

T

The Population Debate in Growth Theory: A Survey

ข้อถกเถียงเกี่ยวกับประชากรในทฤษฎี
การเจริญเติบโตทางเศรษฐกิจ: การสำรวจ

- **Frederic Tournemaine, Ph.D.**
- School of Economics
- University of Chicago-UTCC Research Center
- University of the Thai Chamber of Commerce
- E-mail: frederic.tournemaine@uc-utcc.org

บทคัดย่อ

บทความชิ้นนี้ได้สำรวจประเด็นในงานวิจัยทางเศรษฐศาสตร์ที่ศึกษาความสัมพันธ์ระหว่างการเพิ่มของประชากรและการพัฒนาทางเศรษฐกิจ ซึ่งชี้ให้เห็นว่าในปัจจุบันยังไม่มีฉันทามติเกี่ยวกับความสัมพันธ์ระหว่างตัวแปรทั้งสอง โดยงานวิจัยทั้งเชิงทฤษฎีและเชิงประจักษ์ ต่างพบว่า ค่าสหสัมพันธ์ระหว่างการเพิ่มของประชากรและการพัฒนาทางเศรษฐกิจนั้นอาจเป็นได้ทั้งบวกและลบ ผู้เขียนเห็นว่ามุมมองที่เป็นกลางจะช่วยผลักดันข้อถกเถียงเกี่ยวกับประชากรไปในทิศทางที่เป็นประโยชน์ต่อการวิจัยในอนาคต

คำสำคัญ: การเพิ่มของประชากร การพัฒนาทางเศรษฐกิจ

Abstract

This paper surveys issues from the relevant economic literature dealing with the relationship between population growth and economic development. As this paper makes clear, there does not exist a clear consensus regarding the relation between these two variables: both empirical and theoretical studies suggest either a positive or a negative correlation. We conclude that embracing such a balanced perspective will certainly place the population debate on a firmer and more productive direction for future research.

Keywords: Population Growth, Economic Development

Introduction

The idea that people's standard of living can continue to grow over-time along with an increasing population causes a continuing debate in economic literature. It is sometimes argued that the "rise of population number" is probably the most influential socioeconomic phenomenon since 1798 when Malthus stated the "population debate" alive. The debate centres around the exact sign and magnitude of the effects of population growth on economic development. Kelley (1988: 1685-1728), Ehrlich and Lui (1997: 205-242) discuss the empirical and theoretical literature dealing with the connections between population and economic growth. It looks like a complete agreement about the consequences of population on income per-capita growth has not emerged. For example, the cross-country studies of Barro (1991: 407-443), Mankiw, Romer and Weil (1992: 407-437) show that a larger population is harmful for economic development. The reason is that it leads to a dilution of available resources in the economy. In growth theory, this kind of effect is captured in a simple way in the basic exogenous growth literature (Cass, 1965: 233-240; Koopmans, 1965: 225-300; Solow, 1956: 65-94), and further extended to include endogenous fertility choices (Barro and Becker, 1988: 1-25; 1989: 481-501). In contrast, Boserup (1965), Simon (1981;

1992), and Lee (1988: 265-288) who are among the advocates of the "population push hypothesis" argue that population growth is beneficial to economic development because technical progress being non-rival, the cost of inventing new technologies is independent on the number of individuals who use it. As a consequence, a larger population can stimulate the rate of technological progress and the rate of income growth.

The goal of this paper is to survey the literature dealing with the relationship between population growth and economic development in order to shed some light on the debate depicted above. The main questions that economists want to answer are the following: What is the net impact of rapid population growth on the pace and structure of economic development? What are the key engines that promote long-run self sustained economic growth? How does the demographic change interact with other variables to affect economic growth? In this paper, we attempt to answer these questions in reviewing both the empirical and theoretical literature treating these questions.

