TOTAL FACTOR PRODUCTIVITY IN THE MALAYSIAN CONSTRUCTION SECTOR

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ABSTRACT

Total Factor Productivity (TFP) is regarded as a measure of degree of technological advancement associated with economic growth. According to the 10th Malaysia Plan (2011-2015), Malaysia aims to achieve an average GDP growth of 6% where 38.5% of the growth will come from TFP, 37.5% from capital and the remaining 24% from labour. Data from the past three years shows that the country managed to achieve an average GDP growth of only 5.1% where capital input remained the biggest contributor with a 58% share, followed by labour with 22.2%. TFP is the smallest contributor to GDP growth, at 19.7%. Only sporadic information on TFP is available which had caused difficulty in comparative study. This paper adopted Solow Model to generated TFP series of Malaysian Construction Sector between years 1988 and 2013. Lending to the construction sector by banking system is used as proxy for capital input and number of construction employment as labour input. The overall result indicates a falling trend of TFP for the period of 1989-1998 and rising trend of 1998-2012. The growth of construction sector in 1989-1998 period is fuelled by capital injection, however for the period of 1998-2012 is a period witnessed by adoption of more advanced building practices and systems such as GBI, IBS and BIM in the construction sector.

Keywords: Total Factor Productivity, Construction Sector, Malaysia

INTRODUCTION

Disparities in economic growth among countries or between the past and present in the same country primarily reflect differences in their labour productivity (Manyika J., Remes, J., and Woetzel J. 2014). Labour productivity is driven by two factors: total factor productivity (TFP) and capital intensity (Malaysia Productivity Corporation, 2014). TFP measures the efficiency of the utilisation of all inputs to produce output. It is also regarded as a measure of the degree of technological advancement associated with economic growth. Improvement in TFP will enable the economy to move to a higher production frontier with more efficient use of capital and labour. TFP is being influenced by innovation and incentives like competition; government assistance and regulation; flexibility of labour arrangements; regulations impacting on production decisions; capabilities like skill people and knowledge; and infrastructure (Malaysia Productivity Corporation, 2013).

According to the Productivity Report 2013/2014 published by Malaysian Productivity Corporation, over the periods of the Seventh (7MP) and Ninth (9MP) Malaysia Plans, TFP's contribution to GDP rose nearly 40% between the 7MP (24.8%) and 9MP (34.7%), while the contribution of capital fell from 50.2% to 34.5% and the contribution of labour increased from 25% to 30.8% over the same period (Malaysia Productivity Corporation, 2014). However, the first three years of the Tenth Malaysia Plan (10MP) show that the average contribution of TFP to the country's GDP (19.7% vs. 38.5%) short of the government targets during the period. Meanwhile, the contribution of capital input (58% vs. 37.5%) exceeded government targets during the period. The construction sector recorded a TFP growth of 6.3% in the 2011-2013 period compared to 2.8% during the 9MP period (2006-2011) (Malaysia Productivity Corporation, 2014).

However, the information of TFP is not regularly available. Table 1 summarised the TFP of Malaysian construction sectors published in the recent annual productivity reports. There is lack of information with consistent intervals. Therefore, it is difficult to monitor or compare the data.

[1] Additional Author details may be added as a footnote on page one

Table 1: TFP of Malaysian construction sector

Year	GDP	Labour	Capital	TFP	Productivity Reports
2001-2005	0.95	0.10	0.74	0.11	Productivity Report 2010/2011
2001-2010	2.73	0.09	1.85	0.79	Productivity Report 2010/2011
2006-2010	4.51	0.08	2.96	1.47	Productivity Report 2010/2011
2002-2011	2.75	-0.01	2.12	0.63	Productivity Report 2011/2012
2000-2007	1.82	1.22	2.51	-1.91	Productivity Report 2012/2013
2008-2012	7.33	2.47	1.48	3.39	Productivity Report 2012/2013
2000-2012	3.94	1.7	2.11	0.13	Productivity Report 2012/2013
2006-2010	5.98	1.42	1.78	2.78	Productivity Report 2013/2014
2011-2013	11.12	3.77	1.04	6.31	Productivity Report 2013/2014

Sources: Extract from Productivity Reports 2010/2011, 2011/2012, 2012/2013 and 2013/2014 by MCP

This paper examines the TFP of Malaysian construction sector by generating a TFP time series so that an insights of the construction sector can be carried out. The result will be validated with contextual development of Malaysian construction sector.

