

# Population Growth and Economic Development: Empirical Evidence from the Philippines

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## ABSTRACT

In recent decades, new forms of the Malthusian idea of limited food supply and scarce resources have surfaced. The notion of “peak oil” in the 1970s and warnings of an impending food crisis have generated intense debates among economists and policymakers. Various concerns have been expressed about the ability of the world economy to sustain the ever-expanding world population. This paper aims to provide additional empirical evidence to the ongoing debate about the impact of population growth on economic development with the Philippines as a case study. The findings of this study indicate the existence of a long-run equilibrium relationship between economic performance and population growth in the Philippines. The results of the statistical analyses also point toward the existence of a unidirectional causality from economic development to population growth in the Philippines. That is, economic development in the Philippines has had a positive impact on population growth in the country. This empirical result supports the hypothesis of “economic development-induced” population growth, which is the key outcome of the study.

## INTRODUCTION

New forms of the Malthusian idea of limited resources, especially concerning food supplies and energy, have surfaced in discussions among economists,

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policymakers, and in the mass media. The oil shock in the 1970s and more recent concerns about an impending food crisis have generated intense debates among development and population economists about the ability of the world economy to sustain the ever-expanding world population.

Demographic trends have a substantial impact on any country's economic performance. For example, the declining fertility rates in the industrialized nations have led to labor shortages and put a strain on pension systems. On the other hand, the rapidly expanding population in the developing nations has been viewed as a potential impediment to their socioeconomic development. This prompted some countries such as China and Singapore to introduce policies aimed at decreasing their fertility rate.

In recent years, the relationship between population and economic development in the developing countries has attracted considerable attention from economists and researchers. As Dawson and Tiffin (1998) observed, "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 still no consensus on whether population growth is beneficial or detrimental to the economic performance of a developing nation. The relationship between upward demographic trend and economic growth has been described as "a complex one, and the historical evidence is ambiguous, particularly concerning what is cause and what is effect" (Thirlwall 1994).

In developing countries where the relationship between population growth and economic performance could be viewed as positive, the demographic situation stimulates economic development which leads to a rise in living standards. This is because in these countries population growth tends to encourage competition in business activities and expands the market's potential. The expansion of the market encourages entrepreneurs to set up new businesses. A prominent population economist, Julian Simon, has highlighted the positive side of population growth when he noted that a human being is the vital essential element and "the ultimate resource" that contributes to economic growth (Simon 1996).

In contrast, the relationship between population growth and economic performance in a country is regarded as negative if the increase in population becomes an impediment to the country's economic development. This is because the rapid expansion of population increases the dependency burden (i.e., the number of people who are considered to be economically unproductive such as children and the elderly).

It should be noted that the negative views regarding the consequences of population growth have been prevailing over the positive opinions ever since

Thomas Malthus (1798) warned of the danger of “overpopulation.” As Kelley and Schmidt (1996) pointed out,

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.

Several empirical studies have been done on the long-run relationship between population growth and economic development. Majority of these academic inquiries used cross-section regression to analyze the relationship (Easterlin 1967; Kuznets 1967; Thirlwall 1972; Simon 1992; Ahlburg 1996; Kelley and Schmidt 1996), which led to a considerable methodological problem. In particular, the academic literature on the relationship between per capita income and population growth using cross-section regression analyses tended to suffer from the problem of heteroskedasticity. On the other hand, the main problem faced by the researchers who used time-series regression analysis had been lack of adequate data sets.

In recent years, reliable time-series data sets that are extensive enough to allow conducting of time-series regression analyses have been compiled. The availability of good quality data sets has stimulated the research on the relationship between population growth and economic development. Dawson and Tiffin (1998), for instance, used time-series data to analyze the long-run relationship between population growth and economic development in India. They used the augmented Dickey-Fuller (ADF) unit root test and the Johansen (1988, 1991) co-integration test to analyse the co-integrating relationships between the two variables. The study, however, did not detect a long-run equilibrium relationship between population growth and economic performance in India. As the researchers concluded, “...Population growth neither causes per capita income growth nor is caused by it” (Dawson and Tiffin 1998).