As this paper makes clear, both the pessimistic and optimistic theories regarding the impact of population on economic development are in fact one different side of the same story. Such a notion comes within

the scope of the “revisionist interpretation” of Malthusianism in the sense that depending on the country, population growth may contribute, deter or even have no impact on economic development. This ambiguous result is explained by the fact that the effects of population growth change over-time. For example, a higher fertility rate can have a short-term negative effect caused by the cost of expenditures on children whereas it has a long-run positive effect through the larger labour force it generates (Crenshaw, Ameen, and Christenson, 1997: 974-984). From a theoretical point of view, it is argued that, among other things, population growth can affect growth through the channel of various variables in the economy, namely technical progress and human capital which are themselves key ingredients for long-term economic growth.

The remainder of this paper is organised as follows. In Section 2, we describe the evolution of the debate regarding the relationship between population growth and economic development from an empirical perspective. In Section 3, we explain how population growth has been formalised in theoretical models to explain empirical facts. We conclude in Section 4.

Arguments and Debates on the Effects of Population Growth

1. The Malthusian Theory

The first and most well-known theory analysing the relationship between population and economic growth is due to Malthus (1798). There are two important elements in Malthus’ framework. The first one is the existence of some factors, such as land, which is in fixed supply, implying decreasing returns to scale for all other factors. The second one is the positive effect of living standard on the population growth rate. In such a framework, Malthus argued that food production could not keep up with population growth in an unchecked fashion. The reason is the following. When the size of the population is small, people’s living standard is high, which in turn may cause population growth. However, a larger population will have a negative impact on the living standard, which should be followed by a reduction of the population growth through intentional reduction of fertility and/or apparition of disease and malnutrition.

Malthus’ theory, though it appeared attractive from a theoretical point of view, has rapidly shown its limits. The reason is

that simultaneous with the publication of Malthus' theory, countries such as United Kingdom, United States, France and Germany started experiencing Industrial Revolution. Thus, for these countries, Malthus' theory failed to explain the parallel increase in living standard of people as well as the increase of the population size. A consequence has been that some economists pointed out that a slow population growth could perhaps be a factor explaining insufficient aggregate demand and in turn a low economic growth rate (see e.g. Hansen and Kikuchi, 1939: 1-15; Keynes, 1937: 13-17; Reddaway, 1939).

This view, however, was short lived. Coale and Hoover (1958) brought out a theory stressing that too rapid population growth can force families to consume more resources which otherwise could have been invested in other sectors of the economy. More precisely, they argued that if these resources were invested in growth enhancing activities (see Section 3 for more details), it could have been beneficial to long-term economic growth. Put differently, such theory pointed out the potential negative relationship between population and economic development. During the following two decades, the perspective about the relationship of population growth and economic development experienced an opinion swing period, which went back

to the negative supply-side impacts of population as noted years before by Malthus. As documented by Kelley (1988: 1685-1728), several empirical studies supported this idea. Moreover, a prominent example in favour of this view concerns the case of the countries in the Third World. During the period 1960s-1980s, they had a rapid population growth rate and a very low living standard. Thus, the prevailing opinion was that in the less developed countries, the lack of aggregate demand was no longer important for economic development and some government agencies such as the U.S. Agency for International Development promoted birth-control policy programs.

2. Population Push Theory and a More Balanced Perspective

Though after two decades the Malthusian view was revived, it should be emphasised that some scholars were offering an opposite assessment. Some empirical studies showed some evidence of a non-consistent negative relationship between population and economic development (see e.g. Easterline, 1967: 98-108; Simon, 1977 and 1992). As a consequence, based on these new results, from the 1980s a less pessimistic or somewhat more eclectic view has been developed. Generally speaking, this new wave of literature argues that an individual's economic impact on economic

development varies over a lifetime. This is because people are both producers and consumers. In the short-run, the effect of fertility seems to be negative because of the dilution of resources effect. Yet, at latter stages of an individual's life cycle (adult period), the effect is likely to be positive because working adults are net resources creators. This result was confirmed empirically by Simon and Gobin (1980: 215-234). They show that a high population growth rate may be negatively correlated with a higher population growth rate in earlier decades of the life of individuals: population growth retards economic development due to high birth rates, but is not a problem per se. Along this argument, the empirical works of Brander and Dowrick (1994: 1-25) and Barlow (1994: 153-165) show that past births have a positive impact on the current labour force entry and thus economic growth, although they also deter economic growth through adverse effects on investment. This observation has a two-way effect. On the one hand, the stock of accumulated resources shoots up over time exhibiting negative impact on living standards. On the other hand, as the new births from the past turn out to be "resources creators" in the life cycle, accumulation of resources can induce positive externalities, and thus an increase of living standards.

