

CHAPTER 5

ESTIMATING THE VARIABLES THAT INFLUENCE TFP GROWTH

To sustain long-term GDP per labor growth, efforts must be focused on improving TFPG and knowing what factors will influence TFPG can lead to useful policy implication. According to National Productivity Corporation (NPC), there are 5 determinants of TFPG (Figure 3):

5.1 Determinants of TFPG

5.1.1 Education and Training

Education and training of the workforce, to upgrade skills and knowledge, will result in higher-skilled workers who will be more efficient, thus leading to better-quality products and services.

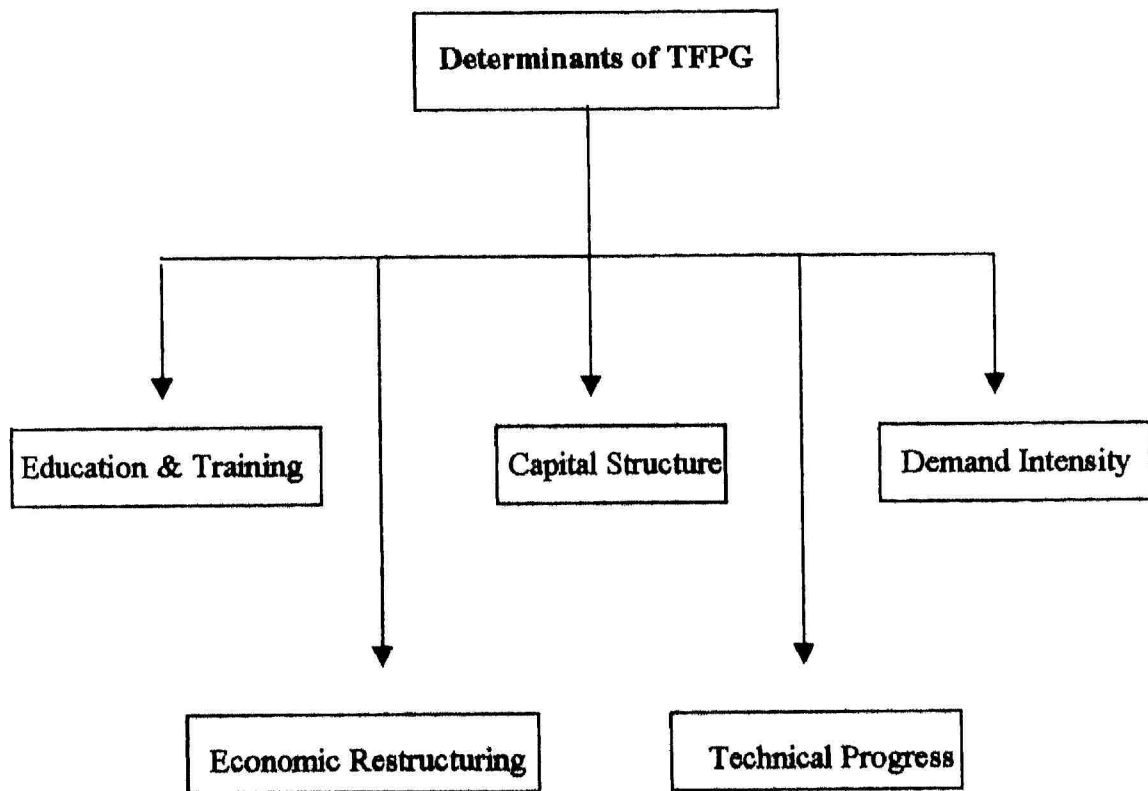
Manpower development has proved to be an effective means of improving productivity around the world. The US Competitiveness Policy Council quoted a study that found that increasing training in companies from 0 to 100 hours over a 2-year period raised productivity by 13% to 15% (Woon Kin Chung & Ellen Yeo, 1996).

5.1.2 Economic Restructuring

Economic restructuring relates to movement of resources from less productive to more productive sectors of the economy. In fact, the various stages of development are associated with restructuring of economies toward higher-value-added activities.

