

Population Growth, Transaction Efficiency And Economic Development In Selected Asian Countries*

Xiujian Peng
Department of Economics
Monash University
Victoria 3800, Australia

Paper presented at 2002 IUSSP Regional Conference on Southeast Asia's
Population in a Changing Asian Context held at Bangkok, Thailand, 10-13, June
2002

* The author is grateful to my two supervisors: Professor YewKwang, Ng and Professor Xiaokai Yang, my colleagues Dingsheng zhang, Tie Wang in Monash University, and Wei Chen in Australian National University.

Abstract:

The paper is devoted to test a new classical general equilibrium model developed by Xiaokai Yang. By using inframarginal analysis framework, which differs from the marginal analysis within neoclassical framework, Yang Model predicts the non-monotonous relationship between population size and per capita real income and the key role of transaction efficiency in determining the productivity progress. The paper shows that the prediction of Yang model is compatible with the empirical evidence. By comparing the experiences of economic growth in six Asian countries with several other developing countries, the paper found the further evidence to support the predictions of Yang model

Keywords: Yang new classical general equilibrium model, transaction efficiency, population growth, economic development

1. Introduction

Debates on the relationship between population growth and economic development have, since Malthus, been vigorous and contentious. In the second half of the twentieth century, the debate acquired special urgency as population growth reached rates higher than had ever been previously recorded in country after country. Given the exceptional complexity and diversity of the various impacts of rapid demographic change and rising population numbers, assessments of the consequences of the population explosion have varied widely, ranging all the way from the view that more population growth leads to more prosperity to forecasts that population growth would precipitate wide-ranging catastrophes (Birdsall and Sinding 1998), for example, Simon (1977) emphasized the positive effects of population growth and Ehrlich (1975) advocated the negative consequences of population growth. The range of views has spurred an outpouring research, much of it by economists and economic demographers. Allen Kelley (1998) traced the evolution of academic research on the significance of population growth for development, from alarmism to what he calls “revisionism”, to a more nuanced form of revisionist thought—from 1950s and 1960s population crisis mentality, to the 1980s view that population growth is a “neutral” phenomenon, to the contemporary view that population does matter.

Since 1970s, Economists explore the effects of population growth on economic development by using different economic methods. New Classical economics is a new frame to study the network effects of division of labour and various economic problems by using inframarginal analysis. My paper will test the predictions of the Yang new classical equilibrium model (Yang model), in which Yang emphasized that population growth has not direct effects on economic development, and a country’s labour productivity is determined by the level of specialization, which is determined by transaction efficiency. Improvement in transaction efficiency factors such as transaction efficiency or coordination efficiency will extend the division of labour and increase labour productivity. Due to the availability of data, in this paper, I only conduct correlation analysis to test the predictions of Yang-Ng Model. My test supports the maintained hypothesis.

The paper runs as following. Section two outlines the algebra and the empirical implications of Yang model, comparing with Solow model and DS model. Section three explains the indicators that measure transaction efficiency and reports the empirical evidence supporting the Yang model. Section four explores analyses the positive effects of improvement of transaction efficiency on economic growth and the role of population growth in the economic progress under the favourable institutional environment in selected Asian countries. The comparison analysis supplies further evidence to support Yang model. The final section concludes the paper.

2 Yang new classical general equilibrium model and its predictions on population and economic relations

Before the test of the predictions in the Yang new classical general equilibrium model (Yang model), I will briefly outline the algebra and its empirical implications.

2.1 New Classical Economics and inframarginal analysis

New classical economics is to apply inframarginal analysis to studies of network effects of division of labour and various economic problems associated with different features of the network pattern of division of labour. New classical economics is distinguished from neoclassical economics and marginal analysis by the following features:

1) In new classical economics, the notions of economies of specialization and network effects of division of labour are used to describe production conditions, while in neoclassical economics, the notion of economies of scale is used to describe production conditions.

2) There is no *ex ante* dichotomy between pure consumers and firms in new classical economics, while this dichotomy is the basis of neoclassical economics.

3) Transaction costs have important implications for the equilibrium topological properties of economic organism in new classical economics, while they may not have such implications in neoclassical economics.

4) In new classical economics, individuals' optimum decisions are always corner solutions and interior solutions can never be optimal. In neoclassical economics, by contrast, the interior optimum is the rule and the corner solution is the exception.

2.2 Yang new classical general equilibrium model

Yang new classical general equilibrium model was developed (Yang model) by professor Xiaokai Yang in 1993. Consider an economy with a continuum of *ex ante* identical consumer-producers of mass M . The self-provided amount of good i is x_i . The amount of good i sold in the market is x_i^s . The amount of good i purchased in the market is x_i^d . The transaction cost coefficient for a unit of goods bought is $1-k$. Thus, kx_i^d is the amount an individual obtains when he purchases x_i^d . The amount consumed of good i is thus $x_i^c \equiv x_i + kx_i^d$. The utility function is identical for all individuals:

$$(1) \quad u = \prod_{i=1}^m x_i^c$$

The system of production for each consumer-producer is

$$(2a) \quad x_i^p \equiv x_i + x_i^s = \text{Max} \{L_i - A, 0\} \quad i = 1, \dots, m$$

$$(2b) \quad \sum_i L_i = 1$$

where x_i^p is the output level of good i , L_i is an individual's level of specialization in producing good i and A is a fixed learning and training cost in producing each

good. This system of production displays economies of specialization for each individual in producing each good. For $L_i > A$, the average labour productivity, $(x_i + x_i^s)/L_i = 1 - (A/L_i)$, increases with an individual's level of specialization in producing good i , L_i . All individuals' production conditions exhibit economies of division of labour.

