Determinants of employees provident fund in Malaysia: Potential factors to jeopardize the EPF sustainability

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Abstract: The topic of EPF sustainability has gained considerable attentions among the governments worldwide. In the wake of growing elderly population, improving life expectancy and declining mortality rate particularly in Malaysia over the years, concerns arise on the EPF's failure to fully commit the retirement incomes provision to the elderly population in the post-retirement periods. Specifically, this paper examines the short run and long run relationships between EPF balances and its determinants; investment earnings, nominal income, elderly population, life expectancy and mortality rate from 1960 to 2014. Of the findings, elderly population and mortality rate are unfolded to represent key deterrents of EPF balances, which acts as the proxy for the EPF sustainability, both in the short run and long run cycles. Thus, new improvements to the existing EPF scheme are recommended as means to alleviate the poverty problems among the elderly population besides addressing other economic and social fronts.

1. Introduction

The employees provident fund (EPF) scheme, which is established in 1951, represents a defined contribution (DC) plan that provides financial security to the elderly population especially coming from the formal private sectors in Malaysia (Narayanan, 2002). By comparing with Malaysia, the DC plans are also practically adopted across the Asian countries such as China, Indonesia and Singapore, respectively despite those of South Korea, the Philippines, Thailand and Vietnam that are characterized as defined benefit (DB) plans. In term of the difference, the DC plans, which are handled by the EPF for employees of the private sector, aim to induce individuals to work longer to earn higher benefits whereas the DB plans, which are managed by the government pensions department for employees in the government service, favour employees with steady jobs but penalize mobile workers (Reynaud, 1998; Roddy & David, 2010).

Amid the EPF is a form of social security that caters financial assistance for the elderly workers in their post-retirement periods, the EPF, on the other hand, serves as a catalyst that positively brings substantial impacts on the steady growth of the country's economic progress either through capital market development or by its economic impact via a corporate engagement (Tan, 2007). To date, the EPF investment assets stood at RM636.53 billion as of December 2014. Out of the total, 50.9 percent was invested in fixed income instruments, followed by 42.4 percent in equity investments and the remaining portions of 3.7 percent and 3.0 percent in money market instruments and inflation asset class, accordingly (EPF, 2014). More importantly, Figure 1 depicts that EPF balances-to-GDP ratio in which the balances are yielded from the differing values between contributions and withdrawals of the EPF scheme that have been empirically witnessed to remain on the rise albeit several observed hiccups due to economic uncertainties, the government's financial

constraint during the episodes of financial crisis and the government's policy interventions from 1960 to 2014.

FIGURE 1. EPF BALANCES AS A PERCENTAGE OF GDP IN MALAYSIA, 1960 - 2014
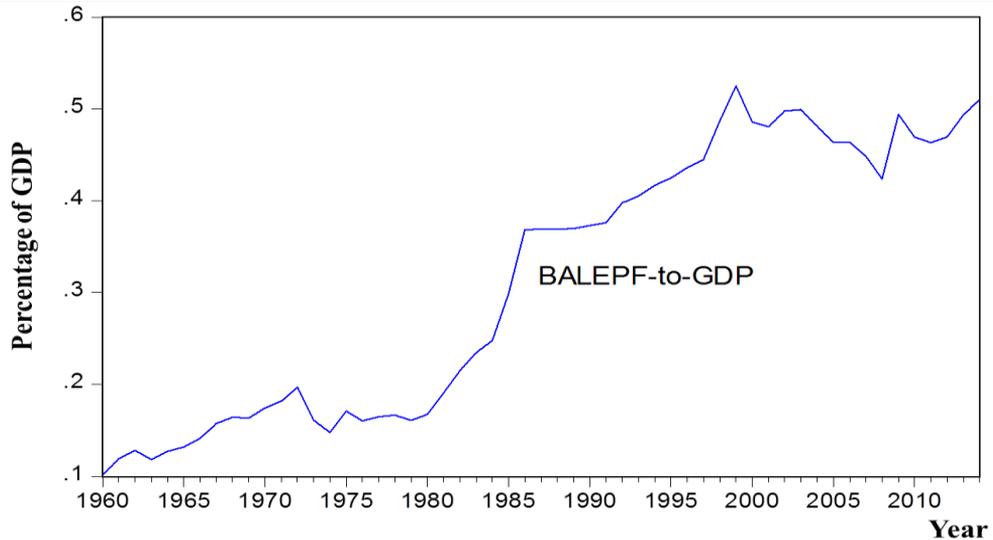
Source: EPF Annual Reports (at various years); Department of Statistics (2016).

