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# A very preliminary survey on growth and development

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## Abstract

Growth and development has always spurred outpouring of research. This paper offers a very preliminary survey of recent literature in the field.

*Keywords:* Growth and development; China's growth; Determinants of economic growth

*JEL classification:* O1; O2; O3; O4;O5

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## 1. Introduction

This article surveys some recent efforts to explain the driving forces behind growth and development in a very preliminary way. To make the task manageable and approximate the full view to this extremely important field, we focus on several topics but just consider a small amount of literature to cover each topic since the literature is vast.

We initiate our survey with several research on China's growth. China's growth and development after 1978 attracts the attention from many economists and causes controversies among them. Chow (2004) analyzes economic reform and growth in China from the following several aspects: (1). the reasons to introduce economic reform in 1978; (2). the major components of economic reform; (3). the characteristics of the reform process; (4). why reform was successful; (5). the shortcomings of China's economic institutions; (6). the factors that contribute to China's rapid economic growth; (7). the future prospects of further reform and growth. In addition, we also consider two papers which analyze empirically the contributions of financial development and transport infrastructure to China's growth respectively.

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As described by Solow (2003), growth clearly encourages and facilitates development, and development in certain directions may be a necessary foundation for durable, stable growth. Aghion (2004) presents a Schumpeterian approach to economic growth, which explains sustainable development and cross country convergence. In addition to its theoretical contribution, Schumpeterian approach also provides the analytical tools to design strategies and institutions to achieve rapid convergence and sustainable development. Riedel (2007) uses Maurice Scott's theory and insights to change the conclusions about the contribution of technological progress, which are drawn by using Solow's residual, by all but eliminating the residual. Sachs (2000) investigates the relationship between economic reforms and constitutional transition. Henderson (2003) provides a guide to study on the relationship between urbanization and economic development.

The variations of growth rates will make drastic differences in the average living standards of a country's residents over a comparatively longer period of time. It's evident that both empirical economists and policy makers all concern themselves with the reason for the variations of growth rates. Barro (2003) analyzes empirically determinants of economic growth in a panel of countries. Besides, we also introduce several empirical papers that analyzes empirically the effects on growth of such factors as residential investment, research and development, human capital externality and knowledge spillover, and natural resources.

Growth theory, except for answering some problems concerning growth, also provides analytical framework to deal with other economic problems. We review some studies on the relationships between growth and inequality, public expenditures, financial sectors, and health.

The rest of the paper is organized as follows. In section 2, we review several studies on China's growth and development. Section 3 introduces some literature on growth and development. Section 4 makes a survey on determinants of economic growth. Section 5 devotes our survey to some important economic problems that can be analyzed using analytical framework provided by growth theory. Section 6 concludes the paper.

## **2. China's growth**

Chow (2004) surveys economic reform and growth in China. He first explains why China introduced market-oriented economic reform in 1978. He considers the following four as the main reasons: (1). the Chinese Communist

Party needed to change direction to correct the adverse effects of the Culture Revolution of 1966-1976 to win support from the Chinese people; (2). many officials in charge of economic planning were gradually aware of the difficulties in managing the economy by planning and the economic inefficiencies caused by it; (3). better performance of the more market-oriented neighboring economies confirmed that the market economy can do better; (4). the Chinese people supported the market-oriented economic reform. The economic reform launched in 1978 had the following several components: (1). agriculture; (2). state-owned enterprises; (3). the open -door policy; (4). the price system; (5). development of non-state sectors; (6). the banking and financial sector; (7). economic and social infrastructure; (8).social welfare system. As compared with the market reform of the Soviet Union and some former socialist countries in the Eastern Europe, China's economic reform had it's own characteristics. First, it left the political system unchanged and thus was able to maintain political stability. Second, China's economic reform was gradual and not all at once, in the sense that each step was taken after learning from the previous experimentation.

As measured with annual growth rate of about 9.5 percent of real GDP in the two decades since 1978, China's economic reform was successful. The author attributes the success to the following three factors: (1). the Chinese government introduced the basic elements of a market economy. (2). there was a large amount of human capital in China. (3). the competence of the political leaders. In spite of the success of economic reform in terms of rapid growth rate of real GDP, China's institutions have some shortcomings. The author attributes most of the shortcomings to the bureaucratic economic institutions and also puts the blame on the behavior of the people who have gained entitlement under the current system. In addition, the institution inertia should also be taken into account in the author's view.