In agricultural economies and economies with labor-intensive manufacturing activities, labor is the critical factor driving growth. As industrialization progresses, the country's comparative advantage shifts toward activities that depend on increasing capital

Figure 3
Determinants of TFPG



Source: National Productivity Corporation (NPC), Malaysia

investments. The range of industries broadens. These industries are characterized by a higher level of capital intensity, as well as higher technical and skills levels of the workforce.

Finally, as the economy matures, innovation takes over as the engine of growth. At this stage, industrial widening and deepening give the country a broad and upgraded industrial mix. The actual pace of progression from one stage to another depends largely on how successfully the process of economy restructuring from the less productive to the more productive industries is managed.

5.1.3 Capital Structure

Capital structure relates to the production of investment in productive capital inputs. The composition of capital investments has an effect on TFPG because the yield from investments in machinery and equipment, which are productive capital inputs, yield immediate output, whereas those in infrastructure, plant and buildings undergo a gestation period.

5.1.4 Technical Progress

Technical progress relates to the effective and efficient utilization of technology, capital, work attitudes and management effectiveness. As shown in Figure 4, technical progress arises from improvements made in 4 major areas: workforce, capital, system and technology. It reflects the impact of a wide range of factors, from individual work attitudes to technology exploitation.

In developed countries like the United States, Japan, France and the United Kingdom, technical progress contributed between $1/3$ and $1/2$ of TFPG. Based on the experiences of these countries, and given the limits of economic restructuring and

Figure 4
Sources of Technical Progress

<p>Workforce</p> <p>Positive work attitudes Harmonious labor-management relations Participation in productivity progress</p>	<p>Systems</p> <p>Systems approach Management & Quality systems Intelligence & access to information Economic of scale</p>
<p>Capital</p> <p>Better quality equipment & machines with higher capabilities</p>	<p>Technology</p> <p>Technical exploitation Innovation R & D</p>

Source: Woon Kin Chung & Ellen Yeo (1996), Singapore's New Productivity Challenges

improvement of the educational profile of the workforce, technical progress should eventually be the main source of TFPG.

5.1.5 Demand Intensity

Demand intensity reflects the extent of the productive capacity of the economy. Demand changes influence TFP through the capacity utilization rates of machinery and equipment. A slowdown in demand intensity will result in lower utilization of machinery and equipment.

5.2 Model

The TFP growth rates estimated in Chapter 4 is used to estimate the variables that have significant influence on TFP growth.

$$\text{TFPG} = f(\text{CAP}, \text{EXPTS}, \text{FC}, \text{MANUG}, \text{TER})$$

Where TFPG = total factor productivity growth

CAP = capital per GDP or investment rate

EXPTS = annual export growth rate

FC = % of companies foreign-owned

MANUG = annual manufactured output growth rate

TER = % of employed persons acquired tertiary education

For the list of explanatory variables, 'capital/GDP ' measures investment rate. The theoretical argument as regards investment is that a high investment rate increases the capital stock and this can permanently increase the growth rate through economic of scale and other beneficial side effects.

The '% of the presence of foreign companies' in Malaysia, which measures foreign ownership with potential technology transfer, was used as a proxy to technical progress.

Another contributor to TFPG was the restructuring of the economy through a shift of resources between sectors. A shift of inputs from resource-based sectors to the manufacturing sectors generated higher output. It is believed that manufacturing sector is the main contributor to TFPG in Malaysia. As manufacturing sector grow, TFPG is expected to grow in the same direction.

Because Malaysia is an open economy, demand changes are strongly influenced by external development. Export complemented by a strong domestic economy, would ameliorate the effect of demand fluctuations to some extent. Thus, 'Openness to the world economy' is another important factor for explaining rapid TFP growth. The theoretical case for this view rests not only on allocate efficiency, but also on externalities associated with trading activities and on "X-efficiency" gains from creating a more competitive environment for domestic industry (World Bank 1993). The theoretical argument is that export orientation increases the openness of the economy and by exposing it to foreign technology and competition, provokes a rapid rate of technological progress.

