DEMOGRAPHIC FACTORS AND ECONOMIC GROWTH: THE BI-DIRECTIONAL CAUSALITY IN SOUTH EAST ASIA

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Abstract

This study has demonstrated new evidence sustaining the idea that variation in demographic factors is an important determinant of growth in per capita income. Using an panel dataset from 1990 to 2013 at the country-level in the Southeast Asia, this study is conducted to analyze the following two key areas. *First,* the prevalent of a number of the demographic factors impact on the economic growth. *Second,* the bi-directional causality is revealed among: (i) the population growth and the economic growth; and (ii) the life expectancy and the economic growth. Furthermore, the two new econometric techniques, Driscoll and Kraay estimation, and structural equation model are applied. Finding from this study manifests the substantial effects on the economic growth from: the positive effect of population growth, the significant boost of the life expectancy, and the pressure of dependent population. In addition, it is a worth noting in its kind of literature due to the confirmation of the significant inverse effects of the economic growth on the two demographic factors.

Key words: *Demographic transition, economic growth, population growth, life expectancy, age structure, bi-directional causality, Southeast Asia, Panel data, SEM.*

1. Introduction

As a result of the linkage between population and both the supply and demand of economic production (Crenshaw et al., 1997), understanding the variation in the factors of population seems to be a necessity for the process of economic development. In recent decades, Asia, and especially East Asia, has been the interesting entities for the investigation of the linkage between demographic factors and economic growth. This has portrayed the economic leap forward, which elevated the position of some Asian countries in the world, was contributed by the enormous alteration in demography. Proving that, Bloom and Williamson (1998) demonstrated a significant improvement in growth due to impact of demographic change in Asia in the period from 1965 to 1990. However, the situation has changed since the world was diversified into the two different demographic regimes: some countries have been taking advantage of demographic dividend, while the others have been facing the aging population (Sanderson et al., 2013). Accordingly, the analysis based on different time periods and regions in Asia may provide the distinct results of the impact of demography on process of economic growth.

There are several reasons why the Southeast Asia seemed to be an interesting sample to investigate the relationship between demographic factors and economic growth in this study. *First,* as reported of United Nations (2015) its labor force is in the third place of the world in size, just behind China and India. *Second,* at the crossroads of the aging population in East Asian and the baby boom generation in South Asian, most of the countries in South East have just experienced the demographic transition in the last two decade and have been receiving demographic bonus (Bloom & Finlay, 2009). *Third,* according to the classification of World Bank, the Southeast Asian countries are relatively diversified from high-income countries, middle-income countries to low-income countries. Consequently, the sample from Southeast Asia could show a large variation in data across countries, but the homogenous group of countries with many similar characteristic like climate, culture, history may be observed.

In addition, this study also concerns the bi-directional causality between the demographic factors (proxied by the population growth and the life expectancy) and the economic growth that has not been clarified in most previous researches (Bloom et al., 2010; Cervellati & Sunde, 2011). Actually, these papers has just dealt with this endogenous problem to confirm the effect of demography on growth based on the estimation instrumental variables, yet ignored the possible impact of economic growth on demographic factor. Therefore, this study will not only focus on the link between economic growth in Southeast

Asia and the demography of this area, but also shed light on the influence from the two factors to each other.

In short, this study is different with the existent researches in the four fundamental areas. *First*, the influence of demographic factors on economic growth has been clarified in the new context (Southeast Asia) where the phenomenon of demographic transition and demographic bonus is coming out (in the period of 1990-2013). *Second*, a various aspects of demographic factors are utilized simultaneously, including: population growth, life expectancy, and age structure. *Third*, the bi-directional causality is interpreted among: (i) the population growth and the economic growth; and (ii) the life expectancy and the economic growth. *Fourth*, the two new econometric techniques, Driscoll and Kraay estimation, and structural equation model, in parallel with the panel regression technique are applied.

2. Literature review

2.1. Demographic factors

There has been a long time since most of economists focused on population growth and population size to evaluate the effects of demography. It can be clarified by the analysis of the demographic transition. In general, it is exhibited the change over the birth rate and death rate, and the trend of population growth. Nevertheless, in recent times, it is a concentration of the age structure, beside the population growth, and the population size. It is not only about the contribution of each stage of life, but also about the different behavior and contribution each age group that could lead to the difference in economic performance. The high proportion of young people will create a high economic burden due to their small savings, and a great budget being spent for in many other life aspects such as health, education and so on. However, this could be a potential labor source for country in the future, when population growth falls based on the drop of fertility rate, the nation will get benefit of high proportion of working-age and low dependence age (the young and the elderly). Nevertheless, when the countries keep improving the living standard, life expectancy will increase and the ratio of elder in population will be higher. The resources for elderly will be greater than the product they create, and then restrict the income per capita of the nation (Bloom et al. 2003). In such explanation, the age structure could be a reasonable proxy to distinguish the countries that have same population size and growth.

Another examined factor is life expectancy. As the definition of United Nations (2013), life expectancy at specific age is the expected years that a person at that age could live base

on the assumption that age-specific mortality levels is constant. In this paper, life expectancy is the short word for life expectancy at birth which was the number of years that one newborn could live if the age-specific mortality rates was not change. Due to the fact that longevity reflects the mortality as well as the health of country, life expectancy could be an important demographic proxy in the process of economic development.

