Population and economic development in Sarawak, Malaysia

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Abstract

This paper chooses a Malaysian state in Borneo Island, Sarawak, as the case study to examine the relationship between population growth and economic development. The findings imply that there is no statistically significant long-run relationship, but a causal relationship between population growth and economic development in Sarawak. In other words, the empirical findings indicate that population can have neither positive nor negative impact on economic development. The findings also indicated that income expansion did cause the population expansion in Sarawak, Malaysia.

Key words
Population growth, Economic development, Sarawak, Malaysia

JEL codes
O53, O18, R11

[1] This paper is a modified version of the second chapter in Furuoka (2011).

1. Introduction

Demographic trends have a substantial impact on any country's economic development. The declining fertility rates in developed countries have caused labour shortages and put strain on the pension systems. Developing nations have been experiencing high birth rate, which is sometimes considered a 'demographic dividend'. However, a rapid expansion of population in some of the developing countries has resulted in over-population and scarce employment opportunities.

Development economists recognise a fact that the relationship between population growth and economic development in the developing countries is a crucial factor that has a great impact on their economic wellbeing. As Dawson and Tiffin (1998, p.149) point out

> The relationship between population growth and economic development has long been thought to be fundamental to our understanding of less developed countries (LDCs). Indeed, most textbooks on economic development include a section on "population and development".

However, there is no straightforward answer as to whether population growth is beneficial or detrimental to the economic growth in the developing countries. As Thirlwall (1994, p.143) comments, "The relationship between population growth and economic development is a complex one, and the historical evidence is ambiguous, particularly concerning what is cause and what is effect".

In those developing countries where the relationship between population growth and economic performance could be regarded as *positive*, the increase in population stimulates economic development and leads to a rise in living standards. This is because the expansion of population sparks economic and business activities and, as a country's population grows, its market size expands as well. Expansion of the market, in its turn, encourages entrepreneurs to set up new businesses, which gives a new impulse to economic activities. By contrast, if the relationship between population growth and economic performance in a country could be described as *negative*, the increase of population is likely to become an impediment to the country's economic development. This is because the rapid expansion of population increases the dependency burden. In other words, the segment of population which is considered economically unproductive, such as children and the elderly, expands alongside with the population growth.

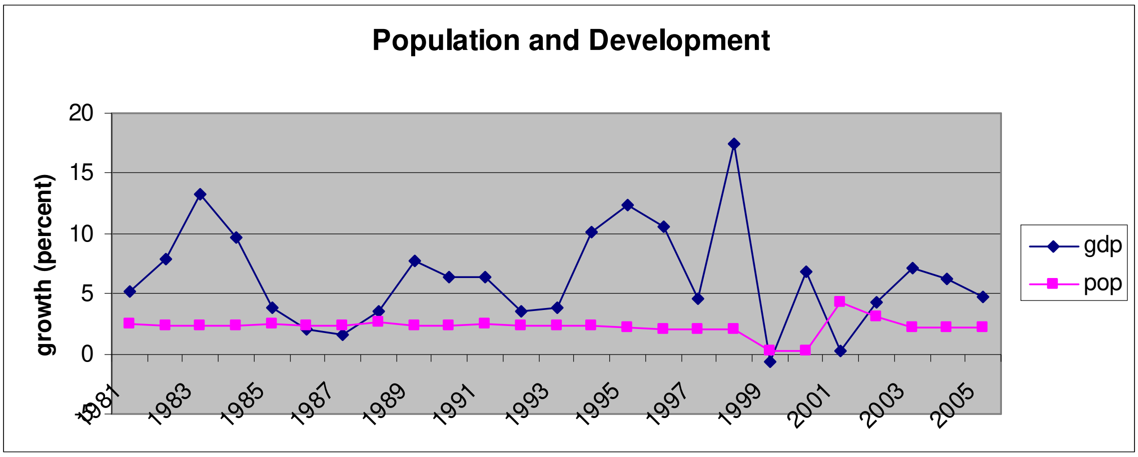
The negative views on the impact of population growth have been prevailing over the positive opinions since Thomas Malthus first raised alarms about the danger of "over-population" in his book *"An Essay on the Principle of Population"* published in 1798. As Kelley and Schmidt (1996, p.13) observe, "Pessimism about the economic impacts of population has dominated the thinking of population analysts since the original alarmist treatise by the Reverend Thomas Malthus was published over two centuries ago". With two schools of thought expounding diametrically different opinions regarding the impact of population growth on economic development, it would be interesting to consider the relationship between population growth and economic development. More importantly, despite several empirical inquiries on national level[2], there is still lack of systematic analysis on this topic in state level. Thus, this paper chooses a Malaysian state, Sarawak, as the case study to examine the population-development nexus. The questions that arise are: Does population expansion in Sarawak obstruct the economic growth? Or, on the contrary, has it