According to the Wen theorem an individual does not simultaneously buy and sell the same good; nor simultaneously buy and self-provide the same good; and she sells at most one good. This implies that the decision configuration of each consumer-producer who sells good i satisfies the following conditions.

$$(3) \quad \begin{aligned} x_i > 0, \quad x_i^s > 0, \quad x_i^d = 0, \quad L_i > 0 \\ x_r = x_r^s = L_r = 0, \quad x_r^d > 0, \quad \forall r \in R, \\ x_j, L_j > 0, \quad x_j^s = x_j^d = 0, \quad \forall j \in J \end{aligned}$$

where R is the set of $n-1$ goods that are purchased from the market, and J is the set of $m-n$ non-traded goods. In words, the conditions imply the following propositions: for good i that is sold, its self-provided quantity, its quantity for sale, and the level of specialization in producing it are positive while its quantity purchased is 0; for each good r that is purchased, its self-provided quantity, its quantity for sale, and the level of specialization in producing it are 0, while its quantity purchased is positive; for each non-traded good j , its quantity self-provided and amount of labour allocated to produce it are positive, while its quantities sold and bought are 0. According to these conditions, the decision problem of an individual selling good i can be specified as follows.

$$\begin{aligned} \text{Max: } u_i &= x_i^c \prod_{r \in R} x_r^c \prod_{j \in J} x_j^c = x_i \prod_{r \in R} kx_r^d \prod_{j \in J} x_j \\ \text{s.t. } x_i^p &\equiv x_i + x_i^s = \text{Max} \{ L_i - A, 0 \}, & (\text{production function for good } i) \\ x_j^c &= x_j^p \equiv x_j = \text{Max} \{ L_j - A, 0 \}, \forall j \in J & (\text{production function for good } j) \\ L_i + \sum_{j \in J} L_j &= 1 & (\text{endowment constraint for time}) \\ p_i x_i^s &= \sum_{r \in R} p_r x_r^d & (\text{budget constraint}) \end{aligned}$$

where p_i is the price of good i , $x_r^c \equiv kx_r^d$ and $x_i^c \equiv x_i$ are respective quantities of goods r and i that are consumed, $x_i, x_i^s, x_r^d, L_i, x_j, L_j, n$ are decision variables. Having inserted all constraints into u_i , we can express u_i as a function of L_i, L_j, x_i^s, x_r^d , and n . One of all x_r^d can be eliminated using the budget constraint, and one of all L_j can be eliminated using the endowment constraint for time. Hence, we can convert the original constrained maximization problem to a non-constrained maximization problem.

$$(4) \quad \text{Max: } u_i = x_i^c x_i^s \prod_r x_r^c \prod_j x_j^c = x_i kx_s^d \left(\prod_r kx_r^d \right) (L_i - A) \prod_j (L_j - A)$$

where $x_i^c = x_i = \text{Max} \{ L_i - A, 0 \} - x_i^s$

$$\begin{aligned} x_s^d &= (p_i x_i^s - \sum_r p_r x_r^d) / p_s & s, r \in R, s \neq r \\ L_t &= 1 - L_i - \sum_j L_j & t, j \in J, t \neq j \end{aligned}$$

The first order conditions for problem (4) yield

$$(5) \quad \begin{aligned} L_i &= A + n[1 - (m-n-1)A]/m \\ x_i^s &= (n-1)[1 - (m-n-1)A]/m \end{aligned}$$

$$x_i = x_j = [1-(m-n-1)A]/m, \quad L_j = [1-(m-n+1)A]/m,$$

$$x_r^d = p_{ir} x_i^s / (n-1) = p_{ir} [1-(m-n-1)A]/m, \quad \forall r \in R$$

where $p_{ir} \equiv p_i / p_r$. Inserting the solution into (4) yields the indirect utility function

$$(6) \quad u_i = \alpha\beta = u_i(n, A, k, p_{ir}),$$

where $\alpha \equiv \{[1-(m-n+1)A]/m\}^m$, $\beta \equiv (kp_i)^{n-1} (\prod_{r \in R} p_r^{-1})$.

(6) are *neoclassical optimum decisions for a given level of specialization*. Here, an individual's level of specialization in producing the good sold is uniquely determined by the number of traded goods n . The neoclassical optimum decision sorts out resource allocation for given prices and a given number of traded goods n .

Since the new classical optimum decision sorts out the optimum level of specialization that relates to n , the new classical optimum decisions are given by (6) and the following condition

$$(7) \quad (\partial u_i / \partial \alpha)(d\alpha / dn) = -(\partial u_i / \partial \beta)(d\beta / dn)$$

Since n can represent an individual's level of specialization in the symmetric model, the left hand side of the equation is the marginal utility of an individual's level of specialization. The right hand side is marginal transaction cost in terms of utility loss caused by an increase in an individual's level of specialization. Hence, (7) implies that the optimum level of specialization is determined by *equality between marginal benefit of specialization and marginal transaction cost*. (6) and (7) give the complete new classical optimum decisions, which sort out optimum organization as well as optimum resource allocation.

