POPULATION GROWTH AS AN ENDOGENOUS FACTOR IN INDONESIA'S ECONOMIC GROWTH

by Wilson Rajagukguk

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E-mail: eco@nam.kiev.ua (головний редактор);
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CONTENTS

Wilson Rajagukguk[1]

POPULATION GROWTH AS AN ENDOGENOUS FACTOR IN INDONESIA'S ECONOMIC GROWTH

This study aims to investigate whether population growth can be used as an endogenous factor of economic growth. The analysis was accomplished by constructing a model to evaluate the interaction between the rate of population growth and the rate of economic growth employing endogenous growth theory and the Pontryagin maximum principle. The parameter that relates population growth to economic growth is the child rearing cost. The results show that the relationship between population growth and economic growth is positive when the child-rearing cost parameter is less than 1 (Simonian), and negative when the child-rearing cost parameter is greater than 1 (Malthusian), and none – when the child-rearing cost parameter equals to 1. The growth rate of capital, consumption and output is proportional to the rate of population growth. Parameters that reduce the steady state rate of economic and population growth are capital coefficient, child-rearing cost, technology and coefficient of relative risk aversion. Based on the dynamics of capital in the Ramsey model, the golden rule will be achieved when the initial value of the vector of the ratio between consumption and capital is maintained at 0.01.

Keywords: *population growth; economic growth; child-rearing cast; Indonesia.*

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Вільсон Раджагукгук

ЗРОСТАННЯ ЧИСЕЛЬНОСТІ НАСЕЛЕННЯ ЯК ЕНДОГЕННИЙ ФАКТОР ЕКОНОМІЧНОГО ЗРОСТАННЯ ІНДОНЕЗІЇ

У статті досліджено, яким чином чисельність населення країни впливає на її економічне зростання. Побудовано модель для оцінювання взаємозв'язку між темпом зростання населення та динамікою економічного розвитку, яка враховує теорію ендогенного зростання та принцип максимуму Понтрягіна. Доведено, що зростання чисельності населення та економічне зростання країни пов'язує між собою такий параметр, як витрати на виховання дитини. Результати аналізу вказують на те, що взаємозв'язок між дослідженими показниками можна вважати позитивним у разі, коли параметр видатків на виховання дитини менше за одиницю, взаємозв'язок стає негативним, коли параметр видатків на виховання дитини стає більше одиниці і нарешті взаємозв'язок не спостерігається взагалі, якщо даний параметр дорівнює одиниці. При цьому, зростання капіталу, споживання та виробництва також пропорційні зростанню кількості населення. Показники, що сповільнюють стабільне зростання економіки та населення – це коефіцієнт капіталу, витрати на виховання дитини, рівень технологічного розвитку та коефіцієнт уникнення відносних ризиків. Згідно моделі Рамзі, для динаміки розвитку капіталу "золоте правило" буде досягнуте, коли початкове значення вектора у відносинах між споживанням та капіталом буде підтримуватися на рівні 0.01.

Ключові слова: *зростання чисельності населення; економічне зростання; витрати на виховання дитини; Індонезія.*

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Вильсон Раджагукгук

РОСТ ЧИСЛЕННОСТИ НАСЕЛЕНИЯ КАК ЭНДОГЕННЫЙ ФАКТОР ЭКОНОМИЧЕСКОГО РОСТА ИНДОНЕЗИИ

В статье исследовано, каким образом численность населения страны влияет на её экономический рост. Построена модель для оценки взаимосвязи между темпом роста

[1] Universitas Kristen Indonesia, Indonesia.

населения и динамикой экономического развития, которая учитывает теорию эндогенного роста и принцип максимума Понтрягина. Доказано, что рост численности населения и экономический рост страны увязывает между собой такой параметр, как затраты на воспитание ребёнка. Результаты анализа указывают на то, что взаимосвязь между исследуемыми показателями можно считать позитивной в случае, когда параметр расходов на воспитание ребёнка меньше единицы, взаимосвязь становится отрицательной, когда параметр расходов на воспитание ребёнка становится больше единицы, и наконец взаимосвязь не наблюдается вовсе, если данный параметр равен единице. При этом, рост капитала, потребления и производства также пропорциональны росту населения. Показатели, замедляющие стабильный рост экономики и населения – это коэффициент капитала, затраты на воспитание ребёнка, уровень технологического развития и коэффициент избегания относительных рисков. Согласно модели Рамзи, для динамики развития капитала "золотое правило" будет достигнуто, когда изначальное значение вектора в соотношении между потреблением и капиталом будет поддерживаться на уровне 0.01.