It is doubtful that Malaysia could have made as productive use of imported capital and foreign knowledge and benefited as much from embodiment without highly skilled domestic labors. The use of 'education level' is an attempt to test for externalities in human capital formation. The tertiary education can have growth enhancing externalities

through the better ability to use and master technology. These externalities may be included in the estimates of TFP change.

All the variables are expected to have positive coefficient, that is when CAP, EXPTS, FC, MANUG and TER increase, TFPG will increase too.

5.3 Data Sources

Secondary data on capital per GDP rate, export growth rate, number of foreign companies, manufactured output growth rate and percentage of employed persons acquired tertiary education are obtained from Monthly Statistic Bulletin, Quarterly Statistic Bulletin and Year Book of Statistics published by Department of Statistics.

5.4 Relationship

5.4.1 Capital / GDP rate

Previous literature has found a weak negative link between TFPG and capital intensity (HM Leung, 1996). However, it is expected that higher capital/GDP rate shows faster TFPG.

5.4.2 Export

It is expected that economy with greater degree of export-orientation shows faster TFPG.

5.4.3 Foreign Companies

Evidence shows that those industries with more extensive foreign-ownership have faster TFPG (HM Leung, 1996). It is believed that as the percentage of companies foreign-owned increase, TFPG will increase too.

5.4.4 Manufactured Output Growth

Manufacturing sector is believed to be the main contributor of TFPG in Malaysia, as manufactured sector grows, TFPG is expected to grow in the same direction.

5.4.5 Tertiary Education

It is expected that higher educational level is associated with faster TFPG because a more educated staff learns faster.

5.5 Result

From the hypotheses,

$$TFPG = c + \alpha CAP + \beta EXPTS + \gamma FC + \delta MANUG + \epsilon TER$$

It is believed that TFPG has positive relationship with all the explanatory variables, that is when capital per GDP rate (CAP), export growth rate (EXPTS), percentage of companies foreign-owned (FC), manufactured output growth rate (MANUG) and percentage of tertiary educated employee (TER) increase, TFPG will increase too.

From the computer output (Table A7), the result of an OLS regression for 1980-1998 is reported below:

$$TFPG = 0.10027 - 0.007930CAP + 0.002303EXPTS + 0.144185FC$$

t = 1.140982	t = -2.554539	t = 3.002545	t = 1.942026
s.e = 0.087825	s.e = 0.003104	s.e = 0.000767	s.e = 0.074245

$$- 0.137694MANUG + 0.006655TER$$

t = -2.897826	t = 0.897559
s.e = 0.047516	s.e = 0.007415

$$R^2 = 0.565688$$

$$Adj R^2 = 0.398644$$

$$F = 3.386474$$

where TFPG = total factor productivity growth (%)

 CAP = capital per GDP rate (%)

 EXPTS = annual export growth rate (%)

 FC = % of companies foreign-owned (%)

 MANUG = annual manufactured output growth (%)

 TER = % of employed persons acquired tertiary education (%)

Table 6 summarizes the results of applying statistical analysis and attempts to test the relationship between these variables and rate of TFP change derived from Chapter 4. The main results are the following:

5.5.1 Capital/GDP rate has a negative impact on TFPG

The coefficient is always negative and statistically significant at least at 0.05 level. The estimate imply that an increase of the investment rate by 1% point is correlated with a decrease in the TFPG by 0.008%.

5.5.2 Export has a positive impact on TFPG

The coefficient is always positive and significant at 0.05 level. The estimate implies that an increase of export by 1% is correlated with an increase in TFPG by 0.002%. Therefore, openness to the world economy matters for TFPG in Malaysia.