TOTAL FACTOR PRODUCTIVITY

Total Factor Productivity (TFP) is the portion of output not explained by the amount of inputs used in production (Comin D. 2006). It represents the efficiency with which the production function transforms the whole set of factors into output. It depends on many things, including the state of human knowledge, specific accumulated know-how and experience, the efficiency with which economic, political, and social institutions encourage productive activity and effort, and the management skills of producers and entrepreneurs (Van Den Berg, H. 2012). Malaysia Productivity Corporation regarded TFP as a measure of degree of technological advancement associated with economic growth, which measures the synergy and efficiency of the utilisation of both capital and human resources (National Productivity Corporation, 2000, P.17). Higher TFP growth indicates efficient utilization and management of resources, materials and inputs necessary for the production of goods and services. TFP also refers to the additional output generated through enhancements in efficiency arising from advancements in worker education, skills and expertise, acquisition of efficient management techniques and know-how, improvements in organization, gains from specialization, introduction of new technology and innovation or upgrading of existing technology and enhancement in Information Technology (IT) as well as the shift towards higher added value processes and industries. Thus, productivity yield better returns if such quantitative increase in capital intensity are simultaneously completed by growth in TFP (National Productivity Corporation, 2000, P.17).

TFP growth is usually measured by the Solow residual (*r*), which is the residual growth rate of output not explained by the growth in inputs (Hulten, C. R. 2001). It is expressed as

$$r = g_Y - \alpha\, g_K - (1 - \alpha)\, g_L \qquad (1)$$

g_Y = the growth rate of aggregate output,

g_K = the growth rate of aggregate capital,

g_L = the growth rate of aggregate labour and

α = the capital share.

Solow's model exhibits constant returns to scale, the coefficients α and 1- α must be adding up to exactly 1 (Van den Berg, H. 2012).

Solow applied actual U.S. data on real GDP, the capital stock, and labour force, and he approximated the value of α using published data on the percentage of U.S. national income accruing to the owners of physical capital. Solow found that, in the United States, real output had grown much more rapidly than the stock of capital or the labour force. This type of measurement of total factor productivity is often referred to as the Solow residual. The term residual is appropriate because the estimate of r represents the part of measured GDP growth that is not accounted for by the weighted-average measured growth of factors of production (Van den Berg, H. 2012). Hulten (2001) claimed that Solow residual is a "measure of our ignorance" in practice. This ignorance covers many components, some wanted (such as the effects of technical and organizational innovation), others unwanted (such as measurement error, omitted variables, aggregation bias, and model misspecification). The unwanted parts of the residual might cancel if they were randomly distributed errors, leaving the systematic part of the residual unbiased (Hulten, C. R. 2001).

There are criticisms of Solow model, such as (1) Solow model is inextricably linked to the constant returns to scale. Constant returns are actually needed to estimate the return to capital as residual. Hulten argued that if an independent measure of the return to capital is used in constructing the share weights, the residual can be derived without the assumption of constant returns. (2) Solow model is married to the assumption of marginal cost pricing. When imperfect competition leads to a price greater than marginal cost, the residual yields a biased estimate. (3) The implied nature of technical change – the model is valid if innovation improves the marginal productivity of all inputs equally. In this case, the production function shifts by the same proportion at all combinations of labour and capital. This is clearly a strong assumption that may well lead to biases if violated (Hulten, C. R. 2001).