In the following, the author estimates an aggregate Cobb-Douglas production function using Chinese official data to account for the average rate of growth of 9.6 percent annually from 1978-1998. He finds that capital formation is the most important factor to promote the growth, and the increase in total factor productivity is secondly important. In light of the abundance of Chinese human capital and an adequate, though defective, market economy system, the China's economy will sustain substantial growth rate in the next decade or two, even if institutional reform can be expected to be slow.

From China's reform experience, the author reaches some conclusion-s concerning economic reform in general: (1). market institutions and high

quality human capital are necessary and sufficient for rapid economic growth; (2). economic growth can take place under different political systems; (3). except for private enterprises, other forms of enterprises can also be efficient economically; (4). alternative economic institutions can serve a market economy; (5). in choosing the economic reform measures, political feasibility should be taken into account as important factor; (6). it's difficult to get rid of bureaucratic economic institutions originating from central planning.

Using VAR approach, Shan and Qi (2006) quantitatively investigate the relationship between financial development and GDP growth in China. The results reveal that financial development in China is secondly important to affect economic growth and economic growth also has significant impact on financial development, thus there is a two-way causality between finance development and growth.

Using panel data of 1994-2002, as well as time series data of 1978-2002 in China, Zou et al. (2008) investigate the relationship between transport construction and economic growth. The investigation brings about the following results: (1). the differences in income level and growth rate between the east area and its counterparts (the central and west areas) are closely related with the difference in transport investment; (2). the externality of transport infrastructure is very important to promote regional growth. At current, more investment in road and railway is in urgent need; (3). one of reasons of income inequality between regions in China is the inequality of transport. More investment in transport should be targeted to poorer inland provinces, especially to rural areas; (4). for promoting poor area's growth, more investment should be directed to road construction rather than railway; (5). improvement of transport infrastructure is the necessary but not sufficient condition to promote regional growth and alleviate poverty; (6). fiscal decentralization in 1994 worsens the inequality of transport infrastructure, as a result, the central government should direct more public investment to transport infrastructure in inland poorer areas.

### **3. Growth and development**

Aghion (2004) presents the Schumpeterian approach to economic growth. Before presenting the approach, he introduces the limitations of growth model based on capital accumulation. The neo-classical model, as he shows, can't explain long-run growth of GDP per capita. The decreasing returns to capital accumulation leads to the conclusion that knowledge creation is necessary

to sustain long-run growth of income per capita. However, the neo-classical model can explain the “conditional” convergence across country. The AK approach, the first variant of endogenous growth model, which regards that the creation of knowledge comes from capital accumulation by any individual firm as by-product through learning by doing or learning by imitating. The creation of knowledge can generate long-run growth of GDP per capita by offsetting the effect of the diminishing marginal productivity of capital under some assumptions on the learning externalities. However, a weak point of the AK model of endogenous growth, as criticized by Mankiw et al. (1992), is its failure to account for conditional convergence. The neo-classical growth model, unlike the AK model, can explain most of the cross-country variation in output per capita. But implied convergence rate in traditional Solow model is much higher than the one estimated from cross-country regressions. Mankiw et al. (1992) partially solve the problem by introducing human capital on top of physical capital. Another drawback of the AK model, as pointed out in Aghion (1998, 2004), is its inability to explain sustained positive growth when exhaustible resource is introduced into the model. A faster rate of the creation of new knowledge will lower the prospect for sustained long-run growth by accelerating the depletion of the exhaustible resource.

The Schumpeterian approach, the second variant of endogenous growth theory, provides a versatile, simple and empirically useful framework to analyze the determinants of long-run growth and convergence. The main ideas underlying the approach are that quality-improving innovations are the main driving force of the growth, most of innovations result from entrepreneurial research activities, and economic environment can influence the incentives to engage in innovative investments.

The model consists of three sectors: producers of final good, R&D firms and consumers. Unlike Aghion and Howitt (1992), the model makes several extensions along the following lines. First, the author introduces the capital which is used both in the production of intermediate goods and in the R&D investments. Second, instead of one intermediate good as in Aghion and Howitt (1992), the author assumes that there exist a continuum of intermediate goods indexed by the interval  $[0, 1]$ . Third, the author assumes that there exist cross-sector knowledge spillovers so that an innovation in sector  $i$  at date  $t$  will bring this sector’s productivity up to the current leading-edge productivity level ( $A^{\max} = \max_j A_j$ ). The backbone equations to describe the equilibrium steady-state level of R&D are capital equation  $\alpha^2 k^{\alpha-1} = r + \delta - \beta$  and research-arbitrage equation  $1 - \psi = \lambda \frac{\bar{\pi}(k)}{r + \lambda n}$ . The rate of growth of the

leading edge productivity is described as  $\frac{\dot{A}^{\max}}{A^{\max}} \lambda n \sigma$ , which is also equilibrium growth rate  $g$  and steady-state growth rate of average productivity  $\frac{\dot{A}}{A}$  by the conclusion that the distribution of productivity ratios  $\frac{A_i}{A^{\max}}$  is stationary. (For more detailed discussion on this point, see Chapter 3 of Aghion and Howitt (1998)).