Since all of n traded goods are produced only if all occupations generate the same utility level for the *ex ante* identical individuals, the inframarginal analysis between configurations establishes the utility equalization conditions

$$(8) \quad u_1 = u_2 = u_3 = \dots = u_n$$

(7) and (8) are completely symmetric between configurations selling different goods. Hence, they hold at the same time only if

$$(9) \quad p_i = p_r \quad \forall i, r = 1, 2, \dots, n$$

And n is the same for all individuals. Using the information about the equilibrium relative prices of traded goods and the equilibrium number of traded goods, each individual's optimum decision can be solved as follows.

$$(10) \quad n = m + 1 - (1/A) - [m / \ln(kp_{ir})]$$

$$L_i = [1 - (\ln kp_{ir})^{-1} + (A-1)mA] / (-\ln kp_{ir})$$

$$x_i^s = A[m - (1/A) - (m / \ln kp_{ir})] / (-\ln kp_{ir})$$

$$x_i = x_j = -A / (\ln kp_{ir}) \quad j \in J$$

$$x_r^d = p_{ir} A / (-\ln kp_{ir}) \quad \forall r \in R$$

$$u_i = (kp_{ir})^{m-(1/A)-(m/\ln kp_{ir})} [1 + (1/A) + (m / \ln kp_{ir})] / m$$

where $p_{ir} \equiv p_i / p_r$ is the price of a good sold in terms of a good purchased. Since the optimum values of all decision variables are no longer functions of n , they are called *new classical optimum decisions*, which differ from the neoclassical optimum decisions in (6). The distinction between the neoclassical decisions and the new classical decisions formalizes Young's idea that demand and supply are two sides of specialization. The optimum decisions that generate individuals' demand and supply are ultimately determined by the optimum level of specialization, n .

Next is the situation of General equilibrium of Yang-Ng model. Assume that the numbers of individuals selling goods i and r are respectively M_i and M_r . The *total market supply* of good i is $M_i x_i^s$. The market demand for good r by individuals selling good r is $M_r x_r^d$. The *total market demand* for good i is then $\sum_{r \in R} M_r x_r^d$. The market clearing conditions are thus

$$(11) \quad M_i x_i^s = \sum_{r \in R} M_r x_r^d, \quad i=1, 2, \dots, n$$

This system comprises n equations. One of them is independent of the other $n-1$ due to Walras' law. The $n-1$ equations and the population equation $\sum_i M_i = M$ determine the numbers of individuals selling n traded goods. The market clearing conditions, together with the utility equalization condition (8), yield the final solution of the general equilibrium

$$(12) \quad \begin{aligned} L_i &= [1 - (\ln k)^{-1} + (A-1)/m] mA / (-\ln k), \\ x_i^s &= aA [m - (1/A) - (m/\ln k)] / (-\ln k), \\ x_i &= x_r^d = x_j = -aA / \ln k, \quad \forall r \in R, \quad \forall j \in J \\ p_{ir} &= 1, \quad M_r = M/n, \quad \text{for } r = 1, \dots, n \\ u_i &= k^{r-1} a [1 - (m-n+1)A] / m, \quad \text{for } i=1, \dots, n \\ n &= m+1 - (1/A) - (m/\ln k) \end{aligned}$$

where $i = 1, 2, \dots, n$. The equilibrium value of utility can be considered as the *absolute price of labour*. $u_i(n)$ in (12) was called the *organization utility function*, which is a function of the number of traded goods, and which relates to an individual's level of specialization and the level of division of labour for society.

Since to choose a structure of division of labour is also to choose a certain network of transactions, many economic phenomena can be generated by inframarginal comparative statics of the general equilibrium as different aspects of the size and structure features of the network of division of labour. Differentiation of the equilibrium value of n in (12) yields

$$(13) \quad \frac{dn^*}{dk} > 0 \quad \frac{dn^*}{dA} > 0$$

This implies that the equilibrium level of division of labour increases as transaction efficiency is improved or as the fixed learning cost increases.

Applying the envelope to u in (12) with respect to parameter k and A yields

$$(14) \quad \frac{du}{dk} = \frac{\partial u}{\partial k} > 0, \quad \frac{du}{dA} = \frac{\partial u}{\partial A} < 0.$$

(14) implies that there are two different ways to increase the equilibrium level of division of labour. The first is to improve transaction efficiency and the second is to increase the fixed learning cost of each activity. The first approach increases while the second decreases per capita real income as they raise the level of division of labour. The country may relate the first method to the development of an efficient banking system, improvement of the legal system, government liberalization policies, and urbanization, all of which reduce the transaction costs coefficient $1-k$. The country also can relate the second method to a stiff license fee and other entry barriers that decrease per capita real income and increase the equilibrium level of division of labour.

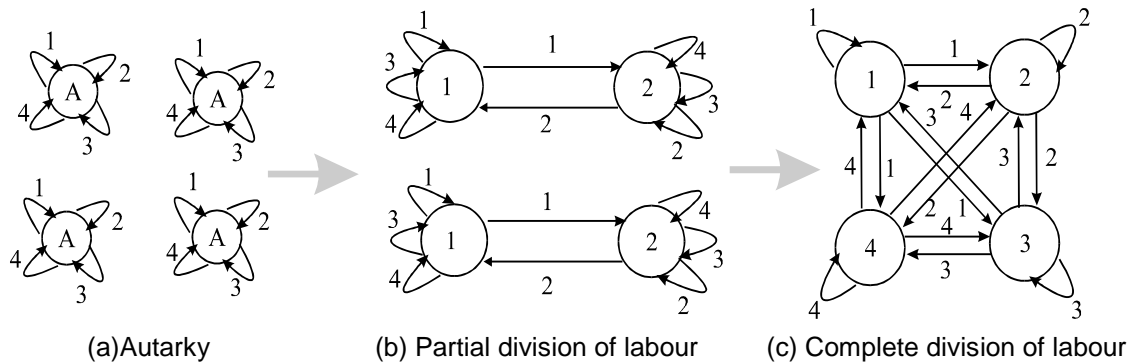


Figure 1: Exogenous Evolution in Division of Labour

Figure 1 gives an intuitive illustration of the inframarginal comparative statics of general equilibrium where the number of goods and the population are assumed to be 4. The lines denote goods flows. The small arrows indicate the directions of goods flows. The numbers beside the lines signify the goods involved. A circle with the number i denotes a person selling good i . Panel (a) illustrates the case of autarky, where each person self-provides 4 goods, due to an extremely low transaction efficiency. Panel (b) shows how an improvement in transaction efficiency leads to partial division of labour, where each person sells one good, buys one good, trades two goods, and self-provides three goods. Panel (c) shows how a very high trading efficiency results in complete division of labour, where each person sells and self-provides one good, buys three goods, and trades four goods.