As such, EPF balances-to-GDP ratio elevated from 0.10 percent in 1960 to 0.51 percent in 2014, thus constituting as an increment of 0.41 percent within the timeframe. To some extent, the changes in EPF balances either increase or decrease, originated from the discrepancies between both EPF contributions and withdrawals, are believed to have been influenced as well by several determinants that are operational in-place namely rising investment earnings i.e. from rising investment earnings i.e. from RM0.03 million in 1960 to RM39.08 million in 2014, robust economic growth i.e. from RM5.87 million in 1960 to RM1,106.58 million in 2014, growing elderly population i.e. from 3.43 percent in 1960 to 5.67 percent of the total population in 2014, improving life expectancy i.e. from 59.48 years in 1960 to 74.72 years in 2014 and declining under-five mortality rate i.e. from 92.80 per 1,000 live births in 1960 to 7.20 per 1,000 live births in 2014 (EPF, at various years; United Nations, 2012; Department of Statistics, 2016; World Bank, 2016).

When touching on the concept of financial sustainability, there are multifaceted issues surrounding the pension schemes that need to be responsibly dealt by the governments notably in the East and South East Asian countries including Malaysia. Of which, these countries are put in the limelight since the nations are currently seen at advanced stages of the demographic transition from a youthful to an elder society (Anwar, 2015). As echoed by many studies such as Narayanan (2002), Mohd (2013) and Jaafar and Daly (2016), key issues are ageing population, improving life expectancy and weakening family-based support that come to the fore by posing great challenges to the sustainable development of a country's social protection system, thus leading to the general conclusion of inadequate and unsustainable retirement income provision to the elderly population. Thus, it is vital that the currently adopted EPF scheme to be undergone for a pension reform so

that a coherent and inclusive EPF scheme can be designed that possibly satisfies the adequacy and sustainability attributes over the coming years.

The rest of this paper is structured as follows. A number of literatures on the relationship between EPF balances and its determinants are reviewed in Section 2. Section 3 describes the data and methodology that are adopted in the time series analysis. The empirical results are reported in Section 4 and Section 5 wraps up with conclusion and policy recommendation.

2. Literature review

Generally, social protection sustainability puts emphasis on maintaining a prolonged quality of life for the people. In Malaysia, one of the main objectives for a pension scheme, e.g. EPF, is to sustain the living standard of elderly population in the post-retirement periods. By analogy, the United States social security system, which is established in 1935, is said to be sustainable if there are some mechanisms to continually reinforce the equilibrium with social security affairs (Cooley & Soares, 1999). Elsewhere, Holmann & Hinz (2005) stressed that any pension scheme, including EPF, attains its sustainability once it is able to provide adequate, affordable, sustainable and robust retirement incomes to the elderly population.

Over the long run, the financial sustainability of EPF equally equates projected contributions with projected liabilities. Therefore, to possibly attain the EPF sustainability, adequacy of payments and of coverage must run in parallel with rising incomes and expectations (Asher & Bali, 2015). Furthermore, the long term prospect of social security programmes in many countries is dependent on the economic and demographic structural changes within this region. Due to growing elderly population, improving life expectancy and declining mortality rate, exacerbated further by increased costs of living, rising health care costs, weakening family-based support and financial crises, these have reasonably contributed to jeopardizing the social and financial sustainability as well as adequacy of the EPF scheme in Malaysia (Mohd, 2013; Jaafar & Daly, 2016). As a result, there is a strong push for the existing EPF scheme to undergo a pension reform, together with a salary reform too, so that a more inclusive and equitable system can be properly designed that is commendable across the Asian economies, so does Malaysia (Anwar, 2015).