[2] For example, Furuoka (2005) examined the population-development nexus in Malaysia. Furuoka (2009) explored the topic in Singapore. Furthermore, Furuoka and Munir (2011) examine whether population growth would have a beneficial or detrimental effects on economic development in Singapore. More recently, Furuoka (2013) uses some innovative method to examine relationship between population growth and economic growth in Indonesia.

been conducive to the state's economic development?

As Figure 1 shows, from 1981 to 2005, population growth rate in Sarawak was quite stable at approximately 2 percent per year. By contrast, during the same period of time, the state's economic development was uneven. Economic growth was quite rapid during the first half of the 1980s, became moderate in the second half of the decade, then regained the pace in the mid-1990s, and was highly volatile from the late 1990s to the early 2000s.

Figure 1: Population Growth Rate and Income Growth Rate in Sarawak



Source: Yearbook of Statistics, Sarawak, various issues

Econometric analysis will be employed in this paper to explore the relationship between the population growth and economic growth in greater detail. Unit root test and Johansen's cointegration test will help examine the long-run relationship between the demographic trends and the economic performance in Sarawak while the error correction model will be used to analyse the short-run relationship between the variables.

2. Literature Review

The origin of the academic debate on the relationship between population and development could be traced back to the year 1798 when Thomas Malthus first published his book, "*An Essay on the Principle of Population, as it affects the Future Improvement of Society with remarks on the Speculations of Mr. Godwin, M. Condorcet, and Other Writers*" (Malthus, 1798). Malthus' theory is based on the assumption of the "law of diminishing returns" on the fixed amount of land. Malthus claimed that there exists a tendency for the population growth rate to surpass the production growth rate because population increases in a geometrical progression while production increases only in an arithmetic one. He concluded that a rapid population growth could plunge a country into a state of acute poverty.

The Malthusian school of thought has attracted trenchant criticisms. However, the arguments presented by Malthus and elaborated further by his followers have withstood all the challenges. Moreover, they have shaped and dominated the discourse in population studies. For example, a group of economists and intellectuals known as the Club of Rome published in 1972 the book entitled "*The Limits to Growth*". The authors of the book claim that in the near future the humankind will face economic disasters and suffer social catastrophes unless some preventive measures are taken, and cite population control as one of such measures (Meadows et al., 1972). Further, in 1973, Robert McNamara, the then President of the World Bank, warned that "population explosion" could be as a serious threat to humankind as nuclear war (Buchholz, 1999). The fear of unchecked population growth has resulted in implementation of new policies by aid donor countries and some international organisations that require the aid recipient countries to carry out 'population control' programmes as a pre-condition for receiving economic assistance. As Simon (1987, pp.182-183) observed, "Under the stewardship of Robert McNamara and A.W. Clausen, the World Bank – along with the

United States Agency for International Development (USAID) – has been the strongest force pushing population-control programs".