2.2. Demographic factors and economic growth

The characterization of modeling the relationship between demographic factors and economic development has been challenged and debated since the time of Malthus (1798). It has portrayed the influential dimension of the demographic factor on the economic growth by defining the Malthusian stagnation mechanism. Nevertheless, this has been changed in recent year due to the changeable idiosyncratic of demographic factors, the economic situation, or even the changeable modern conception. Based on this way of analyzing, a number of researches has been constructed as a summarized framework for the related theories which includes: (i) the traditional "Malthusian regime" that focused on the stagnation from the relationship between the controlling process of demographic transition (population growth) and the food issue; (ii) the "post-Malthusian" state which implied the slight impact of greater population on the growth; (iii) the "modern approach" postulates the steady growth mechanism with a group of number of factors that impact on growth.

2.2.1. The perspective of Malthusian Regime

The main idea of this view is population without control increases geometrically but food supply only rise arithmetically because of limit of some factor of production such as land and technology. As stated by Malthus (1798), the economic performance will be higher with small population, on the one hand, high income per capita have the supportive function to the expansion of population. On the other hand, the higher population with circumscribed resource will lead to the increase in price, it will have a preventable effect to the standard of living. The Malthusian theory implies that population size will be self-adjusted to adapt with the supply of production. The raise in product will counterbalance by increasing in population size, thus the technologically superior countries only had higher population density and the economic performance did not reflect technological progress.

2.2.2. The perspective of Post-Malthusian

Ironically, the two centuries after Malthus's influential theory witnessed a number of countries took off from the Malthusian trap and took advantage of the significant increase in the quick pace technology. During Post-Malthusian Regime, the higher population growth

participated quite considerable contribution in economic transform. The dilute effect on resources per capita of larger population was counteracted by technological advancement and accumulation of capital, and hence the output per capita was continuing to increase in spite of the raise of population. Moreover, the propulsive role of high GDP per capita on the expansion of population from Malthusian Regime continued to function. The theories in this period provided the framework to investigate the relationship between demographic factors and marked growth of economy, in addition, the technological promotion was considered as the most important factors on this process. Notwithstanding, the stagnation during the Malthusian period and the next sustained state would not be captured, hence this problem could be unraveled more clearly in the next section with the modern growth theories.

2.2.3. The perspective of Modern Growth Regime

As referred in Galor (2011), the Post-Malthusian and Modern Growth were separated by the demographic transition with the reduction in population growth. There are two main approaches of explaining the economic growth in Modern Growth Regime, the neoclassical theory of exogenous growth and the new theory of endogenous, the predictable results shows the negative effect to per capita output from a raise in population. It is apparent from these theories that the positive influence of population and demographic transition was neglected despite the fact that demographic change appears to be essential for considerable growth of output per capita over the development process. Meanwhile, there are many theories support for the promotional role of denser population such as the argument of Kuznets (1960) about the contribution of population as the producers, the saver and the consumers in the economy. Besides, he also points out that the optimal income per capita may not the only signal for the benefits of country from more population.

2.3. Empirical studies

2.3.1. The impact of population growth, and age structure on economic growth

From the Malthus's theory, there is much paperwork which provides supportive evidence for pessimistic view. Coale and Hoover (1958) built up a hypothesis based on an Indian database about the negative relationship between a raise in young dependence and savings in a short run which lower the standard of living. Moreover, Bloom et al. (2003) show that the rapid growth of population requires a large part of technological improvement and the fixed resources such as home, infrastructure and so on. Thus, the raise in productivity could not make significant change in standard of living. Until 1800, the gap between the countries with high technology like England, France, Germany and low-technology countries

in Asia and Africa is still small. The empirical review in recent decades such as Barlow (1994), Kelley and Schmidt (1995) also find an evidence about negative correlation between population growth and income per capita with panel database.

The empirical study in recent decades also provide an inconsistent result, while some papers find the negative effects, others find positive or no relationship. The study about 110 countries in the period of 1960-2000 of Azomahou and Mishra (2008) shows that contrary to the negative influence on economic growth in OECD countries, the total population growth make a positive effect in non-OECD countries. Moreover, Bloom and Williamson (1998) sustained that raise in population bolster the miraculous growth in East Asia during the period from 1965 to 1990.

In addition, the empirical studies concern more about the age structure since it provides more information for implied policy. Crenshaw et al. (1997) found that the economic growth in 75 developing countries was hindered by raise in young dependence, though the effect of increase in working population still positive. In addition, the research of Azomahou and Mishra (2008) into about 110 countries from 1960 to 2000 shed light on the growth of each group (0-14, 14-64, 65 and above) shows some different results. The increase in young and working age population have positive contribution to growth in both OECD and non-OECD countries, yet the negative trend was found in non-OECD countries which could be the implication for population-control policy in these countries. The ageing population was found in both group of countries, though the effect in OECD was more serious than in non-OECD.