2.3. The predicts of Yang new classical general equilibrium model

The main predicts of Yang Model on the relationship between population and economic growth is that there is a non-monotonous relationship between population size and per capita real income. Yang Model can explain both positive and negative population and economic relations. Population size itself cannot explain productivity, what determine productivity is the level of division of labour, which is determined by transaction efficiency.

Let E denote the *extent of the market*; then E equals the product of population size and per capita aggregate demand. *An individual's aggregate demand* is the total demand of that individual for all traded goods. *Market aggregate demand* is the sum of all individuals' aggregate demand for all traded goods. From (5) and (12), the extent of the market can be calculated as follows.

$$(15) \quad E = M x_i^s = M (n-1)[1 - (m - n + 1)A] / m$$

$$dE / dk = (dE / dn)(dn / dk) > 0$$

(13) and (15) implies that the equilibrium extent of the market and the equilibrium level of division of labour increase concurrently as transaction efficiency is improved. Smith (1776) proposed the conjecture that the level of division of labour is determined by the extent of the market, which is in turn determined by transaction efficiency. Some economists have misinterpreted this as meaning that division of labour is determined by the size of an economy (population size or resource size). Young (1928) criticized this interpretation. According to him, the extent of the market is determined not only by population size, but also by per capita effective demand, which is determined by income, which is determined by productivity, which is in turn determined by the level of division of labour. In Yang new classical general equilibrium model, the equilibrium level of division of labour and the equilibrium extent of the market are two sides of the equilibrium size of the market network. They are simultaneously determined by transaction efficiency. The driving force of the mechanism is, of course, the trade off between economies of division of labour and transaction costs (Yang 1991b).

By comparing the predictions of Solow Model and D-S model on the relationship between population growth and economic development with Yang Model, we can further understand Yang Model. The famous economic growth model, "Solow Model" with constant returns to scale predicts that an increase in population will have a negative impact on economic growth and productivity progress. Countries that have high savings/investment rates will tend to be richer if all other things are equal. Such countries accumulate more capital per worker have more output per worker. Countries that have high population growth rate, in contrast, will tend to be poorer. According to the Solow model, a higher fraction of savings in these economies must go simply to keep the capital-labour ratio constant in the face of a growing population. This capital-widening requirement makes capital deepening more difficult, and these economies tend to accumulate less capital per worker. Emphasizing on the major role of capital in the economic growth, Solow model describes the negative effects of population growth on economic growth. But this prediction of the Solow model doesn't well hold up the empirical evidence.

In contrast, another neoclassical model: D-S model predicts that an increase in population size has positive implications for economic development because of economies of scale. The Dixit and Stiglitz developed a new trade model (the D-S Model 1977) to endogenize the number of consumption goods by specifying the trade-off between economies of scale and consumption variety. The prediction of D-S model is referred to as *type II scale effect*. Meanwhile, the Romer model also

has a type II scale effect, which means a country with a larger population size grows faster than a smaller country. Even though type II scale effect is consistent with the data of the early economic development of the US, Australia, and New Zealand, and with Hong Kong's data after World War II, it is incompatible with the situation of India and pre-reform China. India did not have a high growth rate of per capita income until the recent reform period, despite its large population size. This was true too for pre-reform China. And Jones (1995a, b), Dasguptal (1995) and National Research Council (1986) reject the type II of scale effect on the grounds of empirical evidence.

Yang model can explain both positive and negative population and economic relations because of the increasing returns to scale and specialization. Population size cannot have positive impact directly on productivity (Yang, 1993). Productivity is determined by labour division, which is determined by transaction efficiency. When transaction is low, even if population size is very large, the large population will be divided into unconnected sectors, so productivity is also low (Yang 1993). This is consistent with the non-positive population impact on economy in India and in China before the reform. Meanwhile, the low transaction efficiency in many African countries explains the low growth rate of per capita real income that coexists with high population growth. When transaction efficiency is high, the large population will be useful to high labour division, the divided local market will become an integrated one, so productivity will increase (Yang 1993). Hence, high transaction efficiency, due to a good legal system, explains productivity progress in Hong Kong, the US, and Australia after the second world war, where population growth passively provides more scope for evolution in division of labour (the number of different occupations cannot exceed population size). The new classical theory about the relationship between population growth, transaction efficiency, and growth in per capita real income and productivity fits empirical observations much better than the D-S model and Solow model.

Furthermore, in a new classical model, productivity progress and the emergence of new goods and technology in equilibrium can be achieved by the merging of many separate local communities into an increasingly more integrated network of division of labour, even if the population size in fixed (Yang 1993). Hence, new classical models do not have a scale effect, which is rejected by empirical evidence. But they do have network effects, which are supported by empirical evidence (Kelly 1997 and Chen, Lin, and Yang 1997).

Thirdly, population growth can become favourable to deepening the division of labour under the favourable institutional environment. Yang model criticizes the pessimistic views on the population growth. Therefore, population policy is not the key to economic development, the key is establishing effective legal system and providing favourable institutional environment and improving transaction efficiency.

3. The correlation analysis supporting the Yang Model

New classical economics has a totally different analytic framework with mainstream economics--neoclassical economics. The present statistic system is based on the neoclassical economics, in which many concepts are different with new classical economics, so there are a lot of problems that need to be solved for testing new classical model, including data processing and obtaining data from indirect estimation. Transaction efficiency is the most important and creative variable in Yang Model, but how to exactly measure transaction efficiency and how to exactly choose suitable measure indicators of transaction efficiency are the biggest challenge to test Yang model.