In academic circles, similar pessimistic views have been expressed by several prominent economists and Nobel Prize winners, including James Meade, Paul Samuelson, and Jan Tinbergen. Meade (1961) who analysed the demographic situation in Mauritius concluded that the country's rapid population growth had been at the root of its economic problems, such as a declining per capita income and the unemployment. Meade called on the government to introduce "family planning" policies to avoid the economic disaster. In a similar vein, Paul Samuelson asserted that population growth would cause resource exhaustion due to the law of diminishing returns. As Samuelson (1975, p.537) put it, "Increases in population will cause the law of diminishing returns to be brought into play and to leave all subsequent generations in a worsened situation". Jan Tinbergen urged developing countries to control their expanding populations. In his opinion, the "population growth should be stopped as soon as possible" (Tinbergen, 1984, pp.137-138) because an unhindered population growth constitutes a threat to humankind's welfare.

However, not everyone agrees with the Malthusian predictions of the dire consequences of population expansion. There are researchers who hold a different opinion about population growth. For example, Robert Repetto (1985) points out that though many empirical studies have claimed that countries with high population growth rates experience lower than average economic growth, these conclusions are not definitive because the statistical correlations between the population growth and the economic growth do not describe the causal relationship between the two. Furthermore, a prominent population economist, Julian Simon, argues that human capital is a crucial element for economic growth. As he succinctly put it, "The ultimate resource is people – skilled, spirited, and hopeful people who will exert their will and imaginations for their own benefit, and inevitably they will benefit not only themselves but the rest of us as well" (Simon, 1996, p.589). Simon considers the population-control programs harmful because they detract the donor countries' attention from other pressing issues. As Simon (1987, p.160) put it

> Some aspects of U.S. Foreign Aid Programmes for "family planning" are not just wasteful, not just fraudulent, not even just politically dangerous for the United States, but they may well be extremely damaging on net balance by offering a palliative that distracts from all-important issues of economic system of the country receiving the aid.

Among the researchers who emphasise the quality of population aspect, or the human capital, is a Nobel Prize laureate, Theodore Schultz. He argues that the mainstream economists tend to overrate the significance of land quantity and to overlook the value of population quality. Schultz maintains that improving the quality of population is a decisive factor in enhancing a country's economic performance and highlights the measurable gains from the population quality for the economic development (Schultz, 1979). Becker and Tomes (1976) argue that the quality of population or human capital can substitute the quantity of population. In the long run, as a country becomes more prosperous the increase in the demand for the quality of population leads to the reduction of its quantity. In other words, as a country develops economically people tend to have fewer children which indicates that economic development can be a solution to the problem of over-population.

Several empirical research studies have been done on the long-run relationship between population expansion and economic growth. The majority of these academic inquiries used cross-section regression to analyse the relations between the two variables (see Ahlburg, 1996; Easterlin, 1967; Kelley & Schmidt, 1996; Kuznets, 1967; Simon, 1992; Thirlwall, 1972). Overall, the outcomes of these research studies do not allow to reach any definit conclusion as some researchers reported that the results did not indicate the presence of a statistically significant relationship between population growth and economic development. It is important to note that the existing discrepancies between different countries could pose a considerable methodological problem and that the cross-section regression analyses tend to suffer from the problem of heteroskedasticity.

More recently, many developing countries have compiled reliable time-series data sets that are extensive enough to allow conducting time-series regression analyses. The availability of good quality data sets has further stimulated research on the topic. Dawson and Tiffin (1998) employed time-series data to analyse the long-run relationship between population growth and economic development in India, and used the augmented Dickey-Fuller (ADF) unit root test and the Johansen co-integration test. The researchers could not detect a long-run *equilibrium relationship* between population growth and economic development in India as these pairs of variables did not seem to move jointly. This result prompted Dawson and Tiffin (1998, p.154) to conclude that "population growth neither causes per capita income growth nor is caused by it".