2.3.2. The impact of life expectancy on economic growth

For a long time, there are a great amount of papers suggest the vital influence of longevity to growth. In cross-country level, Barro and Lee (1994), Caselli et al. (1996), Gallup and Sachs (2000) come into the same results with different econometric method that life expectancy have significantly positive effect on per capita output. The recent study from Ashraf et al. (2008) proved that per capita output have tended to be higher by appropriate 15% in the long-term since the life expectancy raises from 40 to 60. Moreover, the study of Bloom et al. (2004) confirmed the promotional contribution of life expectancy on income per capita due to increase in worker's productivity is about 4% per year. Along the same time, De la Croix et al. (2009) also concerned this nexus and find positive correlation between two proxies.

On the other hand, some results find that the longer life may not improve income per capita in long run. The recent paper of Acemoglu and Johnson (2007) provides an opposite

finding to most of previous studies: the increase in life expectancy contributes to the reduction in economic growth based on cross-country database over the 1940-2000 periods. De la Croix and Licandro (1999) built up an overlapping generations model to consider the relationship between life expectancy and growth, their study suggests that the economic growth may be pushed up by the low levels of life expectancy. In contrast, the economic would tend to be exacerbated when the countries is more developed due to the ageing population. Evidence from research of McDonald and Roberts (2002) also supports the idea of de la Croix and Licandro, their finding exposes that despite the supportive role of longer life in developing countries, income per capita in OECD countries was depressed because of ageing of their population.

2.3.3. Bi-directional causality

One of the first theories that proves the two-way relationship between population growth and economic growth is Malthus (1798), who claimed that the higher income affect the population positively through both reduction in mortality and raise in birth rate. On the other hand, the effect of increase in population growth on economic growth was negative through diminishing returns. Existing research on the linkage between population growth and economic growth uses data at both cross-sectional and within countries. At the macroeconomic level, as reported in Lutz and Quiang (2002), the GDP per capita has a negative influence on population growth. The recent papers have more focused on the contribution of population growth on growth process rather than the impact of standard of living on population. For instance, Bloom and Williamson (1998), Bloom and Finlay (2009) has explored the reverse causality between income growth and population using the lagged population growth as instrument variable.

Naturally, the relationship between life expectancy and economic performance could be considers as a bidirectional causality. One of the first papers studying the positive relationship between life expectancy and income is Preston (1975), who stated that more than one third of the improvement in life expectancy over the 1930 -1960 period could result from increasing income. Moreover, Soares (2007) demonstrates the significant contribution of income to life expectancy during the period of 1940-1970 using the cross-sectional dataset. The simultaneous effect between life expectancy and growth was also considered in many studies such as Acemoglu and Johnson (2007), Ashraf et al. (2008), and Cervellati and Sunde (2011). The results has maintain the causal relationship between two proxies, although the sign of impact was still inconsistent with each other.

2.3.4. Determinants of economic growth, population growth, and life expectancy

Besides the demographic factors, there are a number of determinants affecting the economic growth which is defined as follow. First, it has considered to put into the model is trade as the ratio of sum of export and import to GDP. Trade play an important role on the growth process as could be clarified in the study of Frankel and Romer (1999) which based on the cross sectional dataset. Second, gross capital formation has been demonstrated as a possible channel influencing on growth model by the argument of Bloom et al. (2003). Third, the inequality gender is the other noticeable feature in the growth model since women composed over half of the world's population and their utility is still underused, especially in the developing countries (Cuberes and Teignier, 2014). Finally, the civil liberties was examined as a determinant of growth by Kormendi and Meguire (1985).

There are some determinants of life expectancy beside economic growth. First, the death rate could be the indicator for the equation of life expectancy since the greater death rate naturally leads to lower life expectancy directly. Another features could have influence on life expectancy is percentage of population ages 65 and older. In the study of Shaw and Vogel (2005), the portion of older and its interaction with another lifestyle's factors was considerably significant effect in OECD countries. According to AbouZahr and Roystion (1991), fertility may the suitable explanatory variable for life expectancy since it have the high correlation with maternal health. In addition, the immunization is considered as an important factor that involve the health status by the study of Poland et al. (2005). Last but not least, the nexus between education and health which was analyzed by Ross and Wu (1995) is stated the positive and statistically effect of completed schooling years on health.

2.3.5. Conceptual framework

From previous review, the following figure will clarify the two main key objectives. *First,* it demonstrates the impact on the economic growth from the various aspects of demographic factors, includes: the population growth, age structure, and life expectancy. *Second,* the bi-directional relationship the economic growth and the two demographic factors – population growth, and life expectancy.

Demographic factors and economic growth

Despite the aging population that the East Asia has been dealing with in recent time, the considerable demographic change during the period of 1965-1990 was one of the motivation for the miracle growth in East Asia (Bloom and Williamson, 1998). Besides that, Bloom et

al., (2003) shows the demographic transition in Southeast Asia has lagged behind East Asia, thus the demographic bonus may come to the former lately. It mean that the potential positive effect could be exist in Southeast Asia. The last but not least, this expectation have also been confirmed in current study (Bloom et al., 2010; Bloom and Finlay, 2009).