Following the less pessimistic view regarding the effects of population on income per-capita growth, Kelley and Schmidt (1995: 543-555) argue that the impact of population growth can change over-time. Considering both cross-section and time series data, they find that it is not significant in the sixties and the seventies but becomes large and significantly negative in the eighties. Moreover, the empirical evidence suggests that the effect of population growth varies with the level of economic development and can be positive for some developed countries.

Of course, these results must be viewed in perspective. Firstly, aggregate correlations of current and past births are difficult to interpret. Secondly, these correlations have profoundly affected the population debate. The main point here is that population growth is not all good or all bad for economic growth from an empirical perspective. In that sense, research in the 1990s put heavier weight on the demographic factors in order to explore an alternative explanation to economic growth. For example, Crenshaw, Ameen, and Christenson (1997: 974-984) use a cross-national analysis in 75 countries over the period 1965-1990 to analyse the relationships between income per-capita growth and fertility. They propose to disaggregate population growth into its

productive and non-productive segments. They show that the resulting age-specific population growth rates have countervailing effects on economic developments (i.e. growth in real gross domestic product per-capita). They suggest that the influence of population growth on economic growth on the population age segment is growing. Growth in the number of children may impede economic growth as scarce economic resources are invested in goods and services. But the growth in the economically active population is really beneficial as it can really promote economic growth because of their resource creating abilities.

Theoretical Treatment of Population Growth

The aim of this Section is to review the recent evolution of theoretical frameworks dealing with the relation between population growth and economic development. As suggested in Section 2, it is important to clearly identify the elements which are at work when we want to explain long-term economic growth. The reason is that it will allow us to understand and identify the channels through which population can affect economic growth.

As shown in the previous Section, the empirical relationship between population

growth and living standards is far from clear-cut. As we will see here, the theoretical treatment of this issue was stuck for years in the belief that population can only have adverse effects on economic development. The new wave of endogenous growth models developed in the 1980s and 1990s has, however, helped to explain empirical facts in a more clear-cut manner, giving rise also to the possibility of investigating the role of some family policies. Before reviewing the modern views about growth, the engines of economic growth and the impacts of population growth describe the canonical approach based on the well-known one sector model of growth.

1. The One-Sector Approach

The one-sector model was one of the most widely used frameworks to investigate the impact of population growth on living standards. In such a framework based on Solow (1956: 65-94), the labour force represents a constant share of the total population. The technology for output displays constant returns to scale. The main result is that an increase in population growth lowers the level but not the long-term rate of output per-capita. Basically, in the short run the net impact of population growth and the magnitude of this impact on per-capita output growth is shown to be

negative due to the “resource-shallowing” effects. However, changes on the demographic age structure can depress or stimulate saving rates and technology. The outcome depends on the value of the exogenous saving rate.

In the long run, the net impact is ambiguous. This is because we have two effects going in opposite directions: the diminishing return effect which is negative and technological change which has a positive effect. Most economists, however, believe that the negative “resource-shallowing” impacts of population growth dominate, even in the long run. As a result, unless scale effects associated with population are present, the negative impacts of population growth prevails (Kelley, 1988: 1685-1728). Thus, such formalisation is not appealing when one wants to account for the empirical features described in Section 2. Moreover, nothing is proposed regarding economic policies. Therefore, the development of a more refined theory, namely the multi-sector approach, appears as a necessity to deal with these issues.