3.1 Data and measurement variables

In this paper, communication efficiency, transportation efficiency, and governance efficiency are three major factors of transaction efficiency. This research uses a cross-country data set including more than 100 countries for 1998. The data source is *World Development Indicators* published by World Bank. The level of transportation efficiency is measured by the air freight million ton-km. The level of communication efficiency is measured by the number of Internet hosts per 10,000 people, and the dimension of governance efficiency is measured by rule of law and government efficiency.

3.2 the correlation analysis on Yang model

Lio and Liu (2002) found that both transportation efficiency and communication efficiency have significant direct impacts on the division of labour and indirect impacts on labour productivity by utilizing a confirmatory factor analysis and structural equation modelling procedure. World Bank's (1999) empirical results show a strong positive causal relationship from improved governance to better development outcomes. These two empirical studies support the prediction of Yang model: improvements in transaction efficiency factors will extend the division of labour and promote productivity progress. This paper will further test the predictions of Yang by using simple correlation analysis, but the paper will mainly focus on the prediction of relationship between population growth and per capita real income.

First, Let us observe the relationship between population and economic growth by plotting the per capita real GNP against government efficiency (one of indicators of transaction efficiency) and against population size, respectively. Broadly speaking from figure 2 and figure 3, the prediction of the Yang model is borne out by the empirical evidence. The data from 120 countries in the world shows that countries with high government efficiency tend to be richer on average than countries with low government efficiency, but countries with large population size haven't the tendency to be poorer or richer on average than

countries with small population. This means that the population size has no correlation with per capita real GNP.

Meanwhile, using the data from 120 countries, we found the correlation coefficient between government efficiency and per capita real GNP is 0.825, which means the two variables are highly correlated. But the correlation coefficient between population size and per capita GNP is only -0.027, which means there is no relative between population size and per capita real GNP.

Second, we try to find the relationship between population growth and economic development by comparing the average annual population growth rate against the rate of the average annual per capita GNP growth. Figure 4 plotted the average annual population growth rate between 1965 and 1998 against the rate of average annual per capita GNP growth from more than 100 countries. From figure 4, we can't find the correlation between the two variables. The correlation coefficient between population growth and economic growth is -0.30, which is not significant. Therefore, from both the figure and correlation analysis, we can't find any positive and negative relationship between the rates of population growth and per capita GNP growth.

Third, we can further test the predictions of Yang model by analysing the relationship between population density and per capita GNP growth rate. Figure 5 plotted the population density against the rate of average annual per capita GNP growth from 1965 to 1998. From the figure, we can't find that countries with high population density have the tendency to be richer or to be poorer. There is no correlation between each other.

Furthermore, we can select some typical countries to make a comparison analysis. We ignore the middle income countries in the world and only consider the high income countries and low income countries, Meanwhile, In order to make the result more acceptable, we didn't consider some of the African countries where large amount of areas are not suitable for human being's living and producing. We divide all the typical countries into following four types (see table 1):

1) Type I: The countries with low population density and high per capita real GNP, such as Australia, Canada, Finland, Norway, Sweden, New Zealand, and United States. These countries proudly own large amount of rich natural resources, but their total population is very small. Australia and Canada only have 2 and 3 people per km², respectively, And United States only has 30 persons per km², but all these countries are the richest countries in the world.

2) Type II: The countries with high population density and high per capita real GNP, such as Netherlands, Belgium, Germany, Japan, Singapore, and United Kingdom. As shown in table 1, Hong Kong and Singapore, with the highest population density in the world, have very per capita income. The per capita GNP

of these two countries in 1998 are US\$23660 and US\$30170, respectively. Other developed countries, such as Netherlands, Belgium, and Germany, also suffer high population density, but own very high income.

3) Type III: The countries with high population density and low per capita real GNP, such as Bangladesh, India, Haiti, Rwanda, Vietnam and Burundi. With 965 people per km², Bangladesh is the poorest country in the world and its per capita GNP in 1998 is only US\$350.

4) Type IV: The countries with low population density and low per capita GNP, such as Nicaragua, Guinea, and Honduras. The natural condition in these countries is similar with North America and the population density is very low, but they are poorest countries in the world. As shown in table one, there are only 39 people per km² in Nicaragua, but its per capita GNP in 1998 is only US\$370.

We further notice in the table 1, that the higher the transaction efficiency in the countries, the higher the income level. On the contrary, the countries with low transaction efficiency are very poor. This comparison between four types seems further confirm the predictions of Yang model: there is a non-monotonous relationship between population size and per capita real income. Population size itself cannot explain productivity, what determine productivity is the transaction efficiency. High transaction efficiency can explain the high real income and high productivity.

4. Effects of transaction efficiency and population growth on economic growth in selected Asian countries

East Asian economies grew at unprecedented rates between 1960 and 1990. Eight of them in particular were highly successful: Japan, South Korea, Taiwan, Singapore, Hong Kong, Thailand, Indonesia, and Malaysia (World Bank, 1993a). China has also been experiencing dramatically economic growth since 1978 and continue to keep its high growth rate until now. The literature suggests that rapid increase in physical capital, human capital, and employment played the critical role in these countries' success. In this paper, I will explore the role of the improvement of transaction efficiency in the Asian miracle and the effects of population growth on Asian economic growth. Because of the data limitation, the paper will not consider Indonesia and Malaysia.

Table 2 summarized the rapid growth in real GDP per capita achieved by the six highly successful economies. For comparison, Table 2 also presents the growth rates for several other major developing countries. We can draw two major features from table two. First, average annual growth rates were exceptionally high in the six Asian countries from 1960 to 1990. Growth was especially rapid in the newly industrializing economies—Hong Kong, South Korea, Singapore and Taiwan---in excess of 6 percent per annum. Second, the growth rates for these East Asian economies remained, in general, consistently

high over time. Such sustained growth has not been true for most developing countries.