After introducing the Schumpeterian approach to economic growth, the author uses it to the circumstance in which the production of the final good needs exhaustible resource. Under the assumption that both  $\lambda$ , the productivity of R&D, and  $\sigma$ , the size of cross-country spillovers, are sufficiently large, there will always exist an equilibrium  $n^*$ , the productivity-adjusted quantity of final output devoted to R&D, which can be achieved through a suitable policy combination of capital subsidy with R&D subsidy, so that the creation of new knowledge can sustain long-run growth of income per capita even the economy is limited by the prospect of depletion of natural resource.

The Schumpeterian approach with knowledge spillovers can also shed light on cross-country convergence. For the convenience of exposition, the author presents an  $m$ -country model in which each country is the same as that described above, however, world-wide knowledge spillovers is taken into account. World-wide leading-edge technology  $A^{\max} = \max \{A_{ij}; i \in [0, 1], 1 \leq j \leq m\}$ , and average productivity growth in any individual country is governed by the differential equation  $\dot{A} = \lambda n (A^{\max} - A)$ . Let  $a \equiv \frac{A}{A^{\max}}$  denote a country's average productivity relative to the leading-edge level, the following differential equation for  $a$  can be obtained:  $\dot{a} = \lambda n (1 - a) - ag$ , in which  $g = \frac{\dot{A}^{\max}}{A^{\max}}$  and  $(1 - a)$  is the gap between a country's average productivity and the world-wide leading-edge level. The full dynamics of the multi-country model is characterized by capital equation, research arbitrage equation as derived in closed economy and the differential equation governing the movement of  $a$ .

With the multi-country model being specified, the author uses it to explain three claims in turn: (1). club convergence. More general research arbitrage condition follows from the Kuhn-Tucker conditions and is expressed as  $1 - \psi \geq \lambda \frac{\tilde{\pi}(k)}{r + \lambda n}; n \geq 0$ , with at least one equality. The countries with very low R&D productivity  $\lambda$  and/or low R&D subsidy  $\psi$ , and/or low appropriability of innovation rents (low  $\tilde{\pi}(k)$  for given  $k$ ), or high interest rate  $r$ , will have no innovation and hence no growth. The countries at the other end of the spectrum, however, will converge to the common growth rate  $g$ , and thus form a convergence club. (2). cross-country regression-

s. The steady-state equation in the multi-country model is described as  $\ln \frac{Y}{L} = \ln A^{\max} + \ln a + \frac{a}{1-a} (\ln s - \ln (\delta + g))$ . It is almost identical to that in Mankiw et al. (1992), except for the additional term  $\ln a$ . In general, the positive correlation between  $s$  and  $a$  results in the positive correlation between the regressor  $(\ln s - \ln (\delta + g))$  and the residual term  $\ln A^{\max} + \ln a$ . The positive correlation causes Mankiw et al. (1992) to overestimate the direct contribution of capital to growth. (3). convergence rates. From the equation  $\frac{\dot{A}}{A} = \lambda n \left(\frac{1}{a} - 1\right)$ , countries that are farther to the leading-edge should benefit from greater spillovers and thus experience higher growth rate.

Aghion(2004) also introduces the main ideas of Acemoglu-Aghion-Zilibotti (2002) which contributes to the debate over the appropriate development strategy and gives the development prescriptions. Acemoglu et al. (2002) distinguish between imitation and innovation in the process of technological diffusion, and advocate imitation and therefore investment based strategy to maximize growth if the countries are further below the technological frontier. on the other hand, if the countries are closer to the technological frontier, they should adopt innovation-based strategy and competitive market mechanism. However, the following several considerations which can't be explained in the formal model of the type developed in Aghion (2004) challenge the future research: (1). investment-based strategies don't succeed in all cases, e.g. throughout Africa between the 1950s and 1970s. (2). the current globalization context will cast doubt on the investment-based strategy. (3). it's hard to design truly temporary investment-based policies, the reason is vested interests created as side effect by investment-based strategy are opposed to the transition to more pro-competition policy. (4) striking contrast remains among countries that have achieved high growth through investment-based strategy. Countries, like Japan and Korea, have income inequality under control and widespread education. On the other hand, Countries, like Mexico, Brazil or Peru, are struggling for the eradication of income inequality, poverty traps and high illiteracy rates.