H1a. Population growth has positive effect on economic growth in Southeast Asia

Although the recent paper of Acemoglu and Johnson (2007) provides an opposite finding to almost previous studies: the increase in life expectancy contributes to the reduction in economic growth based on cross-country database over the 1940-2000 periods. The positive relationship between life expectancy and economic growth has been confirmed in a number of empirical studies with different econometric method such as Barro and Lee (1994), Caselli et al. (1996), Gallup and Sachs (2000), de la Croix et al. (2009). Moreover, the study of Cervellati and Sunde (2011) which use framework of Acemoglu and Johnson (2007) as benchmark revealed that the improvement in life expectancy would leads to the increase in income per capita. From these finding, life expectancy is expected to positively affect the economic growth.

H1b. Life expectancy has positive effect on economic growth in Southeast Asia

Age structure was considered as the new aspect in the investigation of effect of demography on development. The finding from studies of Crenshaw et al. (1997), Azomahou and Mishra (2008) using cross-national dataset suggested the distress of dependence age group to economic growth. Moreover, these findings was maintained in the case of Asia countries since both the young and old dependence fraction. On the other hand, the increase in portion of working age population seemed to stimulus the economic growth in recent empirical studies (Azomahou and Mishra, 2008; Bloom and Finlay, 2009). In conclusion, the economic growth could get more benefit from both the raise in proportion of working age population and the reduction in proportion of dependent population.

H1c. Age dependency ratio has negative effect on economic growth in Southeast Asia

Two-way relationship

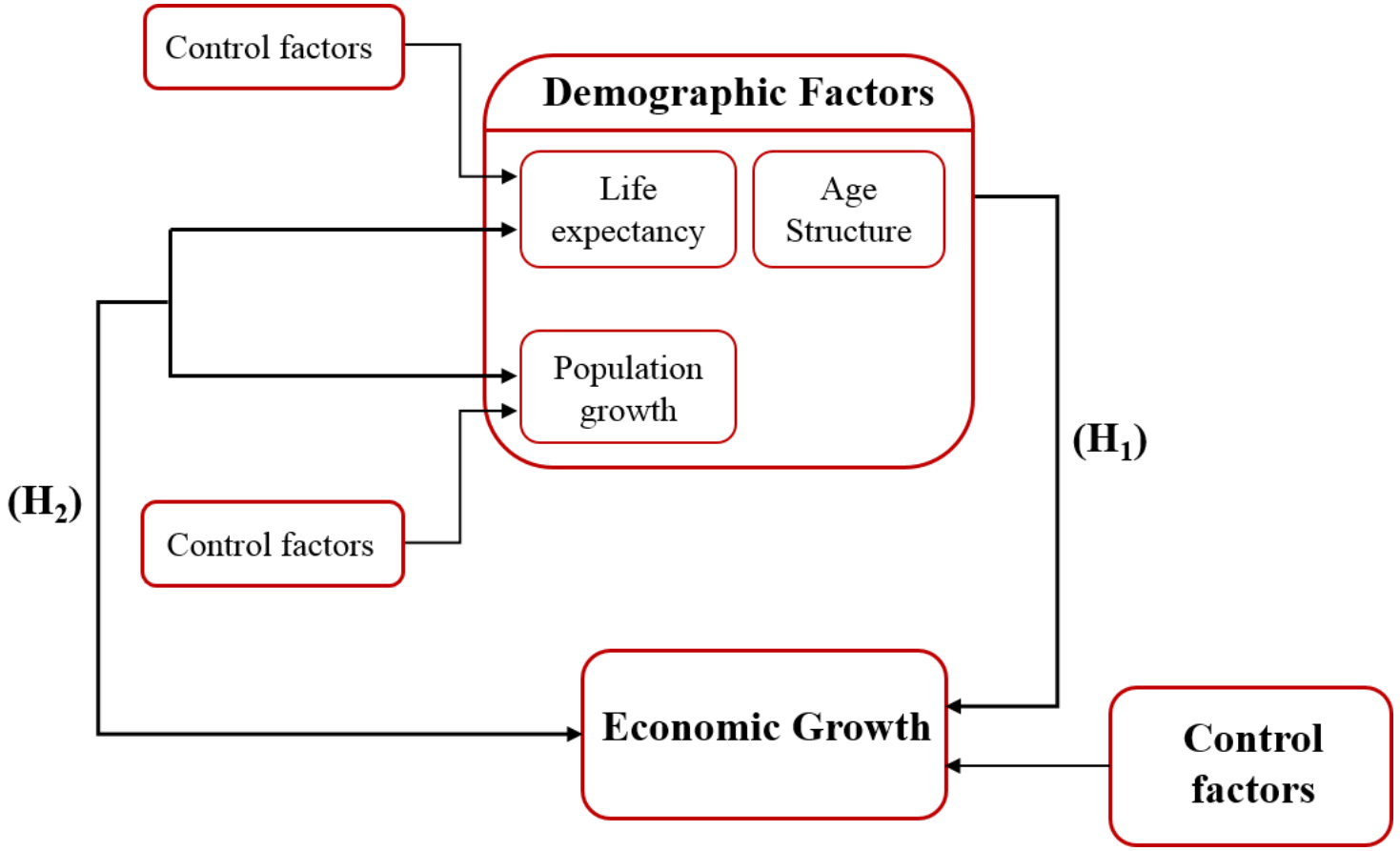
The previous research has been examined the simultaneous relationship between population growth and economic growth to confirm the impact of the former on the

latter. Particularly, the instrument variable technique was observed in the studies of Bloom and Williamson (1998), Bloom and Finlay (2009), Bloom et al. (2010) to deal with this problem. Similarly, the endogenous problem which results from two-way relationship between life expectancy and economic growth was considered in a number of empirical review such as Acemoglu and Johnson (2007), Ashraf et al. (2008), and Cervellati and Sunde (2011). However, most of papers has just handled the simultaneous problem to robust the effect of demographic factors on economic and disregard of the possible impact from the opposite direction. Therefore, the objective of this study is not only examining the impact of demographic factors on economic growth but also clarifying the bi-directional causality of this relationship.