Table 2 also show another feature of the six Asian economies. The indicators of transaction efficiency, including rule of law, government efficiency, Internet host, air freight. All these indicators are also very high in the six Asian economies; exclude Thailand, comparing with other developing countries (Because of the difficulties to collect historical data on transaction efficiency, we only use the data for 1998 to show the level of transaction efficiency in these countries).

There are several reasons for the high level of transaction efficiency in these Asian economies. Firstly, The high rates of saving and investment, which have stimulated the development of transport and communication infrastructure, is one of the reasons of high level of transaction efficiency in these Asian countries. Table 3 is the gross domestic saving rate in the six Asian countries. Secondly, East Asian governments has adopted stable macroeconomic policies and provided political stability, secure property rights, and good industrial relations in order to create favourable investment climate, but all these government policies simultaneously contributed on the reduction of transaction cost and progress of productivity. The World Bank (1998) considers the political stability as one of six indicators of governance efficiency and empirically validated that policy stability is highly correlated with real income. Yang (1996) argues that all stable macroeconomic policies and good legal system are favourable to the improvement of transaction efficiency. Thirdly, Expanding in the economic liberties and decline in the trade tariff in these Asian countries also dramatically improved the transaction efficiency.

Because of good legal system and high transaction efficiency, the highest population density in Japan, Hong Kong, Singapore, and Taiwan become favourable to deepening labour division, which promote the productivity progress. Table two also suggest another two observations. First, the population density in these Asian countries is very high, Hong Kong and Singapore, for example, have the highest population density in the world. There are 6755 and 5186 people per km² in Singapore and Hong Kong, respectively. The population density in Taiwan, Japan, and South Korea are also very high, when compared with other developed and developing countries. Second, even though the population growth rate per annual is lower than other developing countries, but the rate of labour force growth is almost the same as other developing countries, especially in Singapore, the average annual rate of labour force is 3.1 from 1965 to 1998. These two features in population suggest that high population density and rapid labour force growth at least not impede the economic progress in these countries. In contrast, some scholars argue that the rapid growth of labour force is one of the important reasons for the Asian miracle. And several empirical studies suggest that population growth has very small effects on economic growth, but in some period and some favourable conditions, the effects are

significantly positive, especially the effects population density if we consider the situation of increasing returns to scale and specialization economy (Gale, 1999). Increasing returns to scale, labour division and specialization are the characteristics of Yang new classical trade model.

Compared with the six Asian Economies, the transaction efficiency in the other developing countries are very low, especially in Bangladesh and India. Even though the population density in these two countries are also very high, but the average rates of economic growth are very low, which are 1.26 and 1.67, respectively. Low government efficiency, lack of legislation and backward transport and communication infrastructure can't reduce the high transaction cost. Under this unfavourable transaction environment, the transaction efficiency is low and the large population is divided into unconnected small local markets, so there are no advantages of population for labour division. High population density leads to low level of division of labour and low productivity.

From the comparison of different experiences of economic growth from 1960 to 1990 between six Asian countries and several other developing countries, we found that population size itself cannot explain productivity, what determines productivity is transaction efficiency. But with high transaction efficiency, high population density becomes favourable to deepening labour division, which will lead to high productivity. Therefore, population policy is not the key to economic development, the key is establishing effective legal system and providing favourable institutional environment and improving transaction efficiency. Furthermore, the pessimistic views on the population growth are critical because population growth can provide more scope for evolution in the division of labour under favourable institutional and transaction conditions.

5. Conclusion

Using the simple correlation analysis, we have found empirical evidence to support the non-monotone relationships between population size and per capita real GNP. Comparing the experiences of economic growth in six Asian countries with several other developing countries, we have found the further evidence to support the predictions of Yang model. By testing Yang model, the paper criticizes the pessimistic views on the population growth and support Yang's predictions that population size itself cannot explain productivity, what determine productivity is the level of division of labour, which is determined by transaction efficiency. With the favourable institutional environment and high transaction efficiency, Population growth can provide more scope for evolution in the division of labour, which will lead to productivity progress. For the government, population policy is not the key to economic development, the key is establishing effective legal system and providing favourable institutional environment and improving transaction efficiency.

References:

- Andrew Mason, Population change and economic development in Asia, Stanford University Press, 2001
- Allen C. Kelley (1995). "Aggregate population and economic growth correlations: the role of the components of demographic change", Demography, Vol.32, No.4, November 1995.
- Charles I. Jones (2001), Introduction to economic growth, W.W. Norton & Company Ltd.
- D.Gale Johnson (1999), "Population and economic development", China Economic Review 10 (1999) 1-16.
- Daniel Kaufmann, Aart Kraay and Pablo Zoido-Lobaton (1999), "Governance matters", Policy Research Working paper 2196, World Bank.
- Dasgupta, Partha (1995), "The Population Problem: Theory and Evidence", Journal of Economic Literature, 33, 1879-1902.
- Dixit, A. and Stiglitz, J. (1977), "Monopolistic competition and optimum product diversity", American Economic Review, 67, 297-308.
- Monchi Lio and Meng-chun, Liu (2002), "Empirically validating Adam Smith's theory of division of labour with structural equation modelling", the paper presented to the workshop in the Department of Economics, Monash University.
- Nancy Birdsall, Allen C.Kelley and Steven W. Sinding (2001), Population Matters, Oxford University Press.
- National Research Council (1986), Population growth and economic development: policy questions. Washington, DC, National Academy of Science Press.
- Smith, A.1776, An inquiry into the nature and the cause of the wealth of nation.
- Stephen Knack and Philip Keefer (1995), "Institutions and economic performance: Cross-Country tests using alternative institutional measures", 1995, Economics and Politics, Volume 7.
- Yang, X. and Yongsheng, Zhang (2001), "Tests of Scale effects predicted by the Dixit-Stiglitz model", paper presented to International Symposium of Economics of e-Commerce and Networking Decisions at Monash University, 2001.
- Yang, X. and Borland, J. (1991b), "The evolution of trade and economic growth", Mimeo, University of Melbourne.
- Yang, X. (2001), Economics, Balckwell, 2001.
- Yang, X. and Ng, Y-k. (1993), Specialization and economic organization, Amsterdam: North Holland, 1993.
- Young, Allyn (1928), "Increasing returns and economic progress", The Economic Journal, 38, 572-42.