Moreover, Anwar (2015) alarmed that about 80 percent of total workers in Malaysia who turned 55 in 2015, based on the released figures in EPF (2014), did not have adequate savings from their EPF accounts to survive above the RM830 poverty line. Thus, the recent disclosure remains its relevance as comparable to the earlier finding of Ibrahim (2004). As such, he discovered from a random survey by the provident fund that the feasible range to financially survive on a monthly basis lies between RM510 and RM1,000 in the case of contributors that already withdrawn all their savings at the initial start of retirement and being excluded from paying medical expenses on catastrophic illnesses. In this respect, Mohd (2013) enlightened that the accumulated savings of the EPF is inadequate to support for retirement expenses over a long period, of which, one key problem is primarily stemmed from the early withdrawals for financing monthly housing payments and reaping other pre-retirement benefits such as education and health.

Thus far, there is no empirical evidence from the previous studies that are successfully found on the short run and long run relationships between EPF sustainability, which is represented by EPF balances, and possible determinants; investment earnings, nominal income, elderly population, life expectancy and mortality rate. Inevitably, this provides the credence for the study to set a precedent on the topic of EPF sustainability in Malaysia.

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3. Methodology

3.1. Data

Secondary data are utilized to investigate the long run and short run relationships between EPF balances and its identified determinants namely investment earnings, nominal gross domestic product (GDP) or income, population of aged 60 and above group or elderly population, life expectancy and mortality rate in Malaysia for the 1960 - 2014 period. While the recent annual data on EPF Balances (i.e. EPF Contributions minus Withdrawals) and investment earnings were obtained from annual reports in the EPF's website, the older EPF Balances and investment earnings (1980 and earlier) are acquired from the National Archives of Malaysia in paper-based versions. The annual data on nominal income were obtained from the website of Malaysia's Department of Statistics whereas the annual data on life expectancy and mortality rate were collated from the World Bank's website. Also, the annual data on elderly population were taken from the United Nation's World Population Prospects: The 2012 Revision Report. Fittingly, all variables were later converted into the logarithmic (log) form.

3.2. Model specification

Pursuant to the financial security's mainstream literature particularly on the topic of EPF's sustainability as enlightened by many descriptive studies such as Mohd (2013), Ahmad and Sabri (2014) and Jaafar & Daly (2016) as well as empirical or case studies by Samad & Mansor (2013) and Mohd (2015), the functional expression that reasonably reflects the EPF's sustainability is provided in Equation (1):

$$BALEPF = f(INVEARN, GDP, POP60, LIFEXP, MORT) \tag{1}$$

Subsequently, Equation (1) is transformed into the double natural log specifications as per Equation (2) in order to become the empirical model for the study. One benefit of the transformation is that it allows for a direct translation of coefficients into the long run elasticity effects.

$$LBALEPF = \beta_0 + \beta_1 LINVEARN_t + \beta_2 LGDP_t + \beta_3 LPOP60_T + \beta_4 LLIFEXP_t + \beta_5 LMORT_t + \varepsilon_t \tag{2}$$

where $LBALEPF$ is natural log of EPF Balances (in RM billion), $LINVEARN$ is natural log of investment earnings (in RM billion), $LGDP$ is natural log of nominal income (in RM billion), $LPOP60$ is natural log of elderly population (in percentage of total population), $LLIFEXP$ is natural log of life expectancy at birth (in total number of years) and $LMORT$ is natural log of under-five mortality rate (death per 1,000 live births). β_0 is a constant

term while β_1 to β_2 are estimated parameters in the model. Also, t refers to a time series data and ε_t represents a random disturbance term.

3.3. Method of analysis

3.3.1. Unit root Test

According to Johansen & Julieus (2000), it is deemed necessary to verify the stationary properties and the same order of integration for all series before analyzing the existence of long run cointegrating relationship between a set of variables. To check on the stationarity, both Augmented Dickey & Fuller (ADF) (1979)'s test and the Phillips-Perron (PP) (1988)'s test are applied to each variable in the unit root testing. As such, the combination of these tests is aimed at ensuring the robustness of the results motivated by the benefit of PP test to address the presence of serial correlation and/or heteroscedasticity in the residual terms that complements the shortcoming of ADF test to reject a unit root due to its low power. For this reason, the PP test helps to improve the finite sample properties of the ADF test.