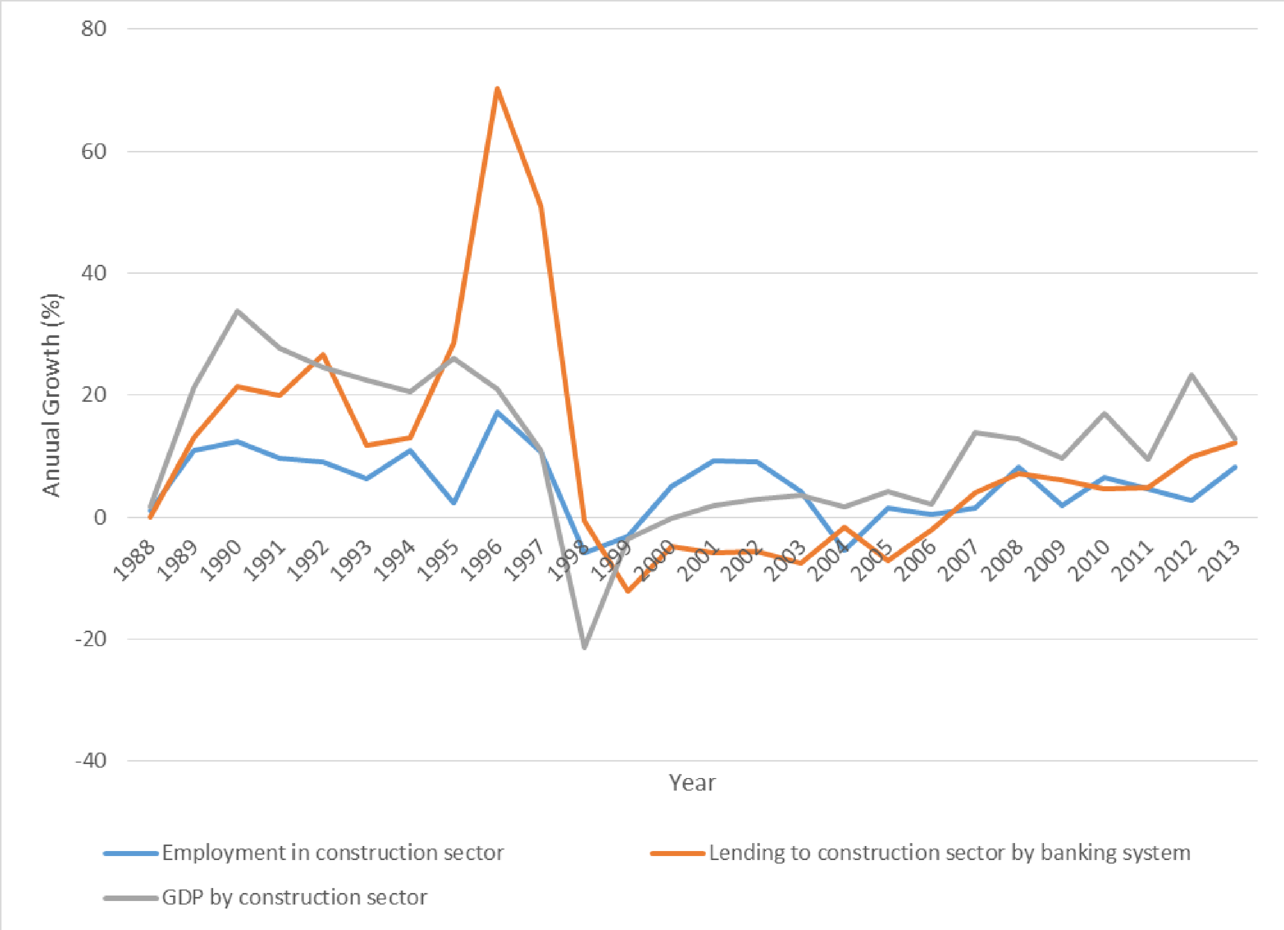
ESTIMATION OF TFP OF MALAYSIAN CONSTRUCTION SECTOR

Table 2 and Figure 1 show the amount and annual growth rate of Gross Domestic Product (GDP) by construction, employment and lending by banking system to Malaysian construction sector between 1989 and 2013. The GDP of construction are obtained from the published National Accounts of GDP by kind of economic activities issued by Economic Planning Unit. The construction employment is obtained from the Labour Force Survey Time Series Data published by the Department of Statistics Malaysia. The employment statistics of 1991 and 1994 are not available in the Labour Force Survey Time Series. The figures in the Table 2 are averaged from data of 1990 and 1992, and 1993 and 1994 respectively. The lending to construction sector from the banking system is used as proxy for capital in the estimation of TFP. The data adopted, Lending by Banking System: Classification of Loans by Sector are obtained from published statistics of Bank Negara Malaysia (Central Bank of Malaysia).