H2a. There is an existence of the bi-directional causality between population growth and economic growth in Southeast Asia

H2b. There is an existence of the bi-directional causality between life expectancy and economic growth in Southeast Asia

Figure 1. The conceptual framework



Sources: Author's analysis

3. Research methods and data

3.1. Data

This study construct an annual panel dataset from 1990 to 2013 using country-level data of the Southeast Asia sample as the classification of United Nations 2015. The original sample consisted of eleven countries; however, the observation from Myanmar has been removed due to the lack of the main outcome variable - GDP per capita. Therefore, the base sample has just consisted of ten countries (Brunei Darussalam, Kingdom of Cambodia, Republic of Indonesia, Lao People's Democratic Republic, Malaysia, Republic of the Philippines, Republic of Singapore, Kingdom of Thailand, Democratic Republic of Timor-Leste, and Socialist Republic of Vietnam).

3.2. Research Methods

3.2.1. Panel regression model with Driscoll and Kraay estimation

Fogel (1994), and Wei and Hao (2010) have concerned the problem of growth theory when the impact of demographic factors on economic growth are analyzed. The emergence of the relevant measurements and misspecification of the demographic factors has put the pressure on an adjustment for the omitted proxies, instead of focusing on the standard factors of the growth model. For that reason, there is a consideration of the extended model in which, a numbers of demographic factors has been concerned, such as: the demographic structure, the dependence ratio, the working age group, and the population growth (Wei and Hao, 2010); and life expectancy (Barro, 1996; Bloom et al., 2000; and Bloom et al., 2004).

As a results, this paper is a careful deliberation of using the extended model (Wei and Hao, 2010), and the linear regression framework (Cervellati and Sunde, 2011) in order to obtain an expansive view from the effects of various aspects of demographic factors - the population growth, the life expectancy, and age structure - on the economic growth.

Model 1:

$$Ln\,(GDP\ per\ capita)_{it} = \beta_0 + \beta_1\,(Population\ growth)_{it} + \beta_2\,Ln\,(Life\ expectancy)_{it} + \beta_3\,(Control\ variables)_{it} + \varepsilon_{it}$$

Model 2:

$$Ln\,(GDP\ per\ capita)_{it} = \beta_0 + \beta_1\,(Population\ 0\_14)_{it} + \beta_2\,(Population\ 65)_{it} + \beta_3\,(Control\ variables)_{it} + \varepsilon_{it}$$

Model 3:

$$Ln\,(GDP\ per\ capita)_{it} = \beta_0 + \beta_1\,(Dependence\ young)_{it} + \beta_2\,(Dependence\ old)_{it} + \beta_3\,(Control\ variables)_{it} + \varepsilon_{it}$$

Model 4:

$$Ln\,(GDP\ per\ capita)_{it} = \beta_0 + \beta_1\,(Population\ 15\_64)_{it} + \beta_2\,(Control\ variables)_{it} + \varepsilon_{it}$$

Where,

(i) Dependence variable: GDP per capita - the natural log of GDP per capita.

(ii) Demographic factors: population growth, log of life expectancy, population 0_14, population 65, dependence young, dependence old, population 15_64.

(iii) Control variables: log of life expectancy in 1990, FE_MA, trade, GCF, transition, civil liberties, log of population density in 1990.

In order to clarify these models, this study concerns the new econometric technique - Driscoll and Kraay standard errors for panel models. Usually, the panel regression technique concerned about the application of the fixed effects model (FEM) or the random effects model (REM). However, it has emerged the issue of spatial dependence in which it specifies the correlation among the error components in the model. In turn, it would lead to a presence of cross-sectional dependence, and take into account the problem of biasness in evaluating the coefficients that can't be handled by FEM or REM model (Sarafidis & Wansbeek, 2012).

