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DETERMINANTS OF LIFE EXPECTANCY AMONG THE INDIAN MINORITY GROUP IN MALAYSIA: A STUDY

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The life expectancy among three major ethnic groups in Malaysia, namely, the Bumiputera, Chinese and Indian varies. The Indian male minority ethnic group, more specifically shows a lower life expectancy compared to that of the Bumiputera, Chinese and the national average. This study therefore compares the determinants of life expectancy between the Indian male and female gender. The key findings of the study are: First, access to healthcare and literacy are important determinants of life expectancy for both Indian males and females. Second, income displays a significant negative relationship with life expectancy for Indian males. Third, the speed of adjustment to equilibrium for life expectancy of the Indians is somewhat sluggish and is marginally lower for the male vis-à-vis the female gender. Future research should focus on the reasons for the lower life expectancy of the Indian males more specifically by identifying the possible influences of lower income opportunities (beyond a postulated threshold income level) for this minority group vis-à-vis the other ethnic groups.

Introduction

Various economic and non-economic factors determine life expectancy. Income is one of the crucial factors in determining life expectancy as suggested by Anand and Ravallion (1993). Once income exceeds a certain threshold, the positive relationship disappears (Wilkinson, 1996). Education is also a key determinant of life expectancy. Studies by Rogot *et al.* (1992), Gulis (2000) and Rogers and Wofford (1989) observed a positive relationship between life expectancy and education. Apart from income and education, access to health is another factor influencing life expectancy. Health input as measured by the number of physicians also shows a positive relationship with health outcomes (life expectancy) as found by Mohan and Mirmirani (2007). Other remaining factors that determine life expectancy include access to safe drinking water, exposure to diseases, healthcare spending and urbanization.

Table 1 shows the life expectancy of three major ethnic groups in Malaysia, the Bumiputera, Chinese and Indian [1]. From Table 1, it is evident that men have a lower life expectancy than women. The Indian male displays a consistently lower life expectancy compared to the national average (see Figure 1), and also compared

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to that of the Bumiputera and the Chinese. In 2005, the recorded life expectancy of the Indian male was found to be only 67.4 years, the lowest among the three ethnic groups in Malaysia. Conversely, the Indian female though displayed a lower life expectancy than the national average (see Figure 1), recorded a slightly higher rate than the Bumiputera females.

TABLE 1: LIFE EXPECTANCY AMONG VARIOUS ETHNIC GROUPS IN MALAYSIA (IN YEARS)

Year	*Male*				*Female*			
	Overall	*Bumi-putera*	*Chinese*	*Indians*	*Overall*	*Bumi-putera*	*Chinese*	*Indians*
2000	70.0	69.0	72.4	65.7	74.7	73.3	77.6	73.5
2001	70.6	69.5	72.8	66.4	75.1	73.7	77.9	73.7
2002	70.8	69.6	73.0	66.8	75.3	73.9	78.1	74.1
2003	70.9	69.7	73.1	66.8	75.6	74.2	78.3	74.5
2004	71.1	69.9	73.3	67.0	75.9	74.5	78.5	75.1
2005	71.5	70.4	73.6	67.4	76.2	74.8	78.8	75.4