2. The Multi-Sector Approach

The treatment of population growth and its relation to economic development is better understood using multi-sector models. It appears to be a useful and powerful instrument to formulate population policies

(such as tax in China or subsidies in many developed countries). Moreover, it allows us to provide quantitative assessments on the real role of population.

Basically, these models add complexity to the one-sector model in the form of accounting details. Population is broken down in several components such as age, sex and labour force participation. The production is divided into several sectors: production of output, education, research and development (R&D). This approach relies on the new development of endogenous growth theory which considers human capital accumulation and R&D activity as the two main engines of economic growth. Before turning to the treatment of population growth in the new generation of growth models, it is useful to review the basic endogenous growth models based on human capital accumulation and R&D activities.

2.1 Recent Development in Endogenous Growth Literature

The so called R&D-based models developed by Romer (1990: S71-S102), Grossman and Helpman (1991: 557-586), Aghion and Howitt (1992: 323-351) analyse the role of innovations resulting from R&D activity. They show how knowledge may appear as a key factor for long-run growth and how technological progress may take

place in the economy. On the other hand, a class of model inspired from Lucas (1988: 2-42) explains long-term growth by the general increase of individuals' skills' level in the economy through a human capital accumulation process. For several years, these two approaches have been considered as two independent ways to formalise and explain long-term economic growth.

However, some authors argue that human capital is a key factor to conduct research. For instance, Nelson and Phelps (1966: 69-75) explain that education facilitates the adoption and implementation of new technologies. In his seminal paper, Romer (1990: S71-S102) clearly distinguishes unskilled labor from human capital. He insists on the key role of educated people to produce innovations. In their cross-country study, Benhabib and Spiegel (1994: 143-173) show that differences in growth rates between two economies are essentially due to the gap in the available stocks of human capital of these economies.

From a theoretical perspective, Aghion and Howitt (1998: 85-121) point out that human capital accumulation and knowledge should not be treated as distinct causal factors of growth because they are two aspects of the same process. Studies by Bartel and Lichtenberg (1987: 1-11), Goldin

and Katz (1998: 693-732) provide empirical support for this view; they show a large degree of complementarity between technical progress and human capital.

Based on this idea, Redding (1996: 458-470), Arnold (1998: 84-105), Blackburn, Hung, and Pozzolo (2000: 189-206), Juntip Boonprakaikawe and Tournemaine (2006: 565-585), Grimaud and Tournemaine (2007: 27-36) have developed models in which both the decisions to acquire skills and to innovate interaction. Knowledge takes place through an R&D activity and individuals acquire skills through a human capital accumulation process "à la Lucas (1988: 2-42)." Though these analyses give a clear formalisation of the interaction between two fundamental engines of growth, population and its effect on economic development is not formalised.

2.2 Introducing Population Growth in Endogenous Growth Models

Before reviewing the recent theoretical treatment of individuals' choice of fertility in growth models, we must mention that in reviewing the economic, sociological, and population theories, Leibenstein (1974: 457-479, 1975: 1-31) argued years ago that to understand the fertility choice of individuals in an economy, the social and economic influences must not be considered separately. Accordingly, Leibenstein (1974:

457-479, 1975: 1-31) developed a theory in which he considers that children are “commitment goods” in that the expenditures on children reflect a commitment from the parents and tends to reject the idea that children may be considered as ordinary consumption goods. He suggests that the population of a society is divided among “social influence groups,” each family belonging to one of them, based on historical and socio-cultural factors. The important behavioural assumption is that households are motivated to achieve socially determined “targets” to avoid a fall in status, and to emulate those with higher status through observable expenditures on “status” or “lifestyle goods” (e.g. housing, means of transport, modes of entertainment). This theory is very helpful in that it helps to explain the fall in fertility rates in modern societies at the same time as the income per-capita rises. However, it has been criticised because no empirical evidence has been provided to support it. Moreover, even if this theory seems to be attractive, it has no predictive power. Finally, the value of a mother’s time in raising their children does not play any role, although there exists substantial evidence suggesting the reverse (see e.g. Becker, 1991).