Considering the following feature of Driscoll and Kraay estimation of the square root of the diagonal element in the covariance matrix:

$$V(\hat{\theta}) = (X'X)^{-1}\,\hat{S}_T\,(X'X)^{-1}$$

And the definite equation (Newey &West, 1987):

$$\hat{S}_T = \hat{\Omega}_0 + \sum_{j=1}^{m(T)} w(j,m)[\hat{\Omega}_j + \hat{\Omega}_j']$$

In this case, the Driscoll and Kraay estimation obtains the covariance matrix that deals with the heteroskedasticity, the autocorrelation and the cross-sectional dependence issues. (Hoechle, 2007)

3.2.2. The bi-directional causality

The current literature has just concerned the presence of the potential endogenous problem in the relationship between demographic factors and economic growth. Nevertheless, these papers have not clarified the possibly inverse effect of

economic growth on several factors of demographic factors (population growth, or life expectancy). It means that this study has been concerned the analysis in both two way of the relationship – bi-directional causality – formulated as following equations:

Model 5:

$$\begin{aligned} Ln\,(GDP\ per\ capita)_{it} = {} & \beta_0 + \beta_1\,(Population\ growth)_{it} + \beta_2\,Ln\,(Life\ expectancy)_{it} \\ & + \beta_3\,Ln\,(Life\ expectancy\ 1990)_{it} + \beta_4\,(FE\_MA)_{it} + \beta_5\,(Trade)_{it} \\ & + \beta_6\,(GCF)_{it} + \beta_7\,(Transition)_{it} + \beta_8\,(Civil\ liberties)_{it} \\ & + \beta_9\,Ln\,(Density\ 1990)_{it} + \varepsilon_{it} \end{aligned}$$

Model 6:

$$\begin{aligned} Population\ growth_{it} = {} & \beta_0 + \beta_1\,Ln\,(GDP\ per\ capita)_{it} + \beta_2\,Ln\,(Density)_{it} \\ & + \beta_3\,(Labor\ female)_{it} + \beta_4\,(Urban)_{it} + \beta_5\,(Food)_{it} + \varepsilon_{it} \end{aligned}$$

Model 7:

$$\begin{aligned} Ln\,(Life\ expectancy)_{it} = {} & \beta_0 + \beta_1\,Ln\,(GDP\ per\ capita)_{it} + \beta_2\,(Population\ 65)_{it} \\ & + \beta_3\,(Death)_{it} + \beta_4\,(Immunization) + \beta_5\,(Fertility)_{it} \\ & + \beta_6\,(Human\ capital)_{it} + \varepsilon_{it} \end{aligned}$$

Where,

(i) Dependence variable: log of GDP per capita, the population growth, and life expectancy are presented respectively in the model 5, 6, and 7.

This study has been analyzed the problem of bi-directional causality by applying the structural equation model (SEM). This modeling equations has been considered widely as a platform of the econometric technique to quantify the theoretical issue, the causal relationship, or the mechanism of transmission. Its procedure may provide the crucial framework which specifies the influential trait based on the view of the causal mediation mechanism, the simultaneous or non-recursive structural equation. (Pugesek et al., 2003; Markus, 2012; and StataCorp., 2013)

The idiosyncrasy of this method is the joint determination of the dependent variables, and a simultaneous equation. Usually, it can be dealt with the biasness of the endogenous problem, the structural error of the equation, and the correlation between the explanatory variables and the residual may cause the inconsistent estimation in the traditional OLS model (Wooldridge, 2012).

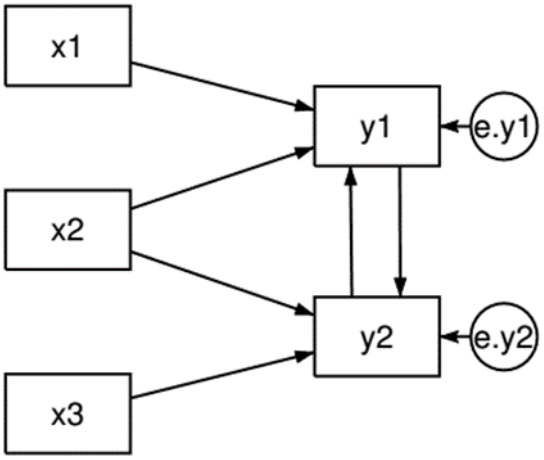
Concerning the following equation of the simultaneous equation:

$$y_1 = \beta_{12} y_2 + \gamma_{11} x_1 + \gamma_{12} x_2 + \zeta_1 \quad (1)$$

$$y_2 = \beta_{21} y_1 + \gamma_{22} x_2 + \gamma x_3 + \zeta_2 \quad (2)$$

In this case, the system of equation has presented the joint determination of the endogenous variables y_1 and y_2 by a group of exogenous variables - $x_1, x_2,$ and x_3. The determination of the endogenous variables has been demonstrated by the following mechanism of the path analysis (StataCorp., 2013):

Figure 2. The non-recursive mechanism.



Sources: (StataCorp. (2013)

In this model, the "loop" is represented for the non-recursive relationship (the bi-directional causality) of the two endogenous variables. (StataCorp., 2013).

4. Empirical Results

4.1. Summary statistic

Our sample in the period of 1990-2013 covers the period when most of the Southeast Asian countries have experienced the demographic transition. According to Table 1, the mean of GDP per capita based on purchasing power parity, which is our response variable, is 18725.690 dollars with a standard deviation of 25472.700 dollars. This quite high standard deviation presents the fact of the relatively high income inequality in this area. The descriptive statistics of demographic factors are reported in Panel B, there is a relative variation in population growth and life expectancy. Besides, the components of population provides general picture about demography in Southeast Asia over the 1990-2013 period. As could be seen from Panel B, the working-age obtains a high proportion from total population - 62.3% - which could be a good signal for motivating the growth process. Furthermore, the

portion of young people is fairly high - 33.005% - in comparison with total population. The other proxy of young population - Dependence young shows that two adults will have to be responsible for one child. Although this age group could be an encouragement for the labor force in the future, a large burden in present time could damage the economy in short run. Last but not least, two variables which illustrate the fraction of old group is considerably small, the maximum value of it is only 10.671%. This age structure may reflect the fact that most of the countries in sample still have been obtaining the demographic bonus according to the definition of United Nations (2004).