Ключевые слова: *рост численности населения; экономический рост; затраты на воспитание ребёнка; Индонезия.*

Introduction. Today some European and Asian countries such as China, Hong Kong, Japan, South Korea and Singapore face a very serious problem for their economic revival because older population outnumbers young one. This demographic deficit has become a serious threat for economic revival in these countries. Demographic deficit may occur because of embracing Malthus assumption that considers population growth rate has negative impact on economic growth.

This study aims to investigate the relationship between population and economic growth. Previous studies have proposed that this association can be positive, negative or hove no relationship. This might imply that population is an exogenous factor of economic growth. This study examines whether population growth can be used as an endogenous factor of economic growth.

Literature review. There are three opinions about the relationship between population and economic growth. The first argues that the relationship is negative (Malthusian), while the second proposes that it is positive (Hayek, Phelps and Simon). F. Hayek (1988) argued that the fear of Malthusian – that is the fear of population surplus, is not realistic. E.S. Phelps (1968) asserted that the larger the population, the more the ideas can be developed. Idea can produce technology. If this technology is developed everywhere it can be imported and adopted by others almost without cost. That is why J. Simon (1996) argued that population growth is good. Further, I. Cohen (1995) proposed that environment carrying capacity change rate is proportional to population growth rate with Condorset parameter as its constant proportion rate. Therefore, the larger the population, the better the environment carrying capacity because of technological progress.

The effect of population growth rate on economic growth rate has been debated (e.g., Phelps, 1968 in Henderson, 2006; Simon, 1977; Hayek, 1988; Jones, 1995; Birdsall and Sinding 2001). Phelps (1968) and Jones (1995) argued that high economic growth in the past was caused by high population growth rate. Simon (1977) firmly stated that population growth is good. Meanwhile, F. Hayek (1988) proposed that population growth rate never affects economic growth rate. He stated that economic growth comes from external forces that change and give opportunity to labor division. Growth and development are the results of market advancement.

Ray (1988) and C. Portner (1996) assumed that population growth can have both positive and negative effect on economic growth. The influence can be positive as a result of an increased market size or scale effect, technological progress and increased labor force participation rate. The impact can be negative as a result of higher dependency ratio and increased capital and resources. Some impacts depend on a time frame. For example, fertility can have negative effect in a short run through greater expenditure for rearing and nurturing children and can be positive in a long run through great future human capital.

Problem statement and research objectives. This study aims to develop an interaction model between population growth and economic growth. Phelps (1968) stated that technological progress today is the results of high population growth in the past. E.S. Phelps (1968) in C. Jones (2001) even realized it and stated he missed Mozart because he forgot population growth in modeling economic growth. Later, M. Kremer (1993) gave reasons to support the importance of a deeper study the relationship between population and economic growth in particular, on a global scale. This study aims to model the relationship between population growth rate and economic growth rate. Specifically, we search to find long-run population growth rate and economic growth rate in Indonesia using the model.

Methods. The data used in this study are divided into two parts – economic and demographic data. Demographic data in 1980-1999 are obtained from the Statistics Indonesia and compilation by the Ministry of Finance of Republic of Indonesia (2008). The data consist of output, household and government expenditure and capital formation. Data used are gross domestic product at constant price (real GDP). Economic data for 1960-1981 are the results of calculation by (Sundrum, 1986). Meanwhile, capital stock data were obtained from the calculation by (Van Der Eng, 2008). The latter used data from the Statistics Indonesia to estimate the capital stock of Indonesia. Meanwhile, demographic data include the population of Indonesia from Bappenas et al. (2005). The yearly population produced was estimated using interpolation. The projection of population in 2035-2050 were downloaded from the United Nations (2009).

To develop an interaction model between population growth and economic growth, the enogeneous growth theory was employed using dynamics optimization method. This method uses the Pontryagin maximum principle (optimum control). Optimization is divided into two parts. The first part is to find the dynamic consumption growth rate using the Euler equation. The second part is to find the steady state growth rate. To find the dynamic growth rate, the Hamiltonian equation has been employed. Meanwhile, to find the steady state growth rate current-value Hamiltonian equation is used. The steady state growth rate is the function of parameters obtained in the model. Further, simulation was done with respect to steady state economic growth. In simulation, the parameters are changed to evaluate its impacts on optimal population and economic growth rate. The values of economic parameters were estimated using nonlinear genetic algorithm method with replication around 10,000 and 15,000 times.