Source: Malaysia Economic Statistics - Time Series, 2007

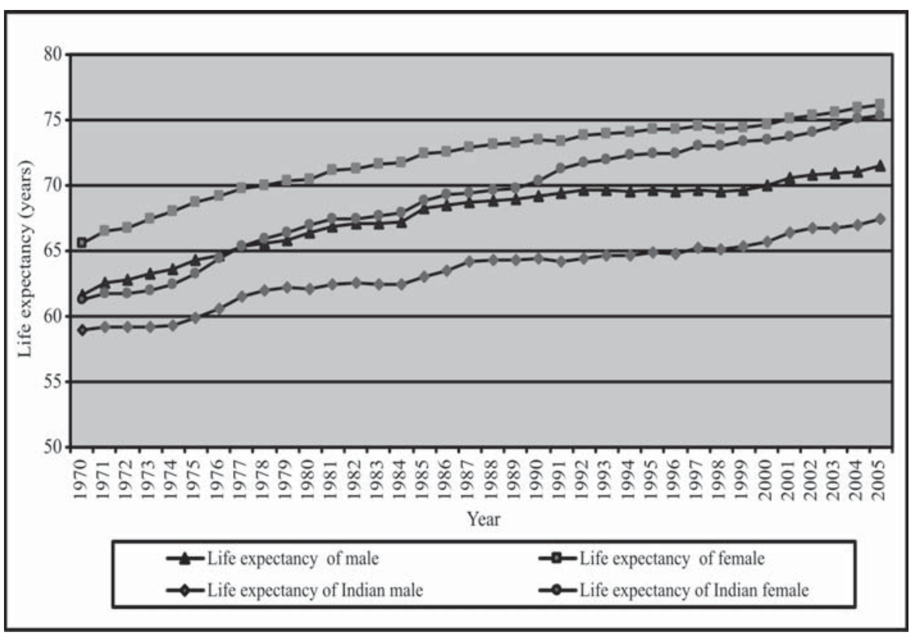

Figure 1: Life Expectancy for the Indians and the National Average in Malaysia, 1970-2005

Source: Malaysia Economic Statistics - Time Series, 2007

Given, the relatively low life expectancy levels of the Indian minority ethnic group in Malaysia, particularly for the male gender, this study assesses and compares the determinants of life expectancy across gender within this group. The paper is organized as follows. Section II presents the methodology and data. Section III discusses the findings and the final section concludes.

Method and Data

Model Specification

Based on the life expectancy model developed by Kabir (2008), we posit the following specification to determine the life expectancy for the Indian ethnic group in Malaysia.

$$LE_t = \beta_0 + \beta_1 DOC_t + \beta_2 GDPC_t + \beta_3 ILIT_t + \varepsilon_t \quad (1)$$

where LE_t is the life expectancy; DOC_t is the doctor to population ratio; $GDPC_t$ is the per capita GDP and $ILIT_t$ is the illiteracy rate, ε_t is the error term, t represents the time period and β_0, β_1, β_2 and β_3 are coefficients to be estimated.

Methodology

Pesaran *et al.* (2001) suggested the use of Autoregressive Distributed Lag Model (ARDL) approach when the time series under study comprised a mixture of $I(0)$ and $I(1)$ and it is small in sample size. The Unrestricted Error Correction Model (UECM) or error correction version of ARDL approach can be written as follows:

$$\Delta LE_t^k = a_0 + \sum_{i=0}^{m} a_{1i}\Delta LE_{t-1}^k + \sum_{i=0}^{m} a_{2i}\Delta DOC_{t-1}^k + \sum_{i=0}^{m} a_{3i}\Delta GDPC_{t-1}^k + \sum_{i=0}^{m} a_{4i}\Delta ILIT_{t-1}^k + a_5 LE_{t-1}^k + a_6 DOC_{t-1}^k + a_7 GDPC_{t-1}^k + a_8 ILIT_{t-1}^k + u_t \quad (2)$$

where Δ represents the first difference operator; m represents the lag length selected based on Akaike Information Criteria (AIC); u_t is normally distributed residuals. The bounds test developed by Pesaran *et al.* is used to test the null hypothesis of no cointegration. The null and alternative hypotheses are as follows:

$$H_0 : a_5 = a_6 = a_7 = a_8 = 0 \quad (3)$$

$$H_1 : a_5 \neq a_6 \neq a_7 \neq a_8 \neq 0 \quad (4)$$

The null hypothesis above indicates that the long-run relationship is non-existent in the model. The alternative hypothesis, indicates that at least one of the a_i's is not equal to zero. The F-value obtained is compared with critical bound values as proposed in Pesaran *et al.* The null-hypothesis of non-existence of long-run relationship can be rejected if the computed F-value exceeds the upper critical bound. Alternatively, the null of no cointegration cannot be rejected if the computed F-value falls below the lower bound. A conclusive inference cannot be made if the F-value computed falls between the upper and the lower bound.