3.3.2. Cointegration, long run and short run relationships

A vector autoregressive (VAR) model is employed in measuring the long run and short run relationships between *LBALEPF* and independent variables; *LINVEARN, LGDP, LPOP*60*, LLIFEXP* and *LMORT*. Hence, under the VAR framework, the variables are orderly illustrated in the matrix form as per Equation (3):

$$
\begin{bmatrix} LBALEPF_t \\ LINVEARN_t \\ LGDP_t \\ LPOP60_t \\ LLIFEXP_t \\ LMORT_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \end{bmatrix} + \begin{bmatrix} \beta_{11}(L) & \dots & \beta_{16}(L) \\ \dots & \dots & \dots \\ \dots & \dots & \dots \\ \dots & \dots & \dots \\ \dots & \dots & \dots \\ \beta_{61}(L) & \dots & \beta_{66}(L) \end{bmatrix} \begin{bmatrix} LBALEPF_t \\ LINVEARN_t \\ LGDP_t \\ LPOP60_t \\ LLIFEXP_t \\ LMORT_t \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \dots \\ \dots \\ \varepsilon_{6,t} \end{bmatrix} \quad (3)
$$

Trace and Maximum Eigenvalue Tests are developed in Johansen (1988) in order to estimate the total number of long run cointegrating equations that potentially exist between the variables. If the variables are found to be cointegrated over the long run, the short run relationship between the variables can be measured via the vector error correction model (VECM) procedure.

To deal with the non-stationary data, a cointegration analysis is performed in the VAR model as can be seen in Equation (4):

$$
\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B x_t + \varepsilon_t \quad (4)
$$

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where $\Pi = \sum_{i=1}^{p} A_i - I, \Gamma_i = -\sum_{j=i+1}^{p} A_j$. Correspondingly, the rank of Π indicates the number of cointegrating equations among the components of the vector y_t of p variables (or $p = 6$ for this paper). If there is no cointegration, Π is a singular matrix i.e. its rank, $r = 0$. Therefore, the rank of Π can take any value between zero and six. For example, when $r = 1$, there is a unique cointegrating vector, thus implying that there is a stable long run relationship between the variables. Additionally, there is a number of cointegrating vectors for $1 < r < 6$. Fundamentally, the variables in the system, which contain r cointegrating vectors, are proven to be cointegrated in the long run. Conversely stated, there is likely that the long run equilibrium relationship to exist between the variables. Thus, this would suggest that the variables collectively move together in the long run. Furthermore, the Π matrix can be factored as provided in Equation (5):

$$\Pi = \alpha\beta'; \quad \beta y_t \sim I(0) \tag{5}$$

where the α matrix refers to the adjustment parameters and the β matrix constitutes as the cointegrating vectors. Under the Johansen's procedure, the Π matrix, which is based on unrestricted VAR, is able to be estimated. Aside from that, the total non-zero eigenvalues of Π (or equals r) can also be tested since the trace and maximum eigenvalue statistics are used in the analysis.

Given the variables are proven to be cointegrated over the long run, the associated residuals relating to the temporary deviation from the long run equilibrium regression can be utilized thereafter to estimate the VECM. Specifically, the VECM procedure can be proceeded with the following form as given in Equation (6):

$$y_t = \begin{bmatrix} \Delta BALEPF_t \\ \Delta LINVEARN_t \\ \Delta LGDP_t \\ \Delta LPOP60_t \\ \Delta LLIFEXP_t \\ \Delta LMORT_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \end{bmatrix} + \begin{bmatrix} \beta_{11}(L) & ... & \beta_{16}(L) \\ ... & ... & ... \\ ... & ... & ... \\ ... & ... & ... \\ ... & ... & ... \\ \beta_{61}(L) & ... & \beta_{66}(L) \end{bmatrix} \begin{bmatrix} \Delta LBALEPF_t \\ \Delta LINVEARN_t \\ \Delta LGDP_t \\ \Delta LPOP60_t \\ \Delta LLIFEXP_t \\ \Delta LMORT_t \end{bmatrix} + \begin{bmatrix} \gamma_1 z_{1,t-1} \\ \gamma_2 z_{2,t-1} \\ ... \\ ... \\ ... \\ \gamma_6 z_{6,t-1} \end{bmatrix} + \begin{bmatrix} \Phi(L) & 0 & ... & ... \\ 0 & \Phi(L) & ... & 0 \\ ... & & & \\ ... & & & \\ ... & & & \\ 0 & ... & 0 ... & \Phi(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ ... \\ ... \\ \varepsilon_{6,t} \end{bmatrix} \tag{6}$$

where y_t is a (6 x 1) vector of the variables in the system, $\alpha's$ is a vector of intercept terms, $\beta's$ are estimated parameters, Δ is a first difference operator and L is a lagged operator. Also, $\beta(L)$ and $\Phi(L)$ are finite polynomials in the lagged operator, $z_{t-1}'s$ represent error correction terms and $\varepsilon_t's$ denote as random disturbance terms.

