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Education Expansion and Unemployment Nexus: Further Evidence from Malaysia

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ABSTRACT

This study seeks to examine the validity of the assumption that increases in the average level of the human capital for a country over a specific level will result in replacing workers with technology; and, hence, boost the unemployment rate. We employ the ARDL approach on time series data covering the period 1980 to 2012 for the Malaysian economy. The results reveal, to some extent, the validity of such an assumption in the short run, but, in the long run, upgrading the average level of the human capital will lead to a lower and not higher rate of unemployment. The overall findings suggest that policy makers should continue in their current effort to expand education since, over time this could lead to a lower rate of unemployment.

Keywords: Human capital, Technical change, Unemployment, Education, ARDL.
JEL Classification : I21,O33, J40.

INTRODUCTION

It is widely accepted that a more educated workforce is less unemployed because it is more mobile and adaptable to learning new tasks and skills as well as capable of using a wider range of new and sophisticated technologies (Mincer, 1991a; Brauns et al. 1999). However, new evidence shows that expanding educational achievements beyond a specific level can boost unemployment via the technology-workers replacement effect (Richardson and Van den Berg, 2001; Chan and Suen; 2003; Ho and Tan 2008). An increase in the human capital accumulation beyond a specific level will affect the structure of technological progress either through an increase in the ability to innovate new technology and/or an increase in the ability to absorb new technology from abroad (Nelson and Phelps, 1966; Moretti, 1999; Papageorgiou, 2003; Hollanders and Weel, 2002). This technical progress is likely to have significant consequences on the structure of the labour market due to the replacement of the workforce in economic activities. For example, Ho and Tan (2008) noted that new jobs are expected to materialise in response to technological progress and render existing jobs using older technology obsolete.[1] Although workers with a relatively higher level of education are likely to be more able to adopt and adapt new technology, unemployment is likely to persist due to the technology-workers replacement effect. According to Ho and Tan (2008), human capital accumulation has a double effect on unemployment. First, the direct effect, which is positive, and, second, the indirect effect, which is negative but is considered dominant in labour market performance. The indirect impact occurs due to the excessive level of human capital accumulation that encourages technological development and usage that reduces the demand for labour.

Although extant studies demonstrate that excessive human capital accumulation could lead to unemployment, they seem to exclude the 'time' factor, which is considered crucial when examining the effect of human capital. Clearly, unemployment may occur because the current levels of human capital do not match the required levels of skill in the long run (the mismatch phenomenon). Nevertheless, efforts to improve the current levels of skill through education expansion and training programmes will facilitate the adoption and usage of new technologies, which will reduce the number of unemployed in the long run. These adaptation processes (adopt and usage) are not captured in previous studies including those by Ho and Tan (2008). Therefore, the main aim of the present study is to examine

[1] Ho and Tan (2008) discribe this process by the "Creative destruction".

whether a rise in the accumulation of human capital beyond certain levels could increase or reduce unemployment over time.

Malaysia has placed great emphasis on the development of its higher education system. The introduction of the Private Higher Education Act in 1996 marked the era of the liberalisation of higher education to ensure greater access. According to Barro and Lee (2010), in 2010, the average number of years of schooling for the population aged 15 years and above for the country was 10.16 years. This figure is relatively high when compared to neighbouring countries, such as Indonesia (5.95), Vietnam (6.34), Thailand (7.41), the Philippines (8.95) and Singapore (9.13). In less than a decade, the number of degree holders has increased substantially; however, this has placed significant pressure on the labour market, which could later lead to the issue of unemployment among the graduates. Although Malaysia has experienced a low unemployment rate, ranging between 3% and 4%, the number of unemployed graduates is relatively high. For example, report by the Bank Negara (2003) shows that the number of unemployed graduates increased from 38,800 in 2001 to 45,400 in 2002.

Malaysia is an open economy with an external sector representing more than 200% of its gross domestic product (GDP). The data on the Economic Globalization Index (Dreher et al. 2012) also show that Malaysia registered a relatively higher score of 78.23 compared with 55.2, 56.12, 63.64 and 47.02 for Indonesia, the Philippines, Thailand and Vietnam, respectively. Theoretically, openness is considered as an important instrument for importing and/or exporting new frontiers of technology (Grossman and Helpman, 1995; Liua and Wang, 2003). Given the education, technology and unemployment nexus, the attainment of such higher levels of education as well the degree of openness of Malaysia’s economy, may expose the labour market to pressure, and, hence, over time, raise the rate of unemployment. Thus, this study addresses this issue and offers advice to policy makers in Malaysia as well as other countries concerning the implications of the relevant policies for expanding their respective education systems. The paper is organized as follows: section one provides the introduction, while section two deals with the methodology. The results and discussion are presented in section three. Section 4 ends with the conclusion and policy recommendations.