John Thornton (2001) conducted a similar research on a long-run relationship between population growth and economic development in seven developing countries in Latin American, namely, Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. His findings are similar to the results of Dawson and Tiffin's (1998) study. According to Thornton (2001, p.466), "A long-run relation between population and real per capita GDP does not appear to exist; hence, population growth neither causes growth of per capita GDP nor is caused by it". Bucci and La Torre (2007) used a two-sector endogenous growth model to examine the relationship between population growth and economic development. They pointed out that population expansion may have a negative or ambiguous effect on economic development. In other words, when physical capital and human capital are substitute, population growth has a negative impact on the economic development. On the other hand, when physical capital and human capital are complementary, the effect of population becomes ambiguous.

In order to analyse the relationship between population growth and per-capita growth, Turnemaine (2007) developed a model in which technical progress, human capital, and population interact endogenously. He pointed out that population growth can have either positive or negative impact on economic development. The outcome depends on the relative contribution of the population or human capital to economic growth. Among more recent studies, Klasen and Lawson (2007) examined the relationship between population and economic development using both cross-country and panel data. The researchers argue that the empirical findings from the cross-country and the panel data indicate a negative relationship between the variables. As they report, the regressions of *per capita* economic growth pointed out that "population growth has a highly significant *negative* influence on *per capita* economic growth" (Klasen and Lawson, 2007, p.11)

3. Data and methods

This paper uses several econometric methods, such as unit root test and cointegration test to examine whether there would exist a long-run cointegrating relationship between real per capita Gross Domestic Product (GDP) and its population (POP) in Sarawak over the period from 1980 to 2005. The main sources of data are various issues of the *Yearbook of Statistics,* *Sarawak*, published by the Department of Statistics, Sarawak. The unit root test of stationarity allows establishing whether the time series data is stationary.[3] The co-integration test is employed here to analyse whether the pairs of variables were co-integrated or moved jointly.[4]

First of all, Pearson correlation test is used in the paper to establish the existence of correlation between the two variables, namely, *GDP* and *POP*. Correlation is a measure of the degree of relatedness between the variables. This study uses a coefficient of correlation, *r*, which is also known as the Pearson product-moment correlation coefficient and is named after an English statistician, Karl Pearson. The statistic *r* is a measure of the linear correlation between two variables (Black, 2004, p.81).

Secondly, an important prerequisite for the existence of a co-integrating relationship between two variables, which are *GDP* and *POP* in this study, is that the variables have the same order of integration. This means that if *GDP* is an integrated of order *d,* the other variable -- *POP* -- should also be an integrated of order *d*.[5] In order to analyse the common integrational property, unit root tests need to be done. A standard stationarity test, namely, the augmented Dickey-Fuller (ADF) unit root test, is employed for this purpose. Dickey and Fuller (1981) suggested a unit root test based on the following regression

$$\Delta y_t = \mu + \beta t_{t-1} + \delta y_{t-1} + \varepsilon_t \qquad (1)$$

[3] The time series data is *stationary* if its mean, variance, and covariance remain constant over time (Thomas, 1997, p.374).
[4] According to the definition, the pairs of variables could be described as co-integrated if they have a long-run equilibrium relationship which means that these variables move jointly (Gujarati, 2003, p.822).
[5] In general, if time series data have to be differenced *d* times to make the data stationary, these time series data are said to be integrated of order *d* (Gujarati, 2003, p.805).

where t is linear time trend, μ is intercept, β and δ are slope coefficients, and ε_t is an error term.

In those cases where the error terms are serially correlated, the method has to be modified. The simplest way to do that is to add many lags of dependent variable Δy_t in the equation (1) in order to ensure that ε_t appears as white noise.[6] This test for stationarity is known as the ADF test. The ADF test is based on the following regression,

$$\Delta y_t = \mu + \beta t_{t-1} + \delta y_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta y_{t-i} + \varepsilon_t \qquad (2)$$

where β, δ and γ are coefficients, and ε_t is an error term.

The null hypothesis is that $\delta = 0$. This means that a unit root exists in y_t. If the null hypothesis is rejected then y_t is stationary. The current analysis also uses Phillips-Perron (PP) test to analyse the stationarity (Phillips and Perron, 1988). The PP test is based on the equation (2) but it uses the modified Dickey-Fuller statistics. The PP test could be more robust for the presence of autocorrelation in the data sets.