Table 2: GDP by construction sector, construction employment and lending to construction sector by banking system in Malaysia (1989-2013)

Year	GDP by Construction Sector (RM million)	Annual growth of GDP by Construction Sector (g_Y)	Employment in Construction Sector (Thousands)	Annual growth of Employment in Construction Sector (g_L)	Lending to Construction Sector by Banking System (RM million)	Annual growth of Lending to Construction Sector by Banking System (g_K)
1989	3,475	21.25	376.9	10.89	6,626.50	12.97
1990	4,649	33.78	423.9	12.47	8,045.90	21.42
1991	5,939	27.75	465.0	9.70	9,653.80	19.98
1992	7,396	24.53	506.7	8.97	12,220.50	26.59
1993	9,054	22.42	538.8	6.34	13,661.50	11.79
1994	10,909	20.49	597.6	10.91	15,444.90	13.05
1995	13,747	26.02	611.3	2.29	19,858.40	28.58
1996	16,641	21.05	716.5	17.21	33,831.20	70.36
1997	18,474	11.01	793.0	10.68	51,064.20	50.94
1998	14,507	-21.47	745.9	-5.94	50,730.70	-0.65
1999	13,987	-3.58	722.8	-3.10	44,575.60	-12.13
2000	13,971	-0.11	759.9	5.13	42,452.20	-4.76
2001	14,241	1.93	829.8	9.20	39,916.90	-5.97
2002	14,673	3.03	905.1	9.07	37,693.50	-5.57
2003	15,200	3.59	942.5	4.13	34,814.90	-7.64
2004	15,458	1.70	890.8	-5.49	34,223.00	-1.70
2005	16,107	4.20	904.4	1.53	31,783.20	-7.13
2006	16,451	2.14	908.9	0.50	31,101.00	-2.15
2007	18,739	13.91	922.5	1.50	32,320.50	3.92
2008	21,156	12.90	998.0	8.18	34,602.00	7.06
2009	23,187	9.60	1,015.9	1.79	36,700.10	6.06
2010	27,112	16.93	1,082.7	6.58	38,421.00	4.69
2011	29,648	9.35	1,133.6	4.70	40,284.10	4.85
2012	36,571	23.35	1,163.7	2.66	44,238.40	9.82
2013	41,280	12.88	1,258.8	8.17	49,646.60	12.23

Figure 1: Annual growth rate of GDP by construction, construction employment and lending to construction sector by banking system (1989-2013)



Nonlinear regression was conducted to determine the value of capital share, α, of the model (2). Model (2) is re-arranged from model (1) but exclude the residual value (*r*).

$$g_Y = \alpha\, g_K + (1 - \alpha)\, g_L \qquad (2)$$

The nonlinear regression process in the SPSS software is used to determine the value α. From Table 3 observe that α = .698. Thus the model (2) is re-written as

$$g_Y = 0.698\, g_K + 0.302\, g_L \qquad (3)$$

Predicted values of annual growth rate of GDP of construction (g_Y) using model (3) are computed and shown in Table 4. The 'residual' column presented the differences of actual annual growth rate of construction activity and the predicted values of the model (3).