Table 1. Summary statistics. The table provides summary statistics for the variables in the full sample.

	Mean	Std. dev.	Min	Max	No. of obs.
Panel A - Dependence variable					
GDP per capita	18725.690	25472.700	1011.094	78958.090	238
Pane B – The demographic factors					
Population growth	1.865	0.891	-1.476	5.322	250
Life expectancy	69.282	6.885	48.480	82.346	240
Population 0_14	33.005	8.411	15.680	50.032	250
Population 65	4.690	1.848	1.915	10.671	250
Population 15_64	62.305	6.994	47.521	73.783	250
Dependence old	7.389	2.282	3.280	14.490	250
Dependence young	55.246	20.470	21.290	105.283	250
Panel C - Other control variables					
Transition	0.360	0.481	0.000	1.000	250
FE_MA	71.781	15.786	47.826	97.494	240
Death rate	6.424	2.453	2.758	15.709	240
Fertility	3.122	1.468	1.150	7.122	239
Labor female	57.843	14.481	24.600	80.100	240
Urban	3.378	1.437	-1.476	7.164	240
Human capital	2.219	0.400	1.590	2.965	198
Civil liberties	4.614	1.153	3.000	7.000	241
Immunization	82.513	18.311	18.000	99.000	238
Density	720.682	1838.379	18.390	7813.857	250
Food	98.665	48.117	27.310	495.070	250

Source: Author's analysis

4.2. The demographic factors and economic growth

As can be seen from Table 2, the average yearly increment in population directly increase the income per capita at the significant level of one percent. In particularly, a one percent increase in population growth would be associated with a 34.6% increase in income per capita if other variables are held constant. This finding is consistent with the result of Azomahou and Mishra (2008) and Bloom and Williamson (1998). Furthermore, a higher life

expectancy give a substantial boost to the economy resulted in one percent increase in life expectancy would lead to 7.798% increase in GDP per capita. This result verifies the contribution of life expectancy in which the previous paper have been considered (Barro and Lee, 1994; Gallup and Sachs, 2000; Ashraf et al., 2008).

Table 2. Panel regression model with Driscoll and Kraay estimation.

Variable	Model 1	Model 2	Model 3	Model 4
Population growth	0.346***			
	(0.091)			
Ln life expectancy	7.798***			
	(0.769)			
Population 0_14		-0.106***		
		(0.006)		
Population 65		-0.533***		
		(0.078)		
Dependence young			-0.022***	
			(0.002)	
Dependence old			-0.322***	
			(0.047)	
Population 15_64				0.058***
				(0.013)
Ln life expectancy 1990	3.875***	4.088***	4.406***	4.891***
	(0.280)	(0.505)	(0.491)	(0.520)
FE_MA	-0.003	0.006	0.008	-0.014***
	(0.003)	(0.005)	(0.005)	(0.003)
Trade	0.006***	0.010***	0.010***	0.009***
	(0.001)	(0.000)	(0.001)	(0.000)
GCF	-0.019***	-0.009	-0.009	-0.017**
	(0.005)	(0.006)	(0.006)	(0.006)
Transition	0.292**	0.285*	0.428***	0.085
	(0.121)	(0.147)	(0.122)	(0.176)
Civil liberties	-0.093	0.003	0.011	0.057
	(0.054)	(0.027)	(0.023)	(0.059)
Ln density 1990	-0.447***	-0.296***	-0.284***	-0.506***
	(0.019)	(0.045)	(0.043)	(0.032)
Constant	-38.715***	-2.416	-6.420**	-12.819***
	(2.975)	(2.003)	(2.111)	(1.942)
No. obs.	216	216	216	216

The dependent variables in all models are Ln GDP per capita. Standard error of each coefficient are provided in parentheses, ***, **, and * denote significance at the 1-, 5- and 10-percent levels, respectively. *Source: Author's analysis*

Moreover, the components of population provides more interesting results. The fraction of working-age population (Population 15_64) from model (4) shows a statistically significant and positive effect to per capita output. This finding is compatible with the

argument of Crenshaw et al. (1997) and Azomahou and Mishra (2008) that the improvement in participation rate of labor force would directly lead to a raise in economic growth. In contrast, it is apparent from model (2) and (3) that the unfavorable impact (significant at 1 per cent) of the dependent population in comparison with total population (Population 0_14, Population 65_above) and the working-age population (Dependence young, Dependence old). This result confirms the results of Bloom et al. (2010) about negative effect of both young and old dependence on short-term growth. Combining with the data from overview section, it is apparent that the raise in working-age population by 8% has undoubtedly improved economic performance in Southeast Asia during the period of 1990-2013. Moreover, the improvement could be resulted from the reduction in young dependency by more than 10%. Despite the slight increase in the old dependency ratio, its impact may results in a huge burden for the economy due to the significantly large marginal effect. In particular, the magnitudes of these coefficient are noticeable, the distress of older people which is illustrated by coefficient of Population 65_above (-0.533) and Dependence old (-0.322) is considerably greater than the one from youth which could be shown in coefficient of Population 0_14 (-0.106) and Dependence young (-0.022). This finding could demonstrate that the old population is becoming a pressure in Southeast Asia in future unless the government could make a suitable pension policy and health care system.