METHODOLOGY

The model used in this study is an extension of the work of Ho and Tan (2008), which can be specified using the following equation:

$$UNEM_t = \beta_0 + \beta_1 HC_t + \beta_2 HC_t^2 + \beta_3 SKEM_t + \beta_4 USRD_t + \beta_5 OPE_t + \mu_t \qquad (1)$$

Where t is the time, UNEM is the unemployment rate (% total labour forces), HC is the proportion of economically active persons aged 25 years and above who possess tertiary education. For robustness, we also test using population aged 15 and above with similar levels of education (tertiary level). SKEM is the number of professional, technical and related workers for measuring the domestic technological level. Whilst, USRD is the US expenditure on R and D (% GDP) to represent global technological progress, OPE is the openness (exports plus imports as a proportion of the GDP) and μ is the random variable. In this study we assume that except HC^2 and OPE, all independent variables are assumed to have positive relationships with the dependent. In the case of HC, unemployment will increase if there is a mismatch between the existing levels of human capital and the required levels of skill. However, the mismatch will disappear through the upgrading of HC to HC^2, and, subsequently, reduce the unemployment rate. Following Ho and Tan (2008), the threshold level of HC can be derived using the following formula:

The threshold level of HC = $\beta_1 / 2\beta_2$ (2)

Data pertaining to unemployment, professional, technical and related workers were obtained from the Department of Statistics Malaysia (DOSM). Data for the proportion of economically active persons of age 25 and above, and 15 years and above, who possess tertiary education were obtained from Barro and Lee (2010, updated). Data on openness were gathered from UNCTAD. Finally, data regarding US expenditure on RandD (% GDP) were retrieved from the World Bank.

The Autoregressive Distributed Lags (ARDL) method developed by Pesaran and Pesaran (1997) is used in the present study due to the various advantages exhibited by the approach. However, the most important advantage of this method is its superior properties for small sample studies. The method comprises three basic steps. First is to test the order of the integration between the variables (unit root test). If there is no *I*(2) variable, the second step is to test the existence of cointegration between the variables using the bounds test. The final step is to analyse the long and short run relationship.

Following Pesaran and Pesaran, (1997), based on equation (1), the conditional VECM is written in the following form:

$$\Delta UNEM_t = C_0 + \gamma_1 UNEM_{t-1} + \gamma_2 HC_{t-1} + \gamma_3 HC^2_{t-1} + \gamma_4 SKEM_{t-1} + \gamma_5 USRD_{t-1} + \gamma_6 OPE_{t-1} + \sum_{j=1}^{q} \varphi_j \Delta UNEM_{t-j} + \sum_{n=1}^{q} \delta_n \Delta HC_{t-n} + \sum_{s=1}^{q} \emptyset_s \Delta HC^2_{t-s} + \sum_{w=1}^{q} \xi_w \Delta SKEM_{t-w} + \sum_{g=1}^{q} \psi_g USRD_{t-g} + \sum_{h=1}^{q} \nu_h \Delta \mathrm{OPE}_{t-h} + \epsilon_t \quad (3)$$

Where q is the lag length, and the null hypothesis of no cointegration is given by $\gamma_1=\gamma_2=\gamma_3=\gamma_4=\gamma_5=\gamma_6=0$ against the alternative hypothesis $\gamma_1\neq\gamma_2\neq\gamma_3\neq\gamma_4\neq\gamma_5\neq\gamma_6\neq 0$. We follow the standard procedure and compare the computed F-statistic with the critical values from Narayan (2005). If there is evidence of a long run relationship between the variables, the next step is to estimate the long run relationship using equation (4):

$$UNEM_t = C_0 + \sum_{i=1}^{p} \lambda_1 UNEM_{t-i} + \sum_{i=0}^{q1} \lambda_2 HC_{t-i} + \sum_{i=0}^{q2} \lambda_3 HC^2_{t-i} + \sum_{i=0}^{q3} \lambda_4 SKEM_{t-i} + \sum_{i=0}^{q4} \lambda_5 USRD_{t-i} + \sum_{i=0}^{q5} \lambda_6 OPE_{t-1} + \epsilon_t \quad (4)$$