Data and Variables

A time series data from 1970 to 2005 was obtained from various sources. Life expectancy data was obtained from the Malaysia Economic Statistics - Time Series 2007 published by the Department of Statistics, Malaysia. Data on illiteracy rate and per capita income were obtained from World Development Indicators. Data on doctors to population ratio was calculated from the Yearbook of Statistics, Malaysia, published by the Department of Statistics, Malaysia. The definition of variables employed for this study are presented in Table 2.

TABLE 2: DEFINITION OF VARIABLES

Notation	*Measure*	*Expected impact on life expectancy*
LEIM	Life expectancy at birth, years, Indian male	-
LEIF	Life expectancy at birth, years, Indian female	-
DOC	Doctor to population ratio	Positive
GDPC	Per capita GDP in purchasing power parity (PPP)	Positive
ILITM	Adult illiteracy of male as percentage of total population	Negative
ILITF	Adult illiteracy of female as percentage of total population	Negative

Empirical Results

In the execution of the analysis, the unit root test is used to differentiate stationary from non-stationary series and to determine whether the variable being investigated is $I(0)$ or $I(1)$ processes. The determination of the order of integration is crucial in order to ascertain the use of appropriate cointegration techniques. The lag length selection for Augmented Dickey-Fuller (ADF) test is based on the AIC. The results of the unit root test based on the ADF test reveals that all series namely LEIM, LEIF, DOC, GDPC, ILITM and ILITF comprise a mixture of $I(0)$ and $I(1)$. This gives us a good basis to employ the ARDL cointegration approach.

The cointegration analysis reveals that the variables for Indian male group (Model 1) is found to be cointegrated (Table 3) because an F-value of 4.3314 was obtained, and this value falls above the critical upper bound of [2.86, 4.01] at the 5

TABLE 3: F-STATISTICS FOR COINTEGRATION RELATIONSHIP

Model (Dependent variable)	*F-value*	*Result*
Model 1 (DLEIM)	4.3314*	Cointegrated
Model 2 (DLEIF)	4.6768*	Cointegrated

Note: The lower and upper critical values for the F-statistic version of the bounds test [lower critical bound, upper critical bound] at 5% significance level is [2.86, 4.01]. * denotes the computed test statistic (F-test) exceeds the upper critical bounds at 5% level of significance, thus rejecting the null of no cointegration. Case III of Pesaran *et al*. (2001), that is unrestricted intercepts and no trends, is followed.

percent level of significance. For the Indian female group (Model 2), an F-value of 4.6768 was obtained, which also falls above the critical upper bound of [2.86, 4.01]. This indicates that there is a steady state long-run equilibrium among the variables for both Indian males and Indian females.

Table 4 shows the long-run estimated coefficients for all models. The variable DOC, displayed positive and significant signs for the life expectancy models 1 (Indian males) and 2 (Indian females). As the doctor to population ratio decreases, the access to healthcare increases and this in turn increases life expectancy. This finding is similar to that of Fulop and Reinke (1981). As expected, illiteracy rates have significant and negative influence on life expectancy of the Indian gender groups. This also implies that the affluent and better educated are more likely to take advantage of better healthcare opportunities. Similar results are obtained in other studies such as Kabir (2008), Messias (2003) and Gulis (2000). Socio-economic status also determines the health status of the population (Upadhyaya, 2003).

Interestingly, a higher income per capita reduces the life expectancy for Indian males. This finding concurs with that of Messias (2003) whereby a negative relationship is observed between life expectancy and GDP per capita in Brazil. One possible reason for this result is offered by Wilkinson (1996). He argued that once a country reaches a threshold level of income of $5,000.00 , the increment in per capita GDP does not necessarily contribute to gains in life expectancy.