Table 3: Parameter Estimates

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
A	.698	.130	.431	.966

Table 4: Predicted value and residual (α = 0.698)

Year	Predicted Value (g_K)	Residual (r)
1989	11.52	9.73
1990	15.17	18.61
1991	12.80	14.95
1992	14.29	10.24
1993	7.98	14.43
1994	11.56	8.93
1995	10.23	15.79
1996	33.26	-12.21
1997	22.84	-11.82
1998	-4.34	-17.13
1999	-5.83	2.24
2000	2.14	-2.26
2001	4.62	-2.68
2002	4.65	-1.62
2003	0.58	3.01
2004	-4.34	6.04
2005	-1.09	5.29
2006	-0.30	2.44
2007	2.23	11.68
2008	7.84	5.05
2009	3.08	6.52
2010	6.01	10.92
2011	4.75	4.61
2012	4.82	18.53
2013	9.40	3.48

Table 5: ANOVA

Source	Sum of Squares	df	Mean Squares
Regression	4501.389	1	4501.389
Residual	2688.844	24	112.035
Uncorrected Total	7190.234	25	
Corrected Total	3622.959	24	

Table 5 provides a breakdown of the sum of squares, a measure of variability in the GDP of construction activity for the model (2). The regression row displays information about the variation accounted for by the model. The residual row displays information about the variation that is not accounted for by the model (2). The uncorrected total represents the entire variability in the dependent variable, while the corrected total is adjusted to only reflect variability about "average" growth rate of GDP in construction activity. The residual sum of squares and corrected total are used to compute coefficient of determination (R^2).

R^2 = 1- (Residual sum of squares)/(Corrected sum of squares) = .258

An R^2 value of 0.258 means that the model (2) accounts for about 25.8% of the variability in the growth rate of construction when the residual value (r) is excluded in the model.