Thereby, we can consider that the first analysis introducing population growth in

a formal endogenous growth framework can be attributed to Becker, Murphy and Tamura (1990: S12-S37). They assume that population is the outcome of the fertility choices of people and that parents and children are linked together through altruism. The fundamental property of their model is the existence of a trade-off regarding the parents’ decisions between the quality and quantity of children. Such a trade-off is considered as a factor which has contributed to the transition of economies from a stage of stagnation (Malthusian poverty trap) to perpetual growth (regime of perpetual sustained economic growth) and clearly suggests a negative correlation between population growth and economic development. They obtain three possible steady states in their model: a stable Malthusian steady state in which there are no investments in human capital, parents raise a lot of children, and the economy stagnates; a stable steady state of sustained long-term growth where people have fewer but higher-quality children; and, between the two former ones, an unstable state of intermediate development: parents invest in the education of their children an amount of resources which is just enough to maintain the level of education constant over-time, leading to zero growth.

The multiple equilibrium property obtained in the model of Becker, Murphy

and Tamura (1990: S12-S37) is very interesting. Indeed, in analysing the empirical evolutions of population, technical progress and income per-capita, Galor and Weil (1999: 150-154) argue that the process of economic development can be divided into three main stages: a Malthusian Regime, characterized by stagnation and underdevelopment where fertility and mortality are high; then, a Post Malthusian Regime where there is an acceleration of technological progress and an increase in per-capita income accompanied by first a decline in mortality, and a rise, then a fall in the fertility rate and finally, a Modern Regime where income per-capita is high and fertility and mortality rates are low. Accordingly, Galor and Weil (2000: 806-828) have developed a growth model which attempts to capture these facts and more importantly which attempts to explain how an economy can switch from one regime to another. Formally, in their framework, the fundamental factor which is working is technical progress. As this variable increases over-time, it affects the rate of returns to education positively. Thereby, as individuals start investing in education, the economy can leave the poverty trap to attain an intermediate state of development and ultimately a state of perpetual development.

Though the above papers clearly suggest that population growth and income per-capita are negatively correlated at least in a modern regime of growth, some authors have a contrasting view. For instance, Kremer (1993: 681-716) tends to confirm the hypothesis of the advocates of the “population push hypothesis.” In a simple framework which combines a Malthusian population model with a production function for “ideas” which depends on the existing stock of knowledge and the size of world population, he captures the evidence on world population when considering the period of time one million years B.C. to 1990. That is, population growth and income per-capita growth are positively related. An even stronger case for the model can be derived from its implications for separated areas of the world. If a fraction of the world population gets cut off from the rest, and starts out with a smaller amount of land, the model predicts that population will be smaller than in the rest of the world. Moreover, as technology depends on population, technological progress will be slower. Thus, even if the initial technology was the same, the model predicts that once sub-populations get cut off from the general flow of history, they will start to fall behind, both in terms of population and in terms of

technology, as evidenced by world history.*

More recently, semi-endogenous growth theorists (e.g. Jones, 1995: 759-784; Kortum, 1997: 1389-1419; Segerstrom, 1998: 1290-1310) have developed frameworks in which the long-run growth rate of income per-capita is determined by the growth rate of population. That is, population growth affects economic development positively. The problem of such models is that population growth is exogenous and therefore the consequences of an explicit family policy in the form of fertility taxes or subsidies cannot be analysed. Strulik (2005: 129-145) got a less stringent conclusion in that he finds that long-term growth can be positively or negatively correlated with the population growth rate. His model, however, is a semi-endogenous one: although technical progress and human capital accumulation interact endogenously, population is treated as an exogenous variable. Thus, once again the problem of economic policies in the form of tax or subsidies to children cannot be implemented. Note that this question is a crucial one because it raises an issue which finds some

application in the real world. For instance, since the beginning of the 1980s, China has carried out a population control policy. In this country, couples are taxed if they have more than one child. In contrast, in western European countries the reverse happens as the policy consists in subsidising children.