4. Empirical results

4.1. Descriptive statistics

Table 1 reports that the mean values of all variables are positive for a total of 55 observations.

TABLE 1. STATISTICAL DESCRIPTION OF VARIABLES

VARIABLE	MEAN	MEDIAN	MAXIMUM	MINIMUM	STANDARD DEVIATION
GDP	241.824	81.085	1,106.580	5.822	305.589
BALEPF	109.423	29.962	564.792	0.595	149.511
LIFEXP	69.061	70.025	74.718	59.475	4.429
MORT	30.371	19.400	92.800	7.200	24.851
INVEARN	6.852	2.516	39.076	0.030	9.504
POP60	3.848	3.635	5.674	3.186	0.620

By discarding the measurement units, GDP and $BALEPF$ record the mean values of over hundreds amid $LIFEXP$, $MORT$, $INVEARN$ and $POP60$ display the mean values of about 69.1, 30.4, 6.9 and 3.8, respectively. On the covered values, GDP posts the interval value of 1,100.8 whereas $POP60$ only covers the interval value of 2.5. While $POP60$ has the lowest standard deviation, GDP and $BALEPF$ register with considerably high values of standard deviation, thus suggesting that their dispersions from the means are larger than other variables.

4.2. Correlation analysis

Concerning on the relationship strength between the variables, Table 2 exhibits that all variables are positively and negatively correlated with each other, accordingly.

TABLE 2. ESTIMATED CORRELATION MATRIX OF VARIABLES

VARIABLE	BALEPF	INVEARN	GDP	POP60	LIFEXP	MORT
BALEPF	1.000	0.989	0.998	0.982	0.741	-0.622
INVEARN		1.000	0.985	0.968	0.723	-0.607
GDP			1.000	0.985	0.755	-0.639
POP60				1.000	0.772	-0.669
LIFEXP					1.000	-0.984
MORT						1.000

With regard to the relationship with $BALEPF$ as the dependent variable, all independent variables, excluding $MORT$, are engaged in various forms of positive correlation. As such, strong correlation linkages of over 70 percent with $BALEPF$ are positively detected i.e.

running from *LIFEXP, POP*60*, INVEARN* and *GDP*, ascendingly. Apart from that, there is also clear evidence of positive strong correlations of over 70 percent between independent variables; *INVEARN, GDP, POP*60 and *LIFEXP* with *MORT* being the exception. Hence, this suggests that the multicollinearity problems do rise especially in the multiple regressions. Therefore, in consideration of such multicollinearity and serial correlation problems to emerge, a VAR framework is adopted as the feasible approach to be undertaken in the time series analysis.

4.3. Stationary properties of data

Table 3 shows that all variables are orderly verified to have non-stationary properties at level.

TABLE 3. RESULTS OF THE UNIT ROOT TESTS

VARIABLE	ADF		PP		CONCLUSION	
	LEVEL	FIRST DIFFERENCE	LEVEL	FIRST DIFFERENCE	ADF	PP
LBALEPF	-0.329 (0.988)	-3.768 (0.026)*	-0.035 (0.995)	-3.854 (0.021)*	I(1)	I(1)
LINVEARN	-0.566 (0.977)	-4.313 (0.006)*	-0.866 (0.952)	-7.303 (0.000)*	I(1)	I(1)
LGDP	-1.801 (0.691)	-5.593 (0.000)*	-1.977 (0.600)	-6.935 (0.000)*	I(1)	I(1)
LPOP60	-1.653 (0.748)	-3.609 (0.046)*	-0.079 (0.994)	-3.703 (0.031)*	I(1)	I(1)
LLIFEXP	-1.971 (0.593)	-4.539 (0.006)*	-2.394 (0.379)	-5.608 (0.000)*	I(1)	I(1)
LMORT	-1.875 (0.653)	-3.756 (0.027)*	-1.321 (0.872)	-4.416 (0.005)*	I(1)	I(1)

Note: Figures in the parentheses are p-values. * shows that the null is rejected at the five percent significance level.