Figure 2: Residuals and predicted values

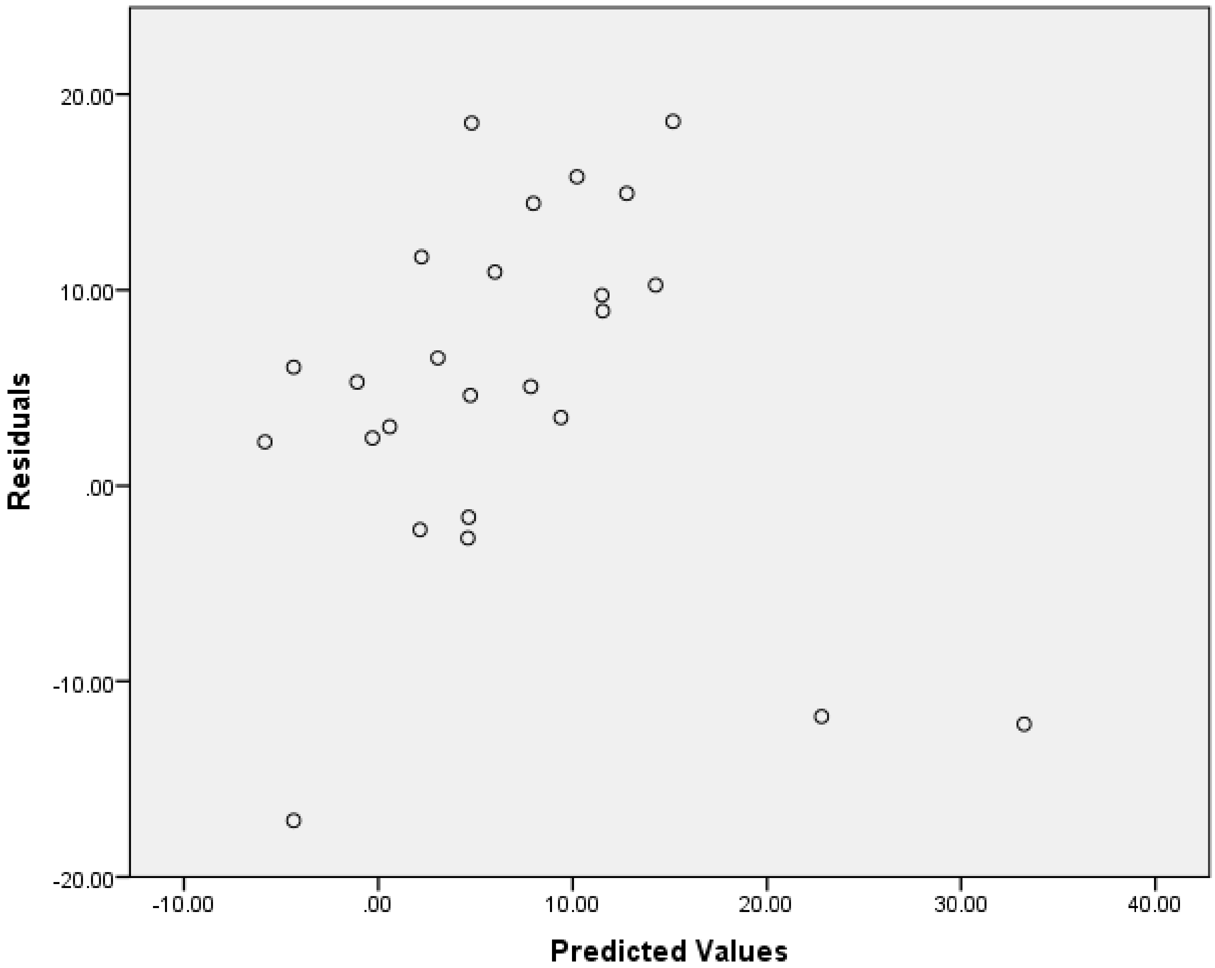


Figure 2 is the scatter plots of the residuals and predicted values of table 5. The nonlinear regression model is acceptable in the sense the residuals do not form any pattern hence they are independent of the fit values.

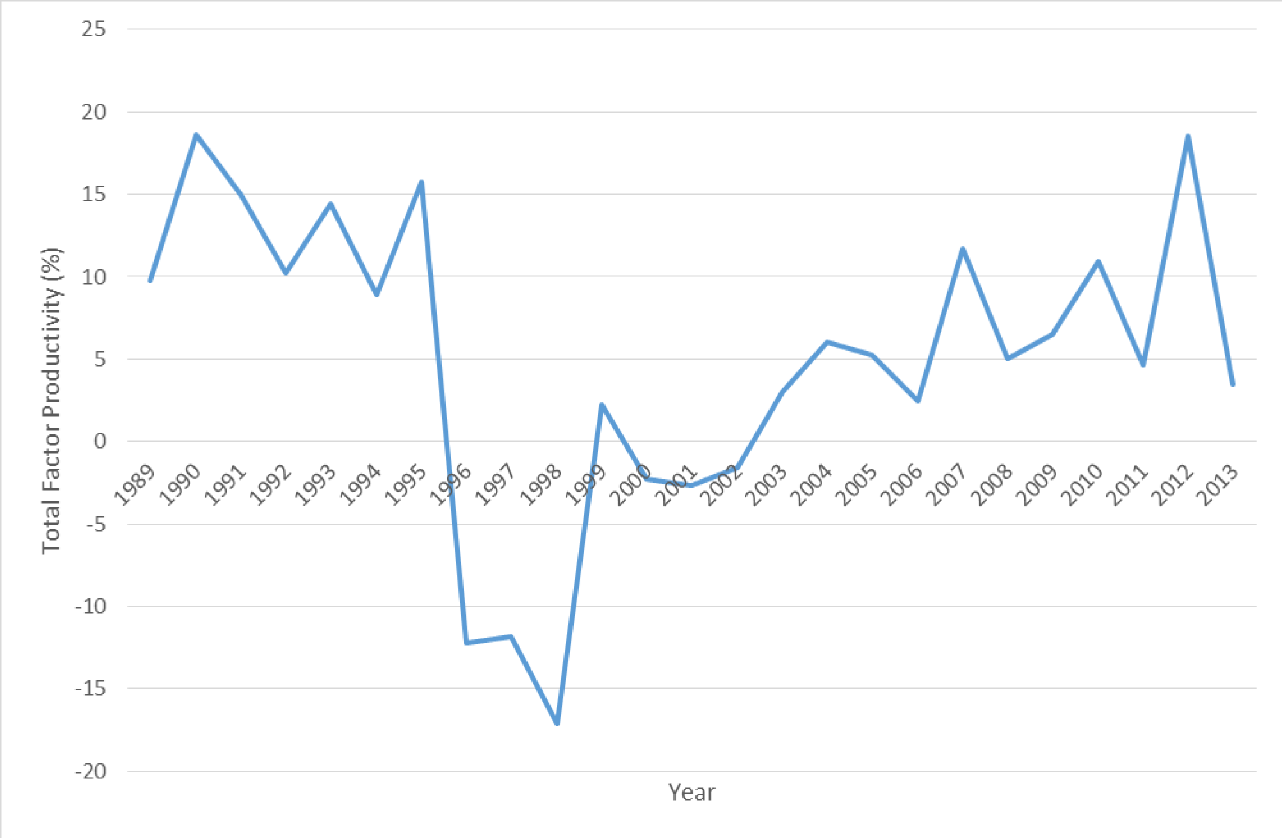
Table 6: Bivariate correlations of annual growth rate GDP in construction activity, employment, lending and residuals (N = 25)