From above, it is then clear that the theoretical analyses should account for endogenous population growth (for example, through endogenous fertility choices) in order to tackle the problem of economic policies. In that sense, Tournemaine (2007: 1-7) has developed a growth model in which technical progress as well as human capital and population growth interact endogenously. To our knowledge, this is the only paper in the literature to treat all three elements endogenously at once. There are two key elements in the model. First, the rate of technical progress is determined both by the level of education of individuals and their total number. This implies that, for a given level of skills, the higher the number of individuals is, the greater the rate of technical progress will be. Second, population growth is the outcome of the choice of

* See also Tournemaine (2008: 49-66) who develops a R&D-based model in which individuals have status concerns [as suggested by Leibenstein (1974: 457-479, 1975: 1-31)], and must choose the number of children to bring up. The author emphasises the trade-off between status and fertility and argues that seeking higher status may affect long-term growth negatively if the growth rate of technical progress depends on population growth, i.e. if the scale effects prevail in the economy.

fertility of individuals. As raising children and acquiring skills require resources among which time is a primary factor, this implies a negative relationship between human capital and population growth (see Becker, Murphy and Tamura, 1990: S12-S37). Therefore, as income per-capita growth is determined by the growth rates of technical progress and human capital, population and income per-capita growth can be either negatively or positively correlated. That is, this framework provides a balanced perspective regarding the relationship between population and income per-capita growth. Such results fit perfectly with empirical evidences. Basically, in this paper the outcome depends on the relative contribution of population and human capital in the determination of the growth rate of income per-capita. A higher fertility rate may promote growth through its effects on the rate of technical progress (scale effect), while a contraction in the fertility rate could also free the resources necessary to promote growth by means of an increase in human capital accumulation activities (quality-quantity trade-off). Thus, from an economic policy point of view, if the government seeks to implement some family policies, the outcome on per-capita income is not clear cut.

Concluding Remarks

This paper describes the recent evolution of growth theory to show how population growth can be formalised in order to study its relationship with economic development. Though disparities of conclusions still persist regarding the relationship between growth and economic development, a clearer picture has started to emerge in the past few years. Most economists now agree that simple correlations are difficult to interpret and believe that population growth has both positive and negative effects on per-capita income growth. It should be noted that the virtual absence of a systematic relationship in the face of both strongly held beliefs has kept the population debate alive. Besides it has supported the “revisionist” position, which emphasizes a balanced, generally “non-alarmist” assessment of the economic effects of demographic components. As a result, the research over the last decade has provided the basis for a modified and moderated appraisal of the consequences of population growth: the effects of population growth on per-capita income are both empirically and theoretically shown to be ambiguous. Embracing such a perspective will certainly place the population debate on a firmer and more productive direction for future research.

References

- Aghion, P., and Howitt, P. 1992. "A Model of Growth through Creative Destruction." **Econometrica** 60, 2: 323-351.
- _____. 1998. **Endogenous Growth Theory**. Cambridge, MA: MIT Press.
- Arnold, L. 1998. "Growth, Welfare, and Trade in an Integrated Model of Human-Capital Accumulation and Research." **Journal of Macroeconomics** 20, 1: 84-105.
- Barlow, R. 1994. "Population Growth and Economic Growth: Some More Correlations." **Population and Development Review** 20, 1: 153-165.
- Barro, R.J. 1991. "Economic Growth in a Cross Section of Countries." **Quarterly Journal of Economics** 106, 2: 407-443.
- Barro, R.J., and Becker, G.S. 1988. "A Reformulation of the Economic Theory of Fertility." **Quarterly Journal of Economics** 103, 1: 1-25.
- _____. 1989. "Fertility Choice in a Model of Economic Growth." **Econometrica** 57, 2: 481-501.
- Bartel, A.P. 1974. "Policy Analysis with a Disaggregated Economic-Demographic Model." **Journal of Public Economics** 3, 1: 43-70.
- Bartel, A.P., and Lichtenberg, F.R. 1987. "The Comparative Advantage of Educated Workers in Implementing New Technologies." **Review of Economics and Statistics** 69, 1: 1-11.
- Becker, G.S. 1991. **A Treatise on the Family**. Cambridge, MA: Harvard University Press.
- Becker, G.S., Murphy, K.M., and Tamura, R.F. 1990. "Human Capital, Fertility, and Economic Growth." **Journal of Political Economy** 98, 2: S12-S37.
- Benhabib, J., and Spiegel, M. 1994. "The Role of Human Capital in Economic Development: Evidence from Aggregate Cross Country Data." **Journal of Monetary Economics** 34, 2: 143-173.
- Blackburn, K., Hung, V.T.Y, and Pozzolo, A.F. 2000. "Research, Development and Human Capital Accumulation." **Journal of Macroeconomics** 22, 2: 189-206.
- Boserup, E. 1965. **The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure**. London: George Allen & Unwin.
- Brander, J.A., and Dowrick, S. 1994. "The Role of Fertility and Population in Economic Growth: Empirical Results from Aggregate Cross-National Data." **Journal of Population Economics** 7, 1: 1-25.
- Cass, D. 1965. "Optimum Growth in an Aggregative Model of Capital Accumulation." **Review of Economic Studies** 32, 3: 233-240.