Because of their associated *p*-values that are greater than the highest acceptable (i.e. 10 percent) significance level, there is a failure to reject the null of a series to contain a unit root. Nevertheless, the variables are proven to possess stationary properties after transforming all series into first-differenced variables. As a result, this induces the tendency to reject the similar null and subsequently concludes that the fitted variables have become stationary series and are cointegrated of same order one, i.e. I(1).

4.4. Cointegration and long run relationship estimation

Prior to determining the presence of long run relationship between the understudied variables via the Johansen cointegration test, it is a prerequisite to ensure that the variables are stationary and cointegrated at I(1). Correspondingly, the results of the Johansen cointegration test are summarized in Table 4. At the five percent significance level, both Trace and Max-Eigen statistics verify the possible existence of four cointegrating equations that are found in the model.

TABLE 4. RESULTS OF THE JOHANSEN COINTEGRATION TEST

Null	Eigen value	Trace Statistic	5% Critical Value	*p*-value	Max-Eigen Statistic	5% Critical Value	*p*-value
r = 0	0.737	184.176	95.754	0.000*	69.372	40.078	0.000*
r ≤ 1	0.636	114.804	69.819	0.000*	52.573	33.877	0.001*
r ≤ 2	0.418	62.231	47.856	0.001*	28.191	27.584	0.042*
r ≤ 3	0.359	34.040	29.797	0.015*	23.143	21.132	0.026*
r ≤ 4	0.174	10.897	15.495	0.218	9.937	14.265	0.216

Note: * denotes a rejection of the null at the five percent significance level.

Regardless the successful detection on the total number of cointegrating equations in the multivariate framework, there is clear evidence that collectively support for the long run equilibrium relationship that potentially exists between the variables in the model. Eventually, the long run equilibrium relationship between the variables is able to be derived thanks to the Johansen cointegration procedure. Equation (7) provides the long run condition that can be alternatively rewritten in the standard notation as follows:

$$LBALEPF = 0.422LINVEARN_t + 0.25LGDP_t - 0.23LPOP60_t - 0.70LLIFEXP_t -$$

$$(0.060) \quad (0.033) \quad (0.102) \quad (0.306)$$
$$[-7.058]* \quad [-7.559]* \quad [2.269]* \quad [2.275]*$$

$$-1.15LMORT_t$$
$$(0.147)$$
$$[7.798]*$$

(7)

Note: Log Likelihood: 1,214.568. Figures in ( ) and [ ] represent standard errors and *t*-statistics, respectively. * - denotes the statistically significant variable that is measured in absolute term at the five percent significance level.

In reference to Equation (7), variables notably *LPOP*60*, LLIFEXP* and *LMORT*, which have positive signs in the pre-normalization process, are found to be statistically significant at the five percent significance level. Given their associated *t*-statistics values of over two, these variables will negatively affect the changes in *LBALEPF* in the long run. By holding other variables fixed, a percent increase in elderly population would lead to a 0.23 percent drop in EPF balance. Similarly, there are decreases in EPF balance by 0.70 percent and 1.15 percent, respectively, associated with a percent rise in life expectancy and mortality rate on a separate basis. Collectively, these variables will cause the variations in EPF balance to considerably shrink over the long run. On the other hand, *LINVEARN* and *LGDP*, which are proven to be positively related with *LBALEPF* in the post-normalization process as per Equation (7), are statistically significant at the five percent significance level in the long run. In this context, a percent escalation in investment earnings and nominal income will likely to render increments by about 0.42 percent and 0.25 percent, accordingly, in the composition of EPF balance over the long run.