Thornton (2001) conducted a research on the long-run relationship between population growth and economic development in seven Latin American countries, namely, Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. His findings supported the conclusion reached by Dawson and Tiffin (1998). That is, “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” (Thornton 2001).

More recently, Bucci and La Torre (2007) employed a two-sector endogenous growth model to examine the relationship between population growth and economic development. They pointed out that population growth may have a negative or an ambiguous effect on economic development. On the one hand, when physical capital and human capital are substitutes, population growth has

a negative impact on economic performance. On the other hand, when physical capital and human capital are complementary, the effect of population growth on economic development becomes ambiguous.

In order to analyze 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 could either have a positive or negative impact on economic development, and that the outcome would depend on the relative contribution of population and human capital to the economy. Klasen and Lawson (2007) examined the relationship between population growth and economic development by using both cross-country data and panel data. The empirical findings from the cross-country and the panel data indicated a negative relationship between population growth and economic performance. As they concluded, all of the regressions of per capita economic growth on population growth indicated that “population growth has a highly significant *negative* influence on *per capita* economic growth” (Klasen and Lawson 2007).

With the two schools of thought expounding polar views regarding the impact of population growth on economic development, and the fact that the findings of the empirical studies have not led to a definite conclusion on the subject, the current study chose the Philippines as a case study to examine the long-run relationship between population and economic development. The Philippines is a member country of the Association of Southeast Asian Nations (ASEAN) with a population of approximately 94 million in 2007 (CICUP 2009). This relatively big population may have been an impediment to the country’s economic development. On the other hand, a neighboring ASEAN member country, Indonesia, with a considerably larger population of approximately 220 million has shown impressive economic performance. This indicates that a big population could have a positive influence on a country’s economic development. Among the reasons for this could be plentiful supply of the workforce. Also, in more populous countries, market competition between companies may be more vigorous, which would spur economic activities and stimulate economic growth.

Several important research studies have addressed the relationship between population and economic development in the Philippines (e.g., Herrin and Pernia 2003; Mapa and Balisacan 2003; Canlas 2004). These studies have concluded that population growth has hindered economic development in the Philippines. For example, the study by Canlas (2004) found a significant negative relationship between population growth and economic development. Herrin and Pernia (2004) noted that there has been a remarkable population growth in the Philippines since the 1970s. They argued that, given structural weaknesses in the economy, the rapid population growth seemed to have exacerbated the unemployment problem

and poverty in the country. In a similar vein, Mapa and Balisacan (2003) pointed out that among the ASEAN member countries, the rapid population growth in the Philippines provided relatively low benefit (i.e., in terms of the demographic dividend) to economic development. Instead, the country had to pay a high price for its unchecked population growth.

This study aims to contribute to the literature on this issue by addressing the following research question: What is the long-run relationship between population growth and economic development in the Philippines? To answer this question, econometric analyses such as unit root test, Johansen co-integration test, and Granger causality test are used to examine the long-run relationship between population growth and economic performance in the Philippines. The paper consists of four sections. Following this introduction, section 2 discusses the empirical methods employed in the study, while section 3 reports the empirical findings. Section 4 offers some concluding remarks.

## RESEARCH METHODOLOGY

The paper conducted statistical tests on the relationship between population growth and economic growth in the Philippines over the period 1950–2007. The data on population and per capita real gross domestic product (GDP) were obtained from the Penn World Table (CICUP 2009).

The empirical analysis in the study comprised the following three tests: (1) the ADF unit root test (Dickey and Fuller 1979); (2) the Johansen co-integration test; and (3) the Granger causality test. It should first be noted that classical regression analysis is based on the assumption that the variables—in this case, population and economic growth—are stationary (i.e., they have a constant mean and variance over time). But in cases where the variables are nonstationary (i.e., they have a time-varying mean or time-varying variance, or both), classical regression analysis may be invalid (Thomas 1996). Even if the regression analysis indicates that there is a significant relationship between the nonstationary variables, the relationship can still be considered as spurious. Therefore, the study first used the ADF test to examine whether the variables are stationary.

However, as Engle and Granger (1987) have pointed out, there can be a meaningful long-run relationship between nonstationary variables provided that the residuals from the ordinary least square (OLS) estimation of the equilibrium relationship among the nonstationary variables are stationary. In other words, stationary residuals indicate that the nonstationary variables are co-integrated. Thus, the study used the Johansen (1988, 1991) co-integration test to examine the co-integrating relationship between the variables. As Granger (1986) has noted, a co-integration test can be used as a pre-test to avoid a spurious regression situation.