- Coale, A.J., and Hoover, E.M. 1958. **Population Growth and Economic Development in Low Income Countries**. Princeton, NJ: Princeton University Press.
- Crenshaw, E.M., Ameen, A.Z., and Christenson, M. 1997. "Population Dynamics and Economic Development: Age-Specific Population Growth Rates and Economic Growth in Developing Countries, 1965 to 1990." **American Sociological Review** 62, 6: 974-984.
- Easterlin, R.A. 1967. "Effects of Population Growth on the Economic Development of Developing Countries." **Annales of American Academic Political and Sociological Science** 369, 1: 98-108.
- Ehrlich, I., and Lui, F. 1997. "The Problem of Population and Growth: A Review of the Literature from Malthus to Contemporary Models of Endogenous Population and Endogenous Growth." **Journal of Economic Dynamics and Control** 21, 1: 205-242.
- Galor, O., and Weil, D.N. 1999. "From Malthusian Stagnation to Modern Growth." **American Economic Review** 89, 2: 150-154.
- _____. 2000. "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond." **American Economic Review** 90, 4: 806-828.
- Goldin, C., and Katz, L. 1998. "The Origins of Technology-Skill Complementarity." **Quarterly Journal of Economics** 113, 3: 693-732.
- Grimaud, A., and Tournemaine, F. 2007. "Why Can an Environmental Policy Tax Promote Growth through the Channel of Education?" **Ecological Economics** 62, 1: 27-36.
- Grossman, G.M., and Helpman, E. 1991. "Quality Ladders in the Theory of Growth." **Review of Economic Studies** 58, 1: 557-586.
- Hansen, Y., and Kikuchi, M. 1939. "Economic Progress and Declining Population Growth." **American Economic Review** 29, 1: 1-15.
- Jones, C.I. 1995. "R&D-Based Models of Economic Growth." **Journal of Political Economy** 105, 4: 759-784.
- Juntip Boonprakakawe, and Tournemaine, F. 2006. "Production and Consumption of Education in a R&D-based Growth Model." **Scottish Journal of Political Economy** 53, 5: 565-585.
- Kelley, A.C. 1974. "The Role of Population in Models of Economic Growth." **American Economic Review** 64, 2: 39-44.
- _____. 1988. "Economic Consequences of Population Change in the Third World." **Journal of Economic Literature** 27, 4: 1685-1728.

