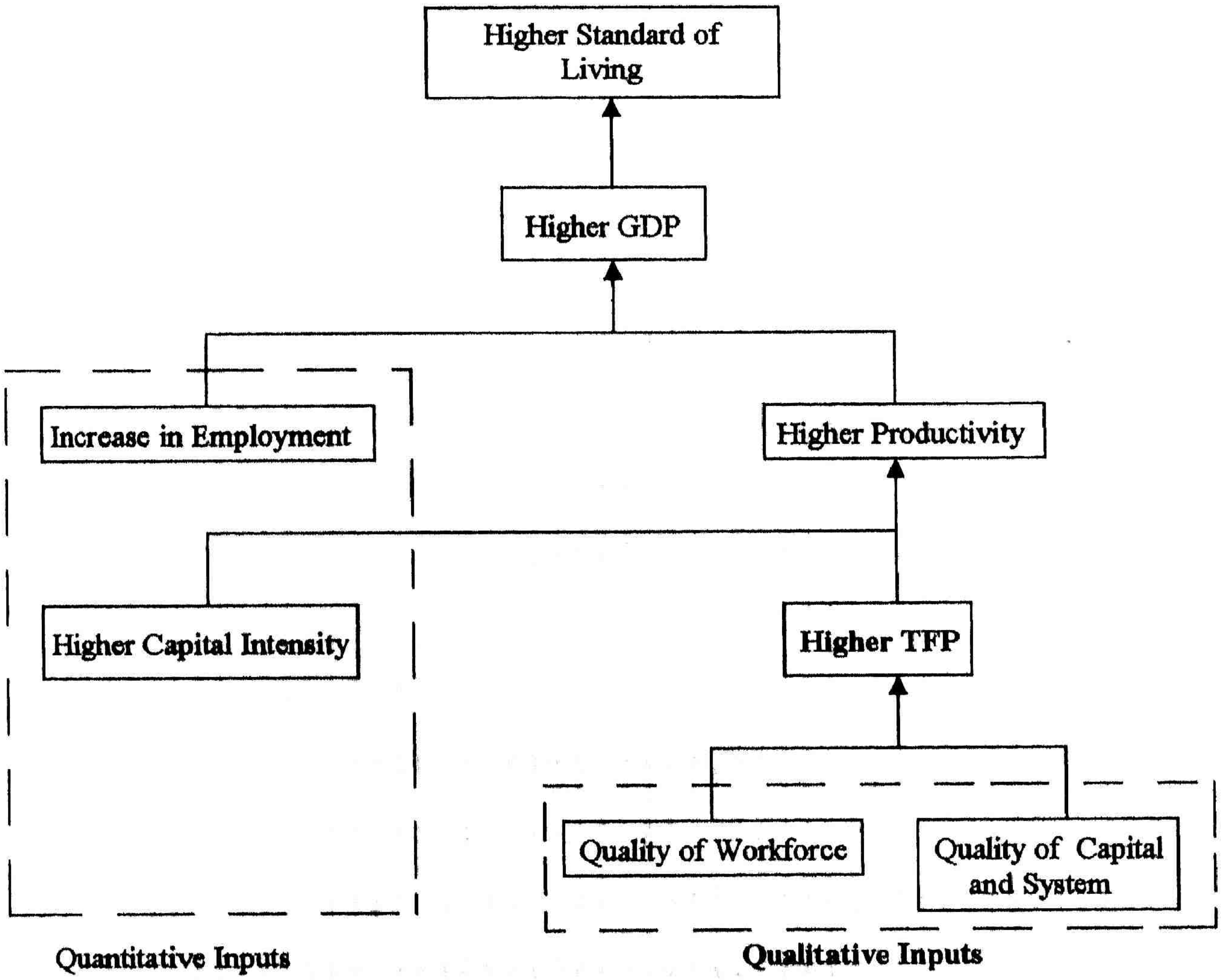
They found that the structural factors that determine long-term productivity growth are capital intensity and TFP. There is a close relationship among changes in productivity, capital intensity and TFP. Briefly, productivity growth is the sum of TFPG and weighted capital intensity growth. To sustain long-term productivity growth, efforts must be focused on improving TFPG to complement the contribution of capital intensity, since increases in capital intensity will eventually reach the point of diminishing returns, resulting in a decreasing contribution to productivity growth.

Higher TFPG can be achieved through enhancing the quality of the workforce, better management practices, more efficient utilization of inputs and innovations through greater R&D. The five determinants of TFPG are education and training, economic restructuring, capital structure, technical progress and demand intensity.

According to them, there are four major issues to address in order to raise TFPG. First, raise the skills and educational level of the workforce through education and training. Second, raise the productivity of small and medium-sized enterprises (SMEs). Third, reiterate the emphasis on R&D and last, must not neglect the qualitative improvements of management and organization that are essential for high-productivity growth.

Figure 1

Productivity Framework



Source: National Productivity corporation, Malaysia