The procedure requires selecting the orders of the ARDL (p, q_1, q_2, q_3, q_4, q_5) model on the five variables using appropriate criteria. The final step involves obtaining the short run dynamic parameters by estimating the error correction model (ECM) associated with the long run estimates using equation (5):

$$\Delta UNEM_t = \mu + \sum_{j=1}^{p} \varphi_j \Delta UNEM_{t-j} + \sum_{n=1}^{q} \delta_n \Delta HC_{t-n} + \sum_{s=1}^{q} \emptyset_s HC^2_{t-s} + \sum_{w=1}^{q} \xi_w \Delta SKEM_{t-w} + \sum_{g=1}^{q} \psi_g \Delta USRD_{t-g} + \sum_{h=1}^{q} \nu_h \Delta OPE_{t-h} + \Omega ecm_{t-1} + \epsilon_t \quad (5)$$

Where, φ, δ, ϕ, ξ, ψ and ν represent the short run dynamic coefficients of the model's convergence to equilibrium, whilst Ω is the speed of adjustment. The significance of ECM_{t-1} suggests a causality relationship in at least one direction.

RESULTS AND DISCUSSION

One of the basic requirements of the ARDL is that the order of integration must not exceed one, i.e. none of the variables are found to be *I*(2). The results of the unit root tests in Table 1 indicate the absence of *I*(2) variables and all the underlying variables have a mixed order of integration (i.e. *I*(0), *I*(1)). The results of the unit root test affirm the need to test for cointegration between the variables. The second step is to test whether a long run relationship exists between the variables.

We performed the bounds test to investigate the existence of cointegration between the underlying variables using equation 3. The cointegration results in Table 2 show that the F-statistic from the bounds test detected the relationships at lag three (3) for the population aged 25 and above, and lag two (2) for the population above 15 years. Pesaran and Pesaran (1997) argue that the existence of cointegration implies that the chosen explanatory variables are long run forcing variables for the dependent variable. Since long run cointegration is detected, the next step in the ARDL procedure is to analyse the long run relationship by applying estimating equation 3.

The results of the criteria for SBC and AIC in Table 3 are typically identical for both specifications, which reflect the robustness feature. The results for the long run of the variables of interest (i.e. HC, HC^2) have the expected sign and both are statistically significant. These findings suggest the existence of a threshold level of human capital, irrespective of the corresponding age group, and, beyond that, a further rise in HC will reduce unemployment. The findings contrast with those of Ho and Tan (2008) in the case of Singapore. This is because in the study conducted by Ho and Tan (2008), the long and the short runs are not distinguished. In fact, as we can see later, the findings by Ho and Tan (2008), are, to some extent, only valid for the short run period. For the case of Malaysia, the findings from the present study imply that the existing level of human capital in the country is likely to create further unemployment due to a mismatch (see Annic and Hamali, 2006, Yussof and Ismail, 2012, Sook Fan et al., 2013). However, the added effort to upgrade the average level of the human capital in the country will help the country to overcome such problems, and, thus, facilitate the further absorption of human capital into the labour market. The estimated threshold level of human capital, beyond that further rise, would result in reducing the unemployment by 6.67% and 5.80% for the age group above 25 years and above 15 years, respectively. Thus, Malaysia should increase the current proportion of its population aged over 25 years and 15 years who complete their tertiary education from 5.4% to 6.7% and from 5.40% to 5.80%, respectively, to ensure the appropriate reduction of its unemployment rate over time.

However, in the long run, the internal and external sources of technical change have a negative influence on the unemployment rate, which is consistent with Ho and Tan (2008). Lastly, the results of the diagnosis test suggest that the model passes all the selected tests. Specifically, the normality test cannot reject the null hypothesis, meaning that the estimated residuals are normally distributed and the standard statistical inferences (i.e. t-statistic, F-statistic, and R-squares) are valid. Moreover, the results of the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) plots also indicate that the regression coefficients are generally stable over the sample period. In the short run, the results of the goodness of fit in Table 4 show that for both specifications, on average, the selected explanatory variables explain 75% of the variation of the unemployment rate in Malaysia. In addition, all these variables play a significant role in explaining unemployment, as indicated by the F-statistic. With regards to the variables of interest, in the short run, it is clear that there is a threshold level of human capital beyond which a further rise would boost unemployment within the economy.

For example as shown in Table 4, an increase in the accumulation of human capital (HC) for age group of 25 years and above will lead to a decrease in unemployment, which reflects the direct effect. Further upgrading in the accumulation of human capital (as represented by HC^2), will lead to increase in unemployment due to the technology-workers replacement effect in the short run. However, for the two time lags, a further upgrading in HC^2 will result in a reduction in unemployment due to the ability of the workers to adopt new technology. In the short run, whilst external sources of technology continue to have a negative influence on unemployment, the impact of the internal sources of technical change (i.e. the number of skilled workers employed - SKEM) is marginal but distributed over time. The insignificant impact for the average level of human capital for the age group of 15 years and above is possibly due to the fact that it tends to include people outside the labour market (i.e. those still in the education system).