	g_K	g_L	g_Y	r
g_K	1	.626	.639**	.039
g_L	.626**	1	.565**	-.129
g_Y	.639**	.565**	1	.708**
r	.039	-.129**	.708**	1

**. Correlation is significant at the 0.01 level (2-tailed).

The residual and annual growth rate of construction output were statistically significant at the .01 level and have a strong correlation at .708 as shown in Table 6. In general, the result suggested that r, which is defined as TFP has a strong correlation with the annual growth rate of the construction.

Figure 3: The TFP of construction sector (1989-2013)



The TFP of construction sector plummeted from annual growth of 15.79% in 1995 to -12.21% in 1996. It continues to decline in 1997 to -11.82% and fell further in 1998 to -17.13%. Table 1 shows that the deceleration of annual change in construction GDP in the 1990s with only exception in the year 1995. However, the annual changes of lending to construction sector by the banking system are growing in most of the time within this period. Two dramatic increments of 70.36% and 50.94% happened in 1996 and 1997 respectively. The annual changes of employment in the construction sector shown similar patterns, it was peaked at 17.51% in 1996 before it plunged to -5.94% in 1998. In 1990s, the nation's relatively sizeable public operating expenses and capital investment for infrastructure development have been financed in large part by natural resource wealth. This is reflected in the changes of capital during this period.

TFP recovered from negative growth (-17.15%) in 1998 to positive growth (2.24%) in 1999. It declined further in two consecutive years in 2000 and 2001 to -2.26% and -2.68% respectively. It improved to -1.62% in 2002 and the subsequent years shown positive growth but with different magnitude. The overall appearance of the TFP shown a growing trend from 1998 to 2012. The GDP of construction sector is on the growing trend from 1999 onwards and it reached the peak of 13.91% in year 2007 before falling downwards to 12.90% and 9.6% respectively in 2008 and 2009. During this period, the lending of banking system to the construction sector were facing with negative growth between year 1999 and 2006. The negative growth rate of construction employment narrowed to -3.1% in 1999 and continue grew to 5.13% and 9.20% in year 2001 and 2002 respectively before they started to fall four years consecutively from 9.20% to -5.49% in years 2001 and 2004 respectively. The construction employment from year 2005 to 2013 shown an overall rising trend with different magnitude of growth rate. The annual growth rate peaked at 8.18% in 2008.

The Asian financial crisis caused the GDP in construction sector to contract by 21.47% in 1998. There was a strong sense of optimism in the year 1997 that the adjustment measures that had been put in place to address existing economic imbalances would achieve a soft landing in terms of more sustainable growth with stability (Bank Negara Malaysia, 1998). However, after July, the economic situation changed dramatically and deteriorated progressively as the regional financial crisis became more intense and widespread. The crisis dramatically undermined confidence in the region, Malaysian economy has not been spared from the contagion effects of adverse developments in the region. There were successive depreciation of the ringgit, major corrections in the equity market, generally weaker investor confidence and large outflows of non-resident short-term capital. These developments caused strains to emerge in the financial system. (Bank Negara Malaysia 1998). There were decline in lending the construction sector by banking system consecutively for eight year from 1999-2006 (Table 2). The measures to restore financial market stability, significant progress made in the restructuring of the banking and corporate sectors, the accelerated implementation of the fiscal stimulus package and the favourable performance of the external sector have contributed positively to a significant revival in private consumption and export-related activities (Bank Negara Malaysia, 2000).