- Kelley, A.C., and Schmidt, R.M. 1995. "Aggregate Population and Economic Growth Correlations: The Role of the Components of Demographic Changes." **Demography** 32, 4: 543-555.
- Keynes, J.M. 1937. "Some Economic Consequences of a Declining Population." **Eugenics Review** 29, 1: 13-17.
- Koopmans, T.C. 1965. "On the Concept of Optimal Economic Growth." In **The Economic Approach to Development Planning**, pp. 225-300. Amsterdam: North-Holland.
- Kortum, S. 1997. "Research, Patenting, and Technological Change." **Econometrica** 65, 6: 1389-1419.
- Kremer, M. 1993. "Population Growth and Technological Change: One million B.C. to 1990." **Quarterly Journal of Economics** 108, 3: 681-716.
- Lee, R.D. 1988. "Induced Population Growth and Induced Technological Progress: Their Interaction in the Accelerating Stage." **Mathematical Population Studies** 1, 3: 265-288.
- Leibenstein, H. 1974. "An Interpretation of the Economic Theory of Fertility: Promising Path or Blind Alley?" **Journal of Economic Literature** 12, 1: 457-79.
- _____. 1975. "The Economic Theory of Fertility Decline." **Quarterly Journal of Economics** 84, 1:1-31.
- Lucas, R.E. 1988. "On the Mechanics of Economic Development." **Journal of Monetary Economics** 22, 1: 2-42.
- Malthus, T. 1798. **An Essay on the Principle of Population, as It Affects the Future Improvements of Society**. London: Johnson.
- Mankiw, N.G., Romer, D., and Weil, D.N. 1992. "A Contribution to the Empirics of Economic Growth." **Quarterly Journal of Economics** 107, 2: 407-437.
- Nelson, R.R., and Phelps, E.S. 1966. "Investment in Humans, Technological Diffusion and Economic Growth." **American Economic Review** 56, 1: 69-75.
- Phelps, E.S. 1968. "Population Increase." **Canadian Journal of Economics** 1, 3: 497-518.
- Reddaway, W.B. 1939. **The Economics of a Declining Population**. London: Allen & Unwin.
- Redding, S. 1996. "The Low-Skill, Low-Quality Trap: Strategic Complementarities between Human Capital and R&D." **Economic Journal** 106, 1: 458-470.
- Romer, P. 1990. "Endogenous Technological Change." **Journal of Political Economy** 98, 5: S71-S102.
- Segerstrom, P. 1998. "Endogenous Growth Without Scale Effects." **American Economic Review** 88, 5: 1290-1310.

- Simon, J. 1977. **The Economics of Population Growth**. Princeton, NJ: Princeton University Press.
- _____. 1981. **The Ultimate Resource**. Princeton, NJ: Princeton University Press.
- _____. 1992. **Population and Development in Poor Countries: Selected Essay**. Princeton, NJ: Princeton University Press.
- Simon, J., and Gobin, R. 1980. "The Relationship between Population and Economic Growth in LDGs." In J. Simon and J. DaVanzo (eds), **Research in Population Economics**, Greenwich, CT: JAI Press.
- Solow, R.M. 1956. "A Contribution to the Theory of Economic Growth." **Quarterly Journal of Economics** 70, 1: 65-94.
- Strulik, H. 2005. "The Role of Human Capital and Population Growth in R&D-Based Models of Economic Growth." **Review of International Economics** 13, 1: 129-145.
- Tournemaine, F. 2007. "Can Population Promote Income Per-Capita Growth? A Balanced Perspective." **Economics Bulletin** 15, 8: 1-7.
- _____. 2008. "Social Aspirations and Choice of Fertility: Why Can Status Motive Reduce Per-Capita Growth?" **Journal of Population Economics** 21, 1: 49-66.



Dr. Frederic Tournemaine graduated from the University of Toulouse in 2004. Currently, he is a full-time lecturer in the School of Economics, University of the Thai Chamber of Commerce. His research interests include endogenous growth, behavioral economics, R&D, education, fertility and sustainable development. He has published several articles in international peer-reviewed journals, such as *Journal of Population Economics*, *Economics Letters*, *Oxford Economic Papers*, *Ecological Economics*, *Scottish Journal of Political Economy*, *Revue d'Economie Politique*, *Economics Bulletin*, *Journal of International Development*, and *Chulalongkorn Journal of Economics*.