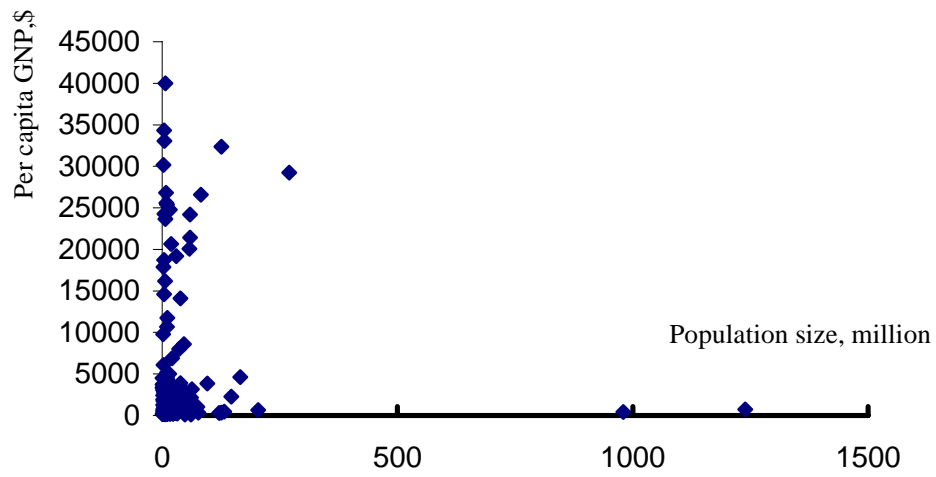


Figure 2: Per Capita GNP versus population size

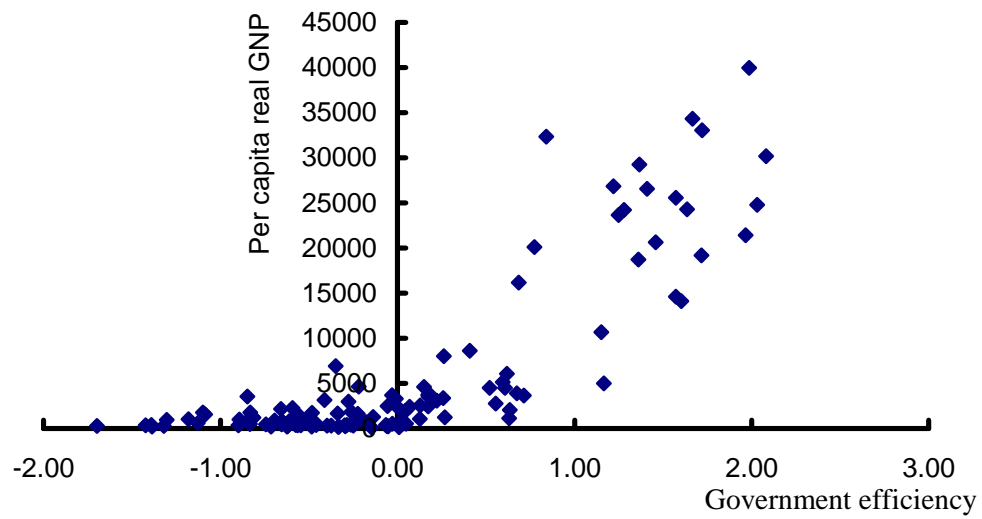


Figure 3: Per Capita GNP versus Government Efficiency

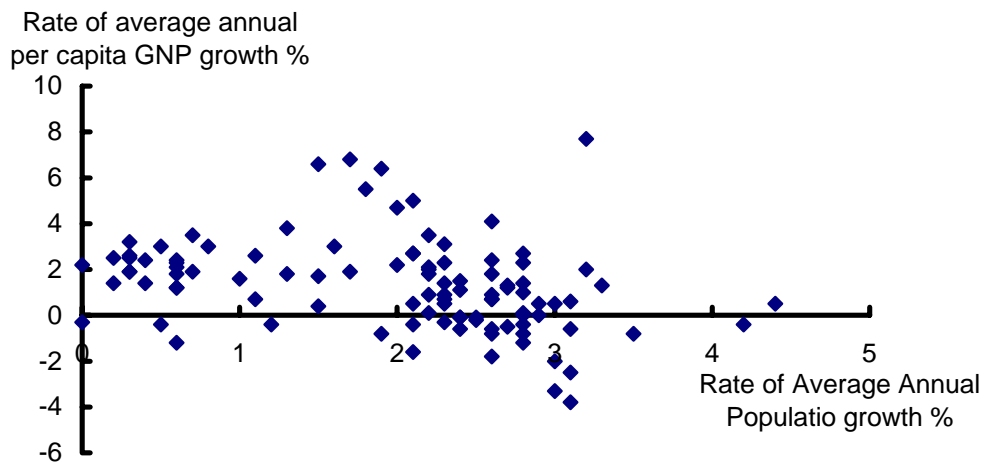


Figure 4: Average annual population growth rate versus average
The rate of annual per capita GNP growth from 1965 to 1998