Pertaining to the disclosure of negative relationships, which appear to push for the EPF balance shrinkage, constitute as potential factors affecting the sustainability of the EPF scheme, the long run findings of this paper do conform to some extent with previous studies such as Mohd, Azman, Sulaiman, & Baba (2010), Mircea, Covrig, & Serban (2014) and Asher & Bali (2015). For instance, Mohd et al. (2010), who carried out a survey in Malaysia, Philippines and Singapore, declared that about 67 percent of total respondents were in consensus that the overall EPF fund is undoubtedly insufficient to cater for their

levels of consumption in the post-retirement periods. This is due to key driving forces, of which, increasing life expectancy is one of them besides various pre-retirement withdrawals and minimal household income on average. Furthermore, Ibrahim (2004) and Mohd (2013) pointed out in respective findings that the inevitable failure of the EPF scheme to provide sufficient retirement benefits among the contributors is mainly rooted from the growing elderly group in the total population in Malaysia. Also, due to the early EPF withdrawal by the elderly group in the pre-retirement that has led to the deterioration of accumulated savings in the fund and relatively few working generations that are willing to provide the long term care for the elderly, there are instances of financial instability cases among the group and the shortage issue in the labour market to likely prevail in the country (Mohd, 2013).

As expected, the detection of positive relationships, i.e. emanating from investment earnings and nominal income to EPF balances, does sustainably contribute to the ongoing EPF prospect as EPF contribution will remain reasonably higher than EPF withdrawal over the long run. Therefore, the long run findings of this paper are found to be in tandem with Asher (2001), Mohd (2009) and Afiq (2016). With the investment diversification that takes place in the EPF scheme, this enabled investment earnings from overseas to partially offset the loss values of some Malaysian underperforming assets in 2015 as stemmed from the slow progress in the oil and gas industry and lower commodity prices, thus providing an indication of a prudent EPF investment management over the coming years (Afiq, 2016).

4.5. Short run relationship estimation

By having the variables that are cointegrated over the long run as per Table 4, the next step is to measure the short run relationship that is believed to potentially exist between the variables under the VECM procedure. Correspondingly, the empirical results are exhibited in Table 5. Among others, the coefficient of the ECT_{t-1} term in Table 5, which has a negative sign and is statistically insignificant at the highest acceptable (i.e. 10 percent) significance level, indicates that the non-existence of long run causality for the model. Thus, there is no relevance for EPF balance to play a key role in the short run based on its negligible speed of adjustment as the system transitorily depart from the long run equilibrium.

TABLE 5. RESULTS OF THE SHORT RUN RELATIONSHIP WITHIN VECM

VARIABLE	COEFFICIENT	STANDARD ERROR	T-STATISTIC	P-VALUE
		DEPENDENT VARIABLE: ΔLBALEPF		
ΔLBALEPF(-1)	0.304	0.163	1.871	0.068**
ΔLINVEARN(-1)	0.028	0.080	0.348	0.729
ΔLGDP(-1)	0.006	0.063	0.087	0.931
ΔLPOP60(-1)	-1.203	0.488	-2.465	0.018*
ΔLLIFEXP(-1)	-8.089	5.472	-1.478	0.146
ΔLMORT(-1)	-0.481	0.259	-1.858	0.070**
C	0.106	0.035	3.031	0.004*
ECT(-1)	-0.004	0.005	-0.927	0.359
R^2	0.519	Durbin-Watson *(DW)* statistic		1.760
Adjusted R^2	0.444	Prob(*F*-statistic)		0.000

Note: Δ is a first difference operator. * and ** - indicate *H₀: βᵢ = 0* being rejected at the five percent and 10 percent significance levels, respectively.

Out of the variables in Table 5, it is empirically observed that the first lagged terms of *ΔLBALEPF, ΔLPOP*60, *ΔLMORT* and a constant term*,* which have positive and negative coefficients, are statistically significant against *ΔLBALEPF* at the significance levels of five percent and 10 percent, respectively in the short run. Furthermore, as far as the elderly population is concerned, the short run results explicitly indicate that there is a 1.2 percent decline in the formation of EPF balance in conjunction with a percent increase in elderly persons in total population. Likewise, another potential reduction, which is anticipated to take place in the short run EPF balance by about 0.5 percent, is originated from the country's estimated mortality rate. On the contrary, the positive relationship between *ΔLBALEPF* and its first lagged term in Table 5 significantly proves the evidence that the current year's EPF balance tends to positively inherit some, but not all, dominant characteristics from the previous year's EPF balance. In addition, the statistically significant constant term against *ΔLBALEPF* at the five percent significance level refers to the fixed country effects. Hence, its inclusion does capture the time series dimension of the positive effect on the EPF balance growth in Malaysia after holding other EPF determinants fixed in-place accordingly.