The most interesting finding is related to the coefficient of the ECT_{-1}, which appears negative, less than one, as well as being statistically strongly significant for both specifications. The ECT_{-1} explains the speed of the adjustment process to restore equilibrium following a disturbance in the long run equilibrium relationship. These results can be interpreted as follows: Given the deviation of unemployment rates from the long run equilibrium relationship, all the explanatory variables will interact in a dynamic fashion to restore long run equilibrium. Most importantly, the significance of the ECT_{-1} also indicates the existence of a causal relationship between the variables, at least in one direction.

CONCLUSION AND POLICY IMPLICATIONS

This study seeks to examine the validity of the hypothesis that an increase in the average level of human capital accumulation over a specific level will increase unemployment due to the technology-workers replacement effect. Theoretically, human capital accumulation has a negative relationship with unemployment. However, new evidence suggests that human capital accumulation beyond a certain level will encourage the utilization of technology, which reduces the demand for labour, and, subsequently, increases the unemployment rate. The empirical results from the present study reveal that, to some extent, the validity of the hypothesis is only valid in the short run. Nonetheless, in the long run, the process of upgrading the average level of human capital accumulation will likely lead to a lower rate of unemployment. The results imply that in the absence of any effort to improve human capital, it is expected that the country will face an increase in the unemployment rate in the long run because of a mismatch in the requirement of skills. In contrast, efforts towards educational expansion and human capital enhancement will create new opportunities for workers to adopt and adapt to new technology, and, hence, the probability of being unemployed declines. In the case of Malaysia, although the current level of human capital ensures a low level of unemployment, this is only a short run phenomenon. A further increase in the human capital level in the long run will help to lower the unemployment rate. Given the relatively small gap between the current level of human capital and the threshold level (the target) for unemployment reduction, the challenge facing the policy makers in achieving the target is less difficult.

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TABLE 1 : The Unit Root Test

The Variables	At level [I(0)]		At first difference [I(1)]	
	ADF	KPSS	ADF	KPSS
UNEM	-2.04 (0.55)	0.07	-3.50*** (0.015)	0.09
HC	-1.78 (0.69)	0.12*	-5.17*** (0.001)	0.09
HC^2	-2.21 (0.47)	0.08	-5.45*** (0.006)	0.07
SKEM	-1.97	0.19**	-3.67**	0.08

	(0.59)		(0.04)	
USRD	-4.31*** (0.009)	0.07		
OP	0.35 (0.99)	0.16***	-3.76** (0.033)	0.06

Notes:

a. The critical values for t-statistic for ADF (with intercept & trend) are -4.16, -3.51 and -3.18 under 1%, 5% and 10% significant level respectively.
b. The Asymptotic critical values for Kwiatkowski-Phillips-Schmidt-Shin test statistic (with trend) are equal to 0.22, 0.15 and 0.12 under 1%, 5% and 10% significant level respectively.
c. (*)(**) (***) in (ADF) and denote rejection of the null of non-stationary of the variable at 10 %, 5% and 1% significant level respectively.
d. (*)(**) (***) in (KPSS) denote acceptance of the null of the stationary of the variable at 10 %, 5% and 1% significant level respectively

TABLE 2 : F-statistic for cointegration tests

NO	The specifications/ Lag length	1	2	3
		F-Statistic		
1	UNEM (HC, HC2, SKEM, USRD, OPE)	2.02	3.34	14.56***
2	UNEM (HC, HC2, SKEM, USRD, OPE)	1.33	5.68**	3.56

Notes:

a. The first letter outside the brackets denotes dependent variable.
b. Specification (1) when HC is represented by the age group of 25 years and above, whilst in specification (2) when HC is represented by the age group above 15 years.
c. The lower-upper critical values for the F-test (with intercept and trend) with five variables (k=5) are (5.347-7.242) (3.181-5.55) and (3.157-4.412) at 1%, 5%, and 10% significant levels, respectively.
d. The critical value is obtained from Narayan (2005) p. 1990.
e. The asterisks (***) and (**) denote significance at 1% and 5% levels, respectively.