Finally, the study used the Granger causality test to analyze the causality between population and economic growth (Granger 1969). If both variables are integrated of order zero or I(0), a standard Granger causality test with the lag length of  $k$  could be based on the following equations:

$$GDP_t = c_1 + \alpha_1 GDP_{t-1} + \dots + \alpha_k GDP_{t-k} + \beta_1 POP_{t-1} + \dots + \beta_k POP_{t-k} + \varepsilon_1 \quad (9)$$

$$POP_t = c_2 + \alpha_1 POP_{t-1} + \dots + \alpha_k POP_{t-k} + \beta_1 GDP_{t-1} + \dots + \beta_k GDP_{t-k} + \varepsilon_2 \quad (10)$$

where  $c_1$  and  $c_2$  are constants;  $\alpha_1, \dots, \alpha_k$  and  $\beta_1, \dots, \beta_k$  are slope coefficients.

Granger causality could be examined by using the Wald test for the joint hypothesis:

$$\beta_1 = \beta_2 = \dots = \beta_k = 0 \quad (11)$$

The null hypothesis for equation (9) is that  $POP$  does not Granger-cause  $GDP$ . On the other hand, the null hypothesis for equation (10) is that  $GDP$  does not Granger-cause  $POP$ . The rejection of the null hypothesis could indicate a causal relationship between the two variables. The lag length,  $k$ , was chosen by minimizing the Akaike Information Criterion.

On the other hand, if both variables are integrated of order one or I(1), and there is a co-integrating relationship between them, Granger causality test could be based on the following vector error correction models (VECMs):

$$\Delta GDP_t = c_1 + \alpha_1 \Delta GDP_{t-1} + \dots + \alpha_k \Delta GDP_{t-k} + \beta_1 \Delta POP_{t-1} + \dots + \beta_k \Delta POP_{t-k} + \gamma_1 EC_{t-1} + \varepsilon_1 \quad (12)$$

$$\Delta POP_t = c_2 + \alpha_1 \Delta POP_{t-1} + \dots + \alpha_k \Delta POP_{t-k} + \beta_1 \Delta GDP_{t-1} + \dots + \beta_k \Delta GDP_{t-k} + \gamma_2 EC_{t-1} + \varepsilon_2 \quad (13)$$

where  $\Delta$  is the difference operator;  $EC_{t-1}$  is the one-period lagged value of the error correction term; and  $\gamma_1$  and  $\gamma_2$  are slope coefficients.

There is an important advantage to using the Granger causality test based on the VECM rather than on the standard one. The Granger causality test based on the VECM could identify both the short-run and the long-run causalities. The Wald test of the independent variables could be interpreted as the short-run causal effect, while the significant correction term ( $EC_{t-1}$ ) could be interpreted as the long-run causal effect.

Four types of causal relationship between population and economic development are possible:

(1) *Independent*: there is no causality between population and economic development, which could be interpreted as an independent relationship between population and economic growth.

(2) *Population-induced economic development*: there is a unidirectional causality from population to economic development, but not *vice*

*versa*, which could be interpreted as support for the existence of a “population-induced” output expansion.

(3) *Economic development-induced population growth*: there is a unidirectional causality from economic development to population, but not *vice versa*, which could be interpreted as support for the existence of an “economic development-induced” population growth.

(4) *Two-way causality*: there is a unidirectional causality from population to economic growth, and *vice versa*, which could be interpreted as a mutually reinforcing bilateral causality between population and economic development.

## EMPIRICAL RESULTS

This section reports the results of the statistical tests on the relationship between population growth and economic growth in the Philippines for the period 1950–2007.

First of all, the ADF unit root test was employed to test the existence of unit roots in the individual time series. The results obtained from the ADF test are shown in Table 1.

Despite some differences in the findings, the individual ADF tests could not reject the null hypothesis of unit roots at levels. On the other hand, the ADF test could reject the null hypothesis of unit roots at first differences. These findings indicate that *GDP* and *POP* are integrated of order one, *I(1)*.