5.5.3 Foreign Companies has a positive impact on TFPG

The coefficient of the foreign companies has a positive and statistically significant at least at 0.05 level. Therefore, not only openness to the world economy, but also openness to foreign companies matters for TFPG in Malaysia. The estimate implies that an increase in percentage of foreign-owned companies by 1% point is correlated with an increase in TFPG by 0.144%. This is also the largest coefficient in economic terms.

Table 6
Regression Results

Dependent Variable	TFPG 1980 - 1998
Sample Period	1980 - 1998
Observations	19
Intercept	0.100207
t - statistic	1.140982
standard error	0.087825
CAP	-0.00793
t - statistic	-2.554539
standard error	0.003104
EXPTS	0.002303
t - statistic	3.002545
standard error	0.000767
FC	0.144185
t - statistic	1.942026
standard error	0.074245
MANUG	-0.137694
t - statistic	-2.897826
standard error	0.047516
TER	0.006655
t - statistic	0.897559
standard error	0.007415
R square	0.565688
Adj R square	0.398644

Note:

-0.00793 statistically significant at 0.05 level

5.5.4 Manufactured output growth has a negative impact on TFPG

The coefficient is always negative and statistically significant at 0.05 level. The estimate implies that an increase of the growth rate of manufactured output by 1% is correlated with a decrease of the TFPG by 0.138%.

5.5.5 Tertiary education has a positive impact on TFPG

The coefficient is always positive but is not statistically significant. Therefore, it is unable to conclude that the coefficient of tertiary education has positive relationship with TFPG.

5.6 Discussion

The view that the rapid transformation of the Malaysian economy in recent years is due mainly to input growth is further supported by the TFPG model. From the OLS regression, investment rate has a negative, albeit small, influence on TFPG. This means faster capital growth have slower TFPG, other things hold constant. It may be that capital is accumulated so quickly that the technology is not properly absorbed. In other words, there may be very substantial diminishing returns to capital.

What is surprisingly is the negative sign of manufactured output growth rate. The manufacturing sector is expected to spearhead Malaysia TFPG and has positive sign. The Malaysia economy has undergone structural changes over the last two decades. Until the 1970s, the economy was mainly depending on agriculture. Beginning from the 1980s, the country focused on changing its economic structure to that of industrial based. Today, as the world moves into the next millennium, the country continues progressively towards economic development that is driven mainly by the manufacturing sector. The