Thus far, the negative effects of elderly population and mortality rate to exert considerable pressures on the shrinkage of EPF balance, neither be in the short run nor be in the long run cycles, are found to be in accordance with previous studies such as Mircea et al. (2014) and Asher & Bali (2015) as both are cited in Jaafar & Daly (2016). Therefore, the current and ongoing sustainability of the EPF scheme is heavily influenced by rising elderly population and declining mortality rate (Asher & Bali, 2015).

When looking into the overall goodness of the model, it is worth to note that the adjusted coefficient of determination (R^2) amounts to 0.44 that is comparably close to the R^2 value of 0.52. Thus, this means that about 44 percent of the variations in EPF balance in Malaysia for the 1960 - 2014 period can be significantly explained by explanatory variables in the model. In addition, the *F*-statistic, which determines the joint statistical influence between explanatory variables and per capita health care expenditure, is proven to be statistically significant at the five percent significance level. With the estimated value of *DW* statistic to be in proximity to two as a rule of thumb, it is expected that the model does not face a serious problem of serial correlation among the explanatory variables in the model.

5. Conclusion and policy recommendation

This paper employed the cointegration and VECM methods to analyze the EPF sustainability by examining the long run and short run relationships between EPF balances and its determinants; investment earnings, nominal income, elderly population, life expectancy and mortality rate in Malaysia for the 1960 - 2014 period. Here, the Johansen cointegration test is conducted to check the presence of long run equilibrium relationship between the variables in the model. Therefore, the results of Johansen cointegration test indicate that EPF balances and its determinants are cointegrated. Accordingly, this indicates that the explanatory variables namely investment earnings, nominal income, elderly population, life expectancy and mortality rate are collectively moving together with EPF balances to attain the long run steady-state notwithstanding that there may be temporary deviation spots to occur in the short run.

With regards to the findings, this study unfolded that elderly population, life expectancy and mortality rate are statistically significant at the five percent significance level but negatively related to EPF balances over the long run. Apart from that, investment earnings and nominal income are revealed to be statistically significant at the five percent significance level and positively related to EPF balances in the long run. Nonetheless, when disclosing the short run results, the first lagged terms of elderly population and mortality rate are proven to be statistically significant at the five percent and 10 percent

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significance levels but negatively related to the first-differenced EPF balances. Hence, in Malaysia, it is worth to note that both elderly population and mortality rate are key driving factors, which are visible from the short run to the long run cycles, to stifle the steady growth of EPF balances by imposing considerable pressures on the indicator to deteriorate over time. Thus, the EPF is expected to lose its financial sustainability when the future trajectory of funds and benefits is imbalanced over an infinite horizon.

Based on the findings of the study, necessary improvements to the existing EPF scheme need to be implemented in-place accordingly so that its sustainability is ascertained and the effective duration of the scheme is able to be prolonged for over an infinite horizon. Also, such improvements are mainly aimed to alleviate the prevalence of poverty problems among the elderly persons in response to growing elderly population, declining mortality rate and improving life expectancy in Malaysia. Thus far, Samad & Mansor (2013) describes that various initiatives led either by the government or the EPF organization, which includes benefits in cash and kind, different types of withdrawal, new investment approach to savings, Malaysia Retirement Plan and nurturing savings habit for old age, have specific roles, respectively, to provide social protection and financial assistance to the Malaysian elderly group. Of which, some are turned out to be financially viable approaches while the redistribution of benefits in cash and kind, for instance, remains a challenge at the policy level due to the eligibility issue on a target group of needy elderly persons (Samad & Mansor, 2013). In the light of a strong call for the EPF reform is able to address both economic and social fronts, improvements such as increasing diversification in potentially certified investments, expanding its coverage for the long term care provision to most elderly persons and improving governance of the EPF structure to prioritize the operational efficiency and transparency of the EPF scheme are deemed imperative to ensure the financial sustainability of the EPF over the long horizon of time besides maintaining the quality of life among the elderly population in the post-retirement periods (Mohd, 2013; Anwar, 2015).

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