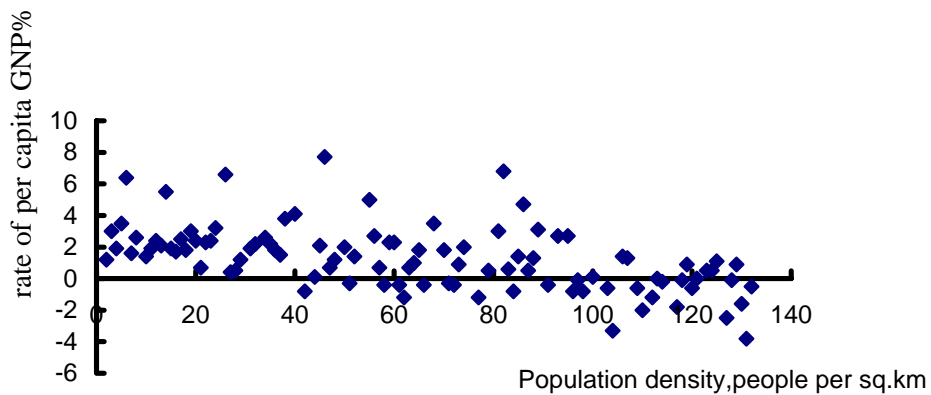


Figure 5: population density and average annual
Per capita GNP growth rate from 1965 to 1998

Table1: Country types with different Population density and income

Type	Population Density People Per sq.km 1998	GNP Per Capita \$, 1998	Rule of Law 1998	Government efficiency 1998	Internet hosts Per 10,000 People	Airfreight Million Ton-km 1998
Type I: Low Population Density, High Per Capita Income						
Australia	2	20640	1.60	1.46	477.85	1904
Canada	3	19170	1.55	1.72	422.97	1806
Finland	17	24280	1.74	1.63	1116.78	276
Norway	14	34310	1.83	1.67	754.15	203
New Zealand	14	14600	1.82	1.57	476.18	826
Sweden	22	25580	1.62	1.57	581.47	294
United States	30	29240	1.25	1.37	1508.77	25756
Type I: High Population Density, High Per Capita Income						
Belgium	311	25380	0.80	0.88	266.90	473
Hong Kong	6755	23660	1.33	1.25	142.77	4185
Japan	336	32350	1.42	0.84	163.75	7514
Germany	235	26570	1.48	1.41	173.96	6242
Netherlands	463	24780	1.58	2.03	403.49	3833
Singapore	5186	30170	1.94	2.08	322.30	4714
United Kingdom	244	21410	1.69	1.97	270.60	4663
Type III: High Population Density, Low Per Capita Income						
Bangladesh	965	350	-0.93	-0.56	0.00	141
Burundi	255	140	-0.88	--	0.00	0
Haiti	277	410	-1.50	-1.23	0.00	0
India	330	440	0.16	-0.26	0.18	531
Rwanda	329	230	-1.20	--	0.00	--
Vietnam	235	350	-0.44	-0.30	0.00	96
Type IV: Low Population Density, Low Per Capita Income						
Guinea	29	530	-0.76	-0.03	0.00	1
Honduras	55	740	-0.90	-0.41	0.19	--
Nicaragua	39	370	-0.73	-0.55	2.21	8
Paraguay	13	1760	-0.70	-1.10	2.43	0

Sources: World Bank, Governance data, 1998, *World Development Indicators, 2000*

Table2: Average Annual Economic growth in per capita GDP (AAEG), 1960-90, Average Annual population growth (AAPG) and labour force growth (AALF), 1965-1998, Population Density and Transaction Efficiency, 1998

Country	AAEG 1960- 90 %	AAPG 1965- 98 %	AALG 1965- 1998 %	Population Density People Per sq.km 1998	Rule of Law 1998	Government efficiency 1998	Internet hosts Per 10,000 People	Airfreight Million Ton-km 1998
Selected East Asian Countries								
Japan	5.26	0.7	1.0	336	1.42	0.84	163.75	7514
South Korea	6.66	1.5	2.6	470	0.94	0.41	55.53	7290
Taiwan	6.20	--	--	619	--	--	--	--
Singapore	6.52	1.9	3.1	5186	1.94	2.08	322.30	4714
Hong Kong	6.29	1.8	2.6	6755	1.33	1.25	142.77	4185
Thailand	4.45	2.1	2.6	120	0.41	0.01	4.49	1522
Comparison Countries								
Egypt	2.87	2.2	2.4	62	0.13	-0.14	0.28	255
Brazil	2.73	2.0	2.9	20	-0.22	-0.22	18.45	1714
Mexico	2.40	2.4	3.3	50	-0.47	0.18	23.02	278
Nigeria	1.87	2.9	2.7	133	-1.10	-1.32	0.00	8
India	1.67	2.1	2.0	330	0.16	-0.26	0.18	531
Philippines	1.47	2.6	2.9	252	-0.08	0.13	1.29	363
Bangladesh	1.26	2.3	2.3	965	-0.93	-0.56	0.00	141

Sources: World Bank, *Policy Research working paper, World Development Indicators, 2000,*

Table 3: Gross Domestic Savings as a Percentage of GDP: Six Asian Countries, 1960-93

Country	1960	1965	1970	1980	1993
Japan	34	28	40	31	33
South Korea	1	8	15	23	35
Taiwan	18	21	26	32	28
Singapore	-3	10	18	30	47
Hong Kong	6	29	25	24	31
Thailand	14	19	21	22	36

Sources: For all countries except Taiwan, World Bank, *World Development Report.* For Taiwan, ROC CEPD, Taiwan Statistical Data Book