Thirdly, Engle-Granger co-integration analysis is used to examine a long-run equilibrium relationship between Sarawak's economic growth and population expansion. The Engle-Granger method aims to determine whether the single-equation estimates of the equilibrium error appear to be stationary (Engle and Granger, 1987). In order to analyse a co-integrating relationship between *GDP* and *POP*, the following two co-integrating equations will be estimated:

[6] White noise is an uncorrelated random error term with zero mean and constant variance (Gujarati, 2003, p.838).

$$GDP_t = \alpha_1 + \beta_1 POP_t + \varepsilon_1 \qquad (3)$$

$$POP_t = \alpha_2 + \beta_2 GDP_t + \varepsilon_2 \qquad (4)$$

If the two variables -- *GDP* and *POP* -- are co-integrated, the residuals of co-integrating equations (3) and (4) are stationary. In other words, the stationary residuals imply that the two variables (*GDP* and *POP*) have a long-run relationship (Thomas, 1997, p.426).

Finally, Johansen co-integration test is used in this paper to examine the long-run movement of the variables. The test is based on a maximum likelihood estimation of the K-dimensional Vector Autoregression (VAR) of order *p*,

$$\Delta Z_t = \mu + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \ldots \Gamma_{k+1} \Delta Z_{t-p+1} + \pi Z_{t-k} + \varepsilon_t \qquad (5)$$

where Z_t is a $k \times 1$ vector of stochastic variable, μ is a $k \times 1$ vector of constants, ε_t is a $k \times 1$ vector of error terms, π and $\Gamma_1 \ldots. \Gamma_{k+1}$ are $k \times k$ matrices of parameters.

Provided that a co-integrating relationship exists between the *GDP* and *POP*, an error correction model will be estimated to analyse the short-run relationship between these two variables.[7] Two error correction models could be estimated as follows,

$$\Delta GDP_t = \beta_1 + \sum_{i=0}^{n} \beta_{2i} \Delta POPt - i + \sum_{i=1}^{n} \beta_{3i} \Delta GDPt - i + \beta_4 EC_{t-1} + \varepsilon_{t1} \qquad (6)$$

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[7] In economics, the difference between short run and long run is not distinguished by a specific period of time. Normally, in short-run period it is not possible to change all inputs to production, and only some inputs to production could be changed. Long-run period refers to a time span when all inputs to production could be changed (Taylor, 2001).

$$\Delta POP_t = \delta_1 + \sum_{i=0}^{n} \delta_{2i} \Delta GDPt - i + \sum_{i=1}^{n} \delta_{3i} \Delta POPt - i + \delta_4 EC_{t-1} + \varepsilon_{t2} \quad (7)$$

where EC_{t-1} is an error correction term, β and δ are coefficients, and ε_t is an error term.

The current study also uses Granger causality test to examine the causal relationship between Sarawak's population growth and economic development. The Granger-causality test with the lag length of k is based on the following equations (Granger, 1969),

$$\ln GDPt = \alpha_0 + \alpha_1 GDP_{t-1} + \ldots + \alpha_k GDP_{t-k} + \beta_1 POP_{t-1} + \ldots + \beta_k POP_{t-k} + \varepsilon_1 \quad (8)$$

$$\ln EXt = \alpha_0 + \alpha_1 POP_{t-1} + \ldots + \alpha_k POP_{t-k} + \beta_1 GDP_{t-1} + \ldots + \beta_k GDP_{t-k} + \varepsilon_2 \quad (9)$$

where GDP_t is Gross Domestic Product (GDP) in Sarawak in the year t; POP_t is population in Sarawak in the year t; α and β are slope coefficients.

The Wald statistics will be used to test the joint hypothesis,

$$\beta_1 = \beta_2 = \ldots \beta_k = 0 \quad (10)$$

The null hypothesis for equation (8) is that *POP* does not Granger-cause *GDP*. On the other hand, the null hypothesis for equation (9) is that *GDP* does not Granger-cause *POP*.