As the next step in the analysis, the Johansen co-integration test was used to examine the long-run movement of the variables (Johansen 1988, 1991). Results of the co-integration test based on the trace statistics of the stochastic matrix are reported in Table 2.

**Table 1. ADF unit root test (POP)**

Variables	Level		First Difference	
	Constant without Trend	Constant with Trend	Constant without Trend	Constant with Trend
GDP	0.034(0)	-1.404(0)	-6.281(2)**	-6.228(2)**
POP	2.887(0)	-0.530(0)	-0.580(4)	-4.629(1)**

Notes: Figures in parentheses indicate number of lag structures

\*\* indicates significance at 1 percent level

**Table 2. Johansen co-integration test**

Eigenvalue	Trace Statistic	GDP and POP Lags Interval: 1 to 2			Number of Co-integrating Equations
		5 Percent Critical Value	P-value for Trace Statistic		
0.246	19.13	15.94	0.013	None*	
0.062	3.57	3.84	0.051	At most 1	

Note: \* indicates significance at 5 percent level

Despite some minor discrepancies, the findings indicate that there exists a co-integrating relationship between the two variables, namely the Philippines' population and economic growth (*POP* and *GDP*), which means that these variables have a long-run equilibrium relation. In particular, the first null hypothesis that there is zero co-integrating equation can be rejected at the 5 percent level of significance. However, the second hypothesis that there is at most one co-integration equation could not be rejected. This means that there exists one co-integrating relation.

Finally, the Granger causality test was employed to examine the causality relationship between population growth and economic growth in the Philippines. The Granger causality test was based on the VECM. This was done because a co-integrating relationship between *POP* and *GDP* in the Philippines was detected by the previous tests. The result of the chi-square test statistics and its degree of freedom, as well as the coefficient of the error correction term ( $ECT_{t-1}$ ) and its t-statistics are reported in Table 3.<sup>2</sup>

According to the results reported in Table 3, the null hypothesis that population growth (*POP*) did not Granger-cause economic development (*GDP*) could not be rejected. That is, the results indicate that in the Philippines, population expansion does not seem to cause the country's GDP. On the other hand, the null hypothesis that *GDP* does not Granger-cause *POP* could be rejected at the 0.01 level of significance. This is because the coefficients of the error terms are statistically significantly different from zero. This means that the obtained results indicate that the Philippines' economic growth (*GDP*) Granger-causes population growth (*POP*).

<sup>2</sup> The empirical findings from the impulse response function and the variance decomposition are reported in the Appendices. These results confirm the results obtained from the VECM. More precisely, the impulse response function indicates that the Philippine *GDP*'s response to population innovation had been positive but nonsignificant from the fourth year. The impulse response function also shows that population's response to income innovation had always been positive and became significant from the eighth year. On the other hand, the variance decomposition indicates that the effects of population innovation accounted for 13 percent of the variance in the forecast error of GDP in the tenth year. The variance decomposition also shows that the effects of income innovation accounted for 32 percent of the variance in the forecast errors of population in the tenth year.

**Table 3. Granger causality test based on VECM**

The Philippines		
(a) $POP \rightarrow GDP$		
Variable	Degree of Freedom	Chi-square statistic
$\Delta POP$	2	0.625
	Coefficient	t-statistics
$ECT_{t-1}$	0.036	0.063
(b) $GDP \rightarrow POP$		
Variable	Degree of Freedom	Chi-square statistic
$\Delta GDP$	2	1.281
	Coefficient	t-statistics
$ECT_{t-1}$	0.063	3.966**

Note: \*\* indicates significance at 1 percent level

In summary, the study has detected a long-run co-integrating relationship between population expansion (*POP*) and economic growth (*GDP*) in the Philippines. Also, it has detected a unidirectional long-run causality from *GDP* to *POP*. In other words, the Philippines' economic development could have Granger-caused the nation's population growth. However, there is no empirical evidence that the Philippines' population growth Granger-caused the nation's income expansion. These findings indicate that, in the Philippines, there was an "economic development-induced" population growth; that is, population growth was driven by economic growth.