TABLE 3: The long run analysis

Variables	Specification 1		Specification 2	
	SBC ARDL(3,1,3,3,0,0)	AIC ARDL(3,1,3,3,0,0)	SBC ARDL(2,2,0,1,1,1)	AIC ARDL(2,2,0,1,1,1)
HC	12.84*** [8.41]	12.84*** [8.41]	9.86*** [3.51]	9.86*** [3.51]
HC^2	-0.96*** [11.24]	-0.96*** [11.24]	-0.85*** [3.81]	-1.42*** [3.81]
SKEM	0.02*** [6.94]	0.02*** [6.94]	0.01*** [4.51]	0.01*** [4.51]
RDUS	8.35*** [4.43]	8.35*** [4.43]	7.64** [2.68]	7.64** [2.68]
OPE	0.0001 [0.99]	0.0001 [0.99]	-0.01 [1.16]	-0.01 [1.16]
C	-3.75*** [3.64]	-3.75*** [3.64]	-23.67** [2.28]	-23.67** [2.28]
T	-1.88*** [5.42]	-1.88*** [5.42]	-0.70*** [4.43]	-0.70*** [4.43]
Diagnostic Tests				
Serial Correlation	0.45 (0.52)	0.45 (0.52)	0.83 (0.38)	0.83 (0.38)
Functional Form	1.95 (0.19)	1.95 (0.19)	1.15 (0.30)	1.15 (0.30)

Normality	3.10 [0.21]	3.10 [0.21]	1.02 (0.60)	1.02 (0.60)
Heteroscedasticity	0.27 (0.61)	0.27 (0.61)	3.84 (0.09)	3.84 (0.09)
CUSUM	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Stable

Note:

a. Serial correlation is F- statistics of Breusch-Godfrey serial correlation LM test. B: Functional form is F- statistics of Ramsey's RESET test using the square of the fitted values. Normality is LM – statistics of skewness and kurtosis of residuals for normality test. Heteroskedasticity is F-statistics of white Heteroskedasticity test. CUSUM; Cumulative Sum of Recursive Residuals is the stability test of the long run coefficients together with the short run dynamics based on Pesaran and Pesaran (1997).CUSUMSQ; Cumulative Sum of Squares of Recursive Residuals is the stability test of the long run coefficients together with the short run dynamics based on Pesaran and Pesaran (1997).

b. The absolute value for t-statistic in [ ] & prob for F-statistic in ( ).

c. (*) denotes significant at 1% level .

TABLE 4: The short run analysis

Variables	Specification 1 (25 years and above)		Specification 2 (15 years and above)	
	SBC ARDL(3,1,3,3,0,0)	AIC ARDL(3,1,3,3,0,0)	SBC ARDL(2,2,0,1,1,1)	AIC ARDL(2,2,0,1,1,1)
ΔHC	-17.14*** [3.66]	-17.14*** [3.66]	-7.01 [1.45]	-7.01 [1.45]
ΔHC^2	1.83*** [3.56]	1.83*** [3.56]	0.77 [1.29]	0.77 [1.29]
ΔHC^2_1	-0.20 [1.17]	-0.20 [1.17]	-	-
ΔHC^2_2	-1.88*** [5.17]	-1.88*** [5.17]	-	-
$\Delta SKEM$	0.006*** [4.60]	0.006*** [4.60]	0.002** [2.71]	0.002** [2.71]
$\Delta SKEM_1$	-0.007*** [6.61]	-0.007*** [6.61]	-0.001** [2.04]	-0.001** [2.04]
$\Delta SKEM_2$	-0.002*** [4.12]	-0.002*** [4.12]	-	-
$\Delta RDUS$	6.96*** [4.13]	6.96*** [4.13]	5.28*** [2.90]	5.28*** [2.90]
ΔOPE	0.0001 [0.01]	0.0001 [0.01]	0.01 [0.96]	0.01 [0.96]
ΔC	-19.81*** [3.36]	-19.81*** [3.36]	-16.37** [2.56]	-16.37** [2.56]
ΔT	-1.57*** [3.36]	-1.57*** [3.36]	-0.49*** [4.40]	-0.49*** [4.40]
ECT_{-1}	-0.83*** [10.74]	-0.83*** [10.74]	-0.70*** [5.61]	-0.70*** [5.61]
Goodness of Fit				
R^2	0.94	0.94	0.80	0.80
R^{-2}	0.87	0.87	0.64	0.64
F-statistic	16.61*** (0.000)	16.61*** (0.000)	7.32*** (0.000)	7.32*** (0.000)

Notes:

a. The absolute value for t-statistic in [ ] & prob for F-statistic in ( ).

b. (***) and (**) denotes significant at 1% and 5% level respectively.