Model Estimation. The purpose of a society is to maximize its welfare as follows:

$$W = \int_0^{\infty} e^{-\rho t} e^{nt} \frac{C^{1-\theta}}{1-\theta} dt \qquad (1)$$

subject to two capital dynamic constraints

$$\partial K(t)/\partial t = AK + BK^{\alpha}N^{\beta} - C - \delta K - bnK \quad (2)$$

and population dynamics

$$\partial N(t)/\partial t = n.N. \quad (3)$$

From equation 1, 2 and 3 the Hamiltonian equation can be made as follows.

$$H = e^{-(\rho-n)t}\frac{C^{1-\theta}}{1-\theta} + \lambda_K\left[AK + BK^{\alpha}N^{\beta} - \delta K - bnK - C\right] + \lambda_N\left[nN\right] \quad (4)$$

The results of optimization are as follows:

a. Dynamic consumption equation:

$$\frac{\dot{C}}{C} = \frac{1}{\theta}\left(A + \alpha BK^{\alpha-1}N^{\beta} - \delta - \rho\right) - \frac{(b-1)}{\theta}n; \quad (5)$$

b. Economic growth rate is proportional to population growth rate:

$$(1-\alpha)\dot{g}_K = \beta\dot{g}_N. \quad (6)$$

It can be seen from this model that it supports Jones (2001) in that economic growth rate is proportional to population growth rate.

c. The steady state of capital, consumption and output:

$$\dot{g}_K = \frac{\beta(\beta A - \beta\delta - \beta\rho + \alpha b\rho)}{\beta^2\theta + \beta b - \alpha b\theta\beta - 2\alpha b + 2\alpha^2 b} \quad (7)$$

d. The steady state population growth rate:

$$\dot{g}_N = \frac{(1-\alpha)(\beta A - \beta\delta - \beta\rho + \alpha b\rho)}{\beta^2\theta + \beta b - \alpha b\theta\beta - 2\alpha b + 2\alpha^2 b} \quad (8)$$

Key results

The Effects of Parameter Changes on Growth Rate. Using the determined benchmark for the parameters it was found that the economic growth rate is 0.063217, or 6.3% and population growth rate is 0.012643, or 1.2%. If the population growth rate of Indonesia in 2009 is estimated to be 1.13%, then in the simulation it is changed to predict its impact on the long-run optimum population growth rate and long run optimum economic growth rate. According to the conditions in 2009, therefore, the long run economic growth rate of Indonesia is 6.3%.

There is a probability that Indonesia's population growth rate will increase. From the aspect of capital coefficient in production process, the greater this figure the larger the population growth rate. If Indonesia's economy becomes more capital intensive, then population growth rate will decline.

The increase of population coefficient in the output function will increase the population growth rate. The economic growth rate and output per capita increases as the population growth grows respectively.

The child-rearing cost has impact on economic growth rate, population growth rate and output per capita growth rate. This parameter relates directly to population and economy and measures the expenditure spent by households on rearing children from childhood to adulthood. Becker (1991) proposed that time and opportunity

costs are included in this expenditure. An increase in child-rearing cost will reduce economic, population and output per capita growth rate.

Capital depreciation has positive effect on the growth rate of economic, population and output per capita. Meanwhile, the rate of time preference has negative influence on the growth rate of economic, population and output per capita. Further, the elasticity of inter-temporal substitution affects the growth rate of economic, population and output per capita negatively. Furthermore, technological progress relates negatively to the growth rate of economic, population and output per capita.

Conclusions and directions. Based on the simulation and analysis performed in the frame of steady state growth rate it is revealed that economic growth rate is proportional to population growth rate. If the steady state population growth rate increases, then the steady state economic growth rate also increases. This finding supports the hypothesis proposed by S. Kuznets (1960), Phelps (1968), J. Simon (1977), Boserup (1981) and Jones (1995). Therefore, it can be concluded that in Indonesia population growth rate influences economic growth rate positively.

The analysis results on the dynamic consumption growth rate employing Euler equation with the child rearing cost of 0.51 show that population growth rate has a positive effect on consumption growth rate. Therefore, to increase consumption growth rate Indonesia needs to keep population growth rate. The 1997-1998 economic crisis experience shows that in the situation where Indonesia's economy is not interesting for investment aggregate consumption can become a soft "pillow" for the country's economy avoiding a deeper crisis. Until today, Indonesia's large population has become the big market even for foreign investments.

The results of simulation indicate that the steady state economic growth rate of Indonesia is 6.3% per annum. This figure can be used as the long-run benchmark for consistent long-run economic growth for decision makers in their development planning for the country. A deviation from this figure is a short-run one. Therefore, the steady state growth rate will give direction to where Indonesia's economy should be pointed to.

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