4. Empirical Results

In this analysis, time series data for the period 1980-2005 is used to examine the long-run relationship between *GDP* and *POP*. First of all, the findings of the Pearson correlation test are reported in Table 1. They indicate that there exists a strong and positive correlation between the two variables. This means that there is a positive linear relationship between *GDP* and *POP*.[8]

Table 1: Pearson Correlation Test

	POP	*GDP*
POP	1	0.941
GDP	0.941	1

Secondly, the augmented Dickey-Fuller (ADF) unit root test is employed to test stationarity of time series data. The results obtained from the ADF test are shown in Table 2.

Table 2: Unit Root Test (ADF)

	Level		**First Difference**	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend
GDP	0.385(0)	-1.692(0)	-5.416 (0)**	-5.555(0)**
POP	1.459(2)	-2.463(4)	-4.095 (1)**	-4.449(1)**

Notes: Figures in parentheses indicate number of lag structures
** indicates significance at 1% level
* indicates significance at 5% level

The Phillips-Perron (PP) unit root test is also employed to test stationarity of time series data. The results from the PP test are reported in Table 3.

Table 3: Unit Root Test (PP)

	Level		**First Difference**	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend
GDP	0.520 (1)	-1.704(2)	-5.388(2)**	-5.545(1)**
POP	2.101 (6)	-1.744(2)	-3.587(7)*	-4.212(10)**

Notes: Figures in parentheses indicate value of bandwidth
** indicates significance at 1% level
* indicates significance at 5% level

[8] Results of the correlation analysis should be viewed with some caution because the correlation between population and income does not imply a causal relationship, but merely indicates a linear association between them.

As the results indicate, despite some very minor differences, the findings from the ADF test and the PP are similar. Both tests indicate that one variable – *POP*-- is integrated of order one, *I(1)*, and the other variable -- *GDP* -- is also integrated in order one, *I(1)*. Thus, it was established that the two variables have the same order of integration.

Table 4 shows the results of estimated cointegration equation (3). In order to test the co-integrating relationship between *GDP* and *POP*, the augmented Engle-Granger (AEG) test was used to analyse the residual series derived from cointegration equation (3).

Table 4: Estimated Co-Integrating Equation (3)
Dependent Variable GDP

	Coefficient	Standard error	t-statistic
Constant	-7738.449**	975.034	-7.935
POP	7.382**	0.540	13.649
R-squared	0.885	Adjusted R-squared	0.881
		Constant without trend	Constant with trend
Co-integration (AEG) test		-1.771 (0)	-1.743 (0)

** indicates significance at 1% level
* indicates significance at 5% level

The findings indicate that the residual series are non-stationary. This implies the absence of a long-run equilibrium relationship between *GDP* and *POP*. In other words, the two variables do not seem to be cointegrated.

Table 5 reports the results from estimated co-integration equation (4). The augmented Engle-Granger (AEG) test was employed to examine the residual series derived from co-integration equation (4). The findings reveal that the residual series are non-stationary, indicating the absence of a long-run equilibrium relationship between the two variables. In other words, *GDP* and *POP* are not cointegrated variables.

Table 5: Estimated Co-Integrating Equation (4)
Dependent Variable POP

	Coefficient	Standard error	t-statistic
Constant	1131.531**	51.601	21.980
GDP	0.119**	0.008	13.649
R-squared	0.885	Adjusted R-squared	0.881
		Constant without trend	Constant with trend
Co-integration (AEG) test		-1.896 (0)	-1.748 (0)

** indicates significance at 1% level
* indicates significance at 5% level

Table 6 reports results from the Johansen cointegration test. The findings confirm the conclusion drawn from the previous analyses, and indicate non-existence of a long-run relationship between the two variables, namely, *GDP* and *POP*. In other words, the findings imply that economic development and population growth in Sarawak were not cointegrated.