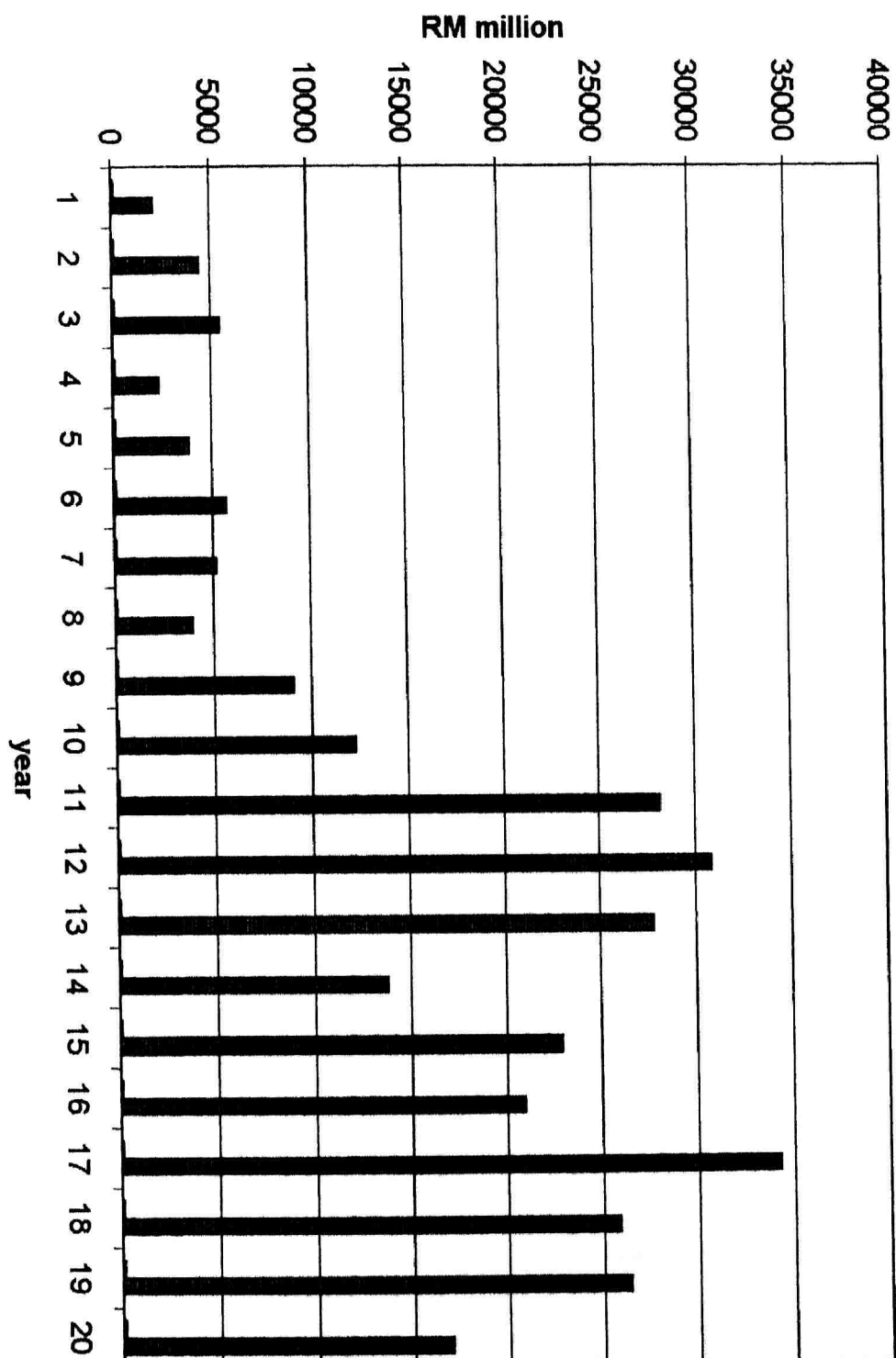
manufacturing sector currently accounts for about 1/3 of GDP and more than $\frac{3}{4}$ of merchandise exports. The restructuring of the economy through a shift of resources between sectors is believed to be another contributor to TFPG. Between period 1980 to 1999, there was almost ten-fold increase in capital investment of manufacturing sector (Graph 3).

But from the regression results, it seems like that manufactured output growth was not accompanied by TFPG. This is disturbing but perhaps goes some way to explain why TFPG has not been more encouraging. Combined with the diminishing returns to capital above, it suggested that perhaps technology using in manufacturing sector was not properly absorbed.

However, a number of other variables also positively influence TFPG. The direction of these influences is the same as expected. More extensive foreign-ownership show faster TFPG, quite probably because of the advanced technology and management skills brought in by the foreign companies.

Greater degree of export orientation also shows faster TFPG, presumably because of the pressure from international competition and benefits of economic of scale. This shift from dependence on the domestic market to production for the export market will necessitate firms to venture into large-scale operations and increase production capacity in order to enjoy the benefits of economic of scale. Large-scale production for the world market will induce greater utilization of technology and skilled manpower and through these, efficiency and productivity enhancements will be obtained that will bring about lower unit costs of production.

Graph 3
Malaysia: Capital Investment in Manufacturing Sector, 1980-1999



Tertiary education also associated with positive TFPG, probably because a highly educated staff learns faster. With a better quality workforce, the learning curve and gestation period associated with the acquisition of new technology will be shortened. In Malaysia, the percentage of labor with post secondary, diploma or university degree rose from 3.6% in 1980 to 13.2% in 1998. But the coefficient is not statistically significant, so that is not enough evidence to show that tertiary education has positive relationship with TFPG.