The fundamental relationship between population and development can be explained by the inevitable demographic transition from high fertility rate to low fertility rate (Dyson 2010). The developed countries with relatively low fertility rates such as Japan may tend to face a serious demographic issue of shrinking population where economic development may have a negative impact on population growth. In contrast, the developing countries with relatively high fertility rates such as the Philippines may tend to face a demographic problem of "excessive" population expansion. In other words, in these countries with high fertility rates, economic development may induce population growth.

## CONCLUDING REMARKS

The present study aimed to provide an additional insight into the complex relationship between population and economic development, and selected the Philippines as a case study. Several econometric tests were carried out to determine whether there existed a meaningful relationship between the Philippines' economic growth (*GDP*) and population expansion (*POP*).

Firstly, the unit root tests showed that both real per capita GDP and population growth in the Philippines were integrated of order one,  $I(1)$ . Next, the Johansen co-integration test confirmed the existence of a co-integrating relationship between the two variables, namely, *POP* and *GDP*. Finally, the Granger causality test indicated the existence of a unidirectional causality from *GDP* to *POP* in the country, which implies that economic development in the Philippines had a positive impact on the country's population expansion. Future research studies may want to ascertain the factors that could have caused such causality.

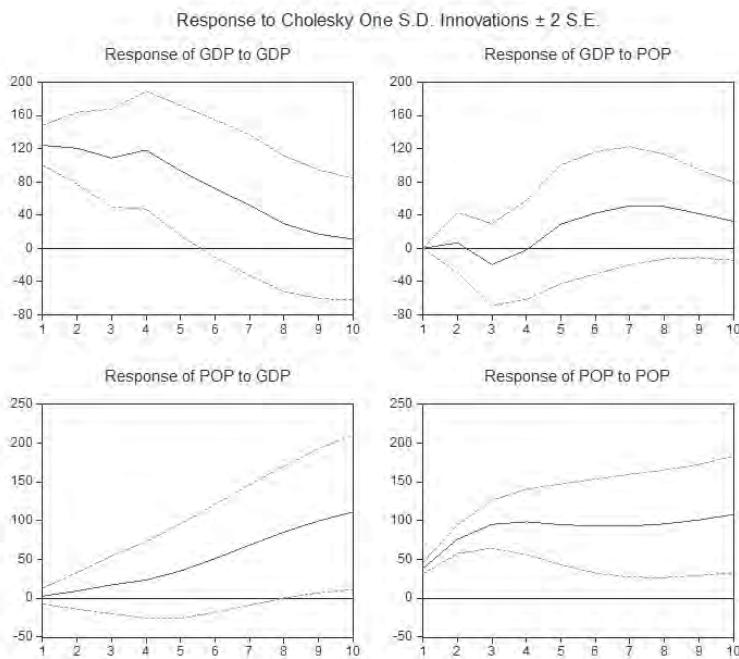
Given the complex relationship between economic performance of a country and its demographic situation, different econometric methods could also be employed to analyze this relationship in the Philippines. This could help to further shed light on what causes changes in demographic trends and what determines economic growth in the Philippines.

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### Appendix 1. Impulse response function



### Appendix 2. Variance decomposition

#### 1. Variance Decomposition of GDP

Period	S.E.	GDP	POP
1	124.1765	100.0000	0.000000
2	173.1049	99.84772	0.152283
3	205.3821	98.98636	1.013639
4	237.0406	99.23217	0.767830
5	256.4312	98.06830	1.931699
6	269.6728	95.76972	4.230282
7	279.4288	92.68129	7.318713
8	285.4421	89.88512	10.11488
9	288.9912	88.04099	11.95901
10	291.0137	86.96131	13.03869

## 1. Variance Decomposition of POP

<b>Period</b>	<b>S.E.</b>	<b>GDP</b>	<b>POP</b>
1	38.42535	0.485611	99.51439
2	85.45760	1.240034	98.75997
3	128.9885	2.274494	97.72 551
4	163.8541	3.449627	96.55037
5	192.4977	5.785120	94.21488
6	219.7117	9.850588	90.14941
7	248.2549	15.31835	84.68165
8	279.3937	21.41157	78.58843
9	313.3127	27.15512	72.84488
10	349.4596	31.91458	68.08542
Cholesky			
Ordering:			
GDP			
POP			