4.3. The Bi-directional relationships

The most noticeable feature could be seen from the Table 3 that the results present the positive effect (significant at 1%) of population growth on change of GDP per capita, although GDP per capita seems to significantly decelerate population growth at 10% significance level. In particular, a 0.1% raise in population growth is equivalent to an increase in GDP per capita by 5.06%, yet the increase of one percent in GDP per capita will decelerate population growth about 0.00182%.

This finding confirm the hypothesis for bi-directional causality in the relationship between population growth and GDP per capita was suggested by previous theory and empirical review (Bloom and Williamson, 1998; Bloom and Finlay, 2009). Moreover, the significantly negative impact of output per capita on population growth may reflect the impact of population policy control in this area.

Table 3. The Structural Equation Model.

Model 1 (Ln GDP per capita)		Model 2 (Population growth)		Model 3 (Ln life expectancy)	
Population growth	0.506***	Ln GDP per capita	-0.106*	Ln GDP per capita	0.002**
	(0.094)		(0.060)		(0.001)
Ln life expectancy	8.682***	Ln density	0.203***	Population 65	0.019***
	(1.675)		(0.044)		(0.001)
Ln life exp 1990	2.635**	Labor_fe	-0.025***	Death	-0.035***
	(1.173)		(0.005)		(0.001)
FE_MA	-0.006	Urban	0.296***	Immunization	0.000***
	(0.006)		(0.042)		(0.000)
Trade	0.005***	Food	0.000	Fertility	-0.006***
	(0.001)		(0.001)		(0.001)
GCF	-0.018***	Constant	2.241***	Human capital	-0.002
	(0.006)		(0.753)		(0.002)
Transition	0.479***			Constant	4.345***
	(0.159)				(0.014)
Civil liberties	-0.110*				
	(0.058)				
Ln density 1990	-0.454***				
	(0.057)				
Constant	-37.25***				
	(4.718)				
N	184		184		184

The dependent variables in model 1, 2, and 3 are Ln GDP per capita, Population growth, and Ln life expectancy respectively. Standard error of each coefficient are provided in parentheses, ***, **, and * denote significance at the 1-, 5- and 10-percent levels, respectively. *Source: Author's analysis*

Similarly, the estimates also confirm the hypothesis about bi-directional causality in the relationship between life expectancy and GDP per capita. The results show that GDP per capita, as expected, affect life expectancy directly, although the magnitude of this impact is fairly small when the one percent raise in GDP per capita only contribute to 0.002% improvement in life expectancy. Contrariwise, the positive impact of life expectancy on GDP per capita is considerably high when one percent increase in life expectancy would be associated with an 8.682% increase in income per capita. This finding confirms the positive influence of life expectancy on economic growth in previous studies (Barro & Lee, 1994; Gallup & Sachs, 2000; Ashraf et al., 2008).

5. CONCLUSIONS

Using a panel dataset from 1990 to 2013 at the country-level in the Southeast Asia (classified by United Nations, 2015), findings from this study provides the empirical evidence of significant effect on the economic growth from the three key following areas. *First*, there is the positive effect of the population growth. *Second*, the life expectancy presents a substantial boost to the growth in income per capita. *Third*, the significant results of age structure are presented, including: (i) the negative effect dependence population (proxied by population 0_14, and population 65) and the dependence working-age structure (proxied by dependence young, and dependence old); and (ii) the positive effect of working age population (proxied by population 15_64). These findings could infer that the old population is becoming a pressure in Southeast Asia in future unless the government don't make a suitable pension policy and health care system.

In addition, this study has demonstrated the significant inverse effects of the economic growth on the two following demographic factors. *First*, the negative effect of GDP per capita on the population growth is present which is reflected by the impact of different population policy control in the Southeast Asia. *Second*, the GDP per capita affects positively on the life expectancy. In general, these findings have filled the gap of current literature by confirms the significant presence of the bi-directional causality between the demographic factors (population growth, and life expectancy) and the economic growth.

From these results, the governments should observe the experience of population policy of other countries and concern different policies due to the stage of demographic transition in each countries. Moreover, there could be certain tradeoffs between the cost for current population burden and future benefit from huge working age group, and policymakers should consider carefully these costs and benefits of in order to maintain the sustainable growth and ensure the benefit for the next generation. In addition, the sustainable pension system and the improvement in statutory retirement age were some considered decisions that Southeast Asian government should endeavor to prepare for the potential risk from aging population. Finally, the pronounced contribution of health to economic growth process was confirmed by the significantly positive impact of life expectancy on GDP per capita in Southeast Asia. On the other hand, the significant relatively small effect of output per capita on life expectancy may reflect the incipient health services in this area. In order to preserve the positive impact

of life expectancy on income per capita and prevent the pressure from aging population, the measures to improve life expectancy should more focus on the child and working-age health.

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