Table 6: Johansen Co-Integration Test (Trace Statistic)

Eigenvalue	Trace statistic	5 percent critical Value	Number of co-integrating equations
0.285	9.185	18.39	None
0.046	1.130	3.84	At most 1

* indicates significance at 5% level

These findings indicate that there is no cointegrating relationship between population and economic development in Sarawak. Therefore, the error correction model (ECM) analysis will not be undertaken mainly because the non-existence of a cointegration relation is a precondition for the ECM analysis. The Granger-causality method is used to analyze the casual relationships between population expansion and economic growth in Sarawak. The results of the F statistics and p-values are reported in Table 7 and Table 8.

Table 7: Granger-Causality Test at Levels

Variable	**F-statistics**	**P-value**
POP→GDP	2.074	0.153
GDP→POP	1.897	0.177

According to the results of the Granger-causality test at levels, the first null hypothesis that *POP* does not Granger-cause *GDP* could not be rejected. This means that population growth do not seem to Granger-cause Sarawak's Gross Domestic Product. Further, the second null hypothesis that *GDP* does not Granger-cause *POP* could not be rejected either. This means that an increase in Sarawak's Gross Domestic Product does not Granger-cause an increase in the state's population.

Table 8: Granger-Causality Test at First Differences

Variable	**F-statistics**	**P-value**
POP→GDP	0.904	0.422
GDP→POP	2.919	0.079

Table 8 reported the results of the Granger-causality test at first differences. The first null hypothesis that *POP* does not Granger-cause *GDP* could not be rejected. However, the second null hypothesis that *GDP* does not Granger-cause *POP* could be rejected at the 10 percent of significance. This means that an increase in Sarawak's Gross Domestic Product *does* Granger-cause an increase in the state's population.

In short, the empirical findings indicate that population and economic growth in Sarawak over the observation period were integrated order one, *I(1)*. These variables have the same order of integration. However, a cointegrating relationship between population and economic development in Sarawak is non-existent. On the other hand, Granger causality test at the first difference indicated that there was a unilateral causality from economic development to population growth. In other words, the findings indicate that income expansion can cause the population expansion, but not *vice versa*.

5. Concluding Remarks

This paper sought to provide additional empirical evidence regarding a complex relationship between economic development and population growth in a developing economy. Several econometric tests were carried out to determine whether there existed a meaningful relationship between the two variables in both short run and long run. The unit root tests show that both Sarawak's real per capita GDP and its population were integrated of order one, *I(1)*. These results suggest that the two variables have the same order of integration. Other econometric tests employed in this study, such as the augmented Engle-Granger (AEG) cointegration test, the Johansen cointegration test confirmed the proposition regarding non-existence of a cointegrating relationship between GDP and POP. On the other hand, Granger causality test at the first differences detected that there is a unilateral causality from economic development to population growth. In other words, the findings indicate that income expansion can cause the population expansion, but not *vice versa*.

Overall, the findings of the econometric analyses imply that there is no statistically meaningful long-run, but a causal relationship between Sarawak's economic development and its population growth. In other words, the findings indicate that population can have neither positive nor negative impact on economic development. The findings also indicated that income expansion did cause the population expansion in the state. As the Sarawakian become more wealthy, there were increase in its population.

For future research, establishing factors that cause population expansion and identifying determinants of the economic growth could shed additional light on the relationship between economic development and demography. Considering a complex relationship between population expansion and economic performance, different econometric methods could be employed to analyse the co-integrating relationship between the two variables. It is also possible that should the quality of population be incorporated in the equations, the empirical results could be different from those reported in this study. This paper did not aim to explore the quality aspect of population but rather concentrated on its quantity. Including the quality of population into empirical analysis is a promising direction for future studies. On the whole, it is a ripe moment for development economists to have a closer look at one of the fundamental socio-economic factors – demography.

Furthermore, future research should pay attention to the multi-ethnic groups of the population in Sarawak. It assumes that each ethnic group would play different role in state economy. The disaggregated demographic and economic data for each ethnic group can be used for this purpose.

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