The problems in the US financial system started in mid-2007 with a deteriorating quality of sub-prime assets that subsequently escalated into a major severe global financial crisis (GFC) in the second half of 2008. The impact of the global recession was felt strongly in Malaysia's external trade-related sectors and started to impact on the economy as a whole in the fourth quarter of 2008 (Bank Negara Malaysia, 2009). Malaysia experienced the full impact of the GFC in the first quarter of 2009. In response, the government introduced several policy measures to mitigate its adverse impact and to prevent the economy from entering into a fundamental economic recession. These measures included two economic stimulus packages, i.e. RM7 billion (US$2 billion) announced in November 2008 and RM60 billion (US$20 billion) in March 2009. The stimulus packages included the construction of low- and medium- cost houses; maintenance and refurbishment of public amenities such as schools, hospitals and roads; reviving abandoned housing projects; improving public infrastructure; and the implementation of new infrastructure projects (Bank Negara Malaysia, 2010).

The governmental intervention measures were reflected in the annual growth of 12.90% and 16.93% in years 2008 and 2011 respectively (Table 2). Similarly the lending to construction sector from the banking system also reversed to positive growth. TFP growth in the construction sector in the new millennium shown a rising trend. The Considerable efforts to increase the application of Industrialised Building System (IBS) have been implemented to enhance construction productivity and reduce over-dependency on unskilled foreign labour as well as to promote quality and safety. The Government has planned to make it compulsory for public project to utilise IBS components to a minimum of 70% and for private projects to a minimum of 50% by 2015 as stated in the IBS Roadmap, 2011-2015 (Malaysia Productivity Corporation 2012). Other measures including adoption of more advanced building practices and systems such as the Green Building Index (GBI) and Building Information Modelling (BIM) (Malaysia Productivity Corporation 2014).

CONCLUSIONS

Productivity improvements is the primary source of sustained and long-term economic growth. Macro level insights of country's competitiveness or the prospect of its future economic performance can be generated only by rolling granular examination of individual business up to the industry, sector, and country levels (Manyika J., Remes, J., and Woetzel J. 2014).

Productivity gains are largely driven by the changes TFP which measures the synergy and efficiency of the utilisation of TFP also refers to the additional output generated through enhancements in efficiency arising from advancements in worker education, skills and expertise, acquisition of efficient management techniques and know-how, improvement in an organisation, gains from specialisation, introduction of new technology and innovation or upgrading of existing technology and enhancement in Information Technology (IT) as well as the shift towards higher added value processes and industries.

There was growing of GDP of the construction sector in the period of 1989-1997. TFP was declining during this period. The growing of construction was mainly fuelled by relatively sizeable public operating expenses and capital investment for infrastructure development which have been financed in large part by natural resource wealth. The resources are now rapidly depleting (National Economic Advisory Council 2009). The growth of GDP in construction sector decelerates in 1998-2013, but the TFP shows a rising trends. It is attributed to the adoption of more advanced building practices and systems such as GBI, IBS and BIM.

To enhance TFP, Malaysia needs to increase the utilisation of its productive assets and increase the quality of its workforce. To enhance labour productivity, firms and individuals need to engage in increased entrepreneurship and be involved in more innovative activities. They should also leverage on innovation taking place elsewhere by accessing new ideas and new markets abroad.

The execution of the Economic Transformation Programme (ETP) in 2010 are expected to add RM200 billion in construction contracts over the next 10 years. With this substantial increase in the volume of high quality construction works, it provides an opportunity for the construction sector to adopt new technologies and new methods of construction that will see a quantum leap in productivity through efficient utilisation of technologies, manpower and resources. Conventional building methods will soon be replaced by wider adoption of IBS with more innovative and profitable companies expected to evolve over this decade of opportunity (Malaysia Productivity Corporation 2010).

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