TABLE 4: ECONOMETRIC RESULTS FOR THE LONG-RUN MODEL, 1970-2005

Model	*Model 1*	*Model 2*
Dependent variable	LEIM ARDL (1,3,1,2)	LEIF ARDL(2,4,2,1)
Constant	+58.1180***	+46.7733***
DOC	+0.0003***	+0.0001*
GDPC	-0.0005***	-0.0002
ILITM	-0.4545***	-
ILITF	-	-0.2741***
Goodness of fit and diagnostics		
R-squared	0.7912	0.8520
Adjusted R-squared	0.6086	0.6698
F-statistic (*p*-value)	4.3314 (0.0032)	4.6768 (0.0038)
Serial correlation (*p*-value)	2.2637 (0.1407)	2.9364 (0.0951)
Normality (*p*-value)	0.4318 (0.8058)	0.5426 (0.7624)
Heterogeneity (*p*-value)	2.0305 (0.1652)	0.0336 (0.8559)
Stability (*p*-value)	0.0097 (0.9230)	1.5797 (0.2327)

Note: Asterisks *, **, *** denote statistical significance at 10%, 5 % and 1% respectively.

The speed of adjustment in the dynamic model is captured by the error correction term, EC_{t-1} as reported in Table 5. The EC term appears with a negative sign and is highly significant at the 1 percent level in both models 1 and 2. The coefficient of -0.37 for the EC term in Model 1 implies that the adjustment to equilibrium is somewhat slow. The speed of adjustment to equilibrium is only marginally higher for the Indian female life expectancy vis-à-vis that of the male. For model 2, the coefficient of -0.42 for EC suggests that a deviation from long-run life expectancy in the current period is corrected by about 42 percent in the next period.

TABLE 5: ECONOMETRIC RESULTS FOR THE SHORT RUN MODEL, 1970-2005

Variables	*Dependent variable*	
	ΔLEIM	*ΔLEIF*
Constant	-0.5788** (-2.1195)	-0.5415* (-1.9134)
ΔLEIM(-1)	0.5424*** (3.8402)	-
ΔLEIF(-1)	-	0.50998*** (3.5737)
ΔDOC	-0.0002** (-2.5362)	-0.0001 (-1.6075)
ΔGDPC	0.0002 (0.9790)	0.0001 (0.1416)
ΔLITM	-1.0787*** (-3.0528)	-
ΔLITF	-	-0.6542*** (-3.1288)
EC_{t-1}	-0.3722*** (-3.8532)	-0.4215*** (-4.0535)

Note: Asterisks * , ** , *** denote statistical significance at 10%, 5 % and 1% respectively. Figures in the parentheses denote t-values.

Concluding Remarks

To the best of our knowledge, no other study done in Malaysia has identified the determinants of life expectancy for the Indian minority ethnic group using the bounds testing approach. In this respect, this study contributes to the empirical literature on life expectancy within minority groups using a more reliable empirical strategy. This study brings to fore several interesting findings. First, a long run relationship can be observed among the variables under investigation for both Indian male and female in Malaysia. Second, access to healthcare and education (proxy by literacy) are important determinants for life expectancy of both Indian males and Indian females. Third, income displays a negative relationship with life expectancy for the male gender implying the possibility of the threshold income hypothesis as suggested by Wilkinson (1996).

Future research should pay more attention to the growing inequality in life expectancy between different ethnic background in Malaysia. In this context, attempts should be made to carefully delineate the reasons for the lower life expectancy of the Indian males more specifically by identifying the possible influences of lower income opportunities (beyond a postulated threshold income level) for this minority group vis-à-vis the other ethnic groups.

Note

1. In 2008, the Bumiputera comprised 67.2 per cent of the population, the Chinese 24.5 per cent and the Indian 7.1 per cent (Social Statistics Bulletin, Malaysia, 2008).

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