Solow(2003) takes stock of the growth and development and casts doubt on the some current practices to which economics researchers seem to get accustomed. On top of reflections of the status quo of growth and development, the author also points out the possible approach to explain the China's experience. In the discussion of the relationship between social institutions and economic growth, the author confirms that growth will foster development clearly, and the institutions and attitudes in the course of development



will also affect growth. However, The ways that the various choices made in the course of development affect the path of economic growth remain to be difficult to be described exactly. It's the reason that the author has to describe the discussion of development as "politicized". As for the research on the China's growth and development, the author reminds the future researchers of geographical dimension and believes the success of the analysis of geographically large economy will depend on the extent to which relative factors prices differ from one region to another. In light of the difficulty in inferring the importance of reform when model-based comparisons before and after China's reform are performed, the author recommends second-best model-based comparisons among China, the U.S. and the European Union. In a separate section to discuss China's growth, the author believes that Zhou Fang's study, in which technological progress has no credit to claim in promoting growth and everything is imputed to economies of scale, needs to be improved. After improvement, there will be a major imputation to technological progress or total factor productivity. Furthermore, if the production function is altered to allow for the effect which is the increasing function of time, the decomposition of pure time-effect will reveal the footprints of reform. The author also expresses his concern about too much focus on differences in growth rates of output and too little on differences in levels of output. The reason is that the country farther to the technological frontier can imitate the frontier technology, the situation facing the frontier country, however, is different. As a result, it's more fruitful to identify and analyze the sources of differences in productivity itself, and not its rate of change. International differences in the level of productivity, indicated by microeconomic research, can be explained in terms of organizational and institutional characteristics. What are the priorities to be endogenized in the model to analyze the country comparatively farther to the technological frontier? The author believes that the mechanisms and incentives of producing and reproducing human capital should be on the top of the list, besides this, the type of the advanced technology to be adopted and the speed of the adoption should also be given consideration to explore endogenous mechanisms. The author also doubts the meaningfulness of the cross-country regressions on the basis of the obvious failure of the cross-country regression to predict some country's growth rate, like China. It's useful to know—if it's true— some descriptive prescriptions, which include that more open economies have tended to grow faster than otherwise similar but less open economies, so do for politically stable economies, and so on.

On the basis of the insights of Maurice Scott's New View of Economic Growth (1989), Riedel (2007) calls into question the widely acclaimed conclusion that the growth of the Asian Tigers is unremarkable because it is mainly due to factor accumulation, with relatively little total factor productivity growth in Young (1995) in which the Solow growth accounting methodology is used. Under the assumption that capital goods are homogeneous, the conventional practice treats the contribution to growth of a dollar of new investment as that of a dollar of depreciation in the opposite sense. However, if technology change renders capital assets obsolete, the investment must take the form of new and improved machines, as suggested by Scott (1989). Riedel (2007) shows theoretically and empirically that, if capital assets are replaced mainly because of obsolescence rather than wear and tear, then gross investment rather than net investment should be used to measure the contribution to growth of capital accumulation. However, the improved practice will all but eliminate the Solow residual. Thus, Young's conclusion based on Solow residual is not warranted from the perspective of Scott (1989), since there is no growth residual to be attributed to total factor productivity growth when contribution of investment is fully counted. The failure to measure technology change independently of the contribution of investment leads to Young's claim that there is little technology change no longer hold water.

Sachs et.al (2000) investigate the relationship between economic reforms and constitutional transition and consider economic reforms as just a small part of large scale of constitutional transition. Constitutional transition is driven by the rivalry and competition between states and between political forces within each country. Sachs et.al (2000) conclude that economic transition will be hijacked by state opportunism if the ruling party remains political monopoly. Besides, long-term cost of dual track approach to economic transition, in terms of constitutional transition, may be greater than its short-term benefit of buying out the vested interests.

Henderson (2003b) revolves around three issues to review the urbanization and economic development. The first issue is about whether the urbanization process is reasonably efficient, or whether it is subject to some types of market failures or distortionary government policies. Recent literature, diverging from some literature along this line of research, has centered on the form that urbanization takes. The second issue is about why industrialization involves urbanization. What market and non-market interactions is important to cause economic activity to cluster spatially to form cities. The

third issue is about how cities form and interact with each other, in an urban system in both static and dynamic contexts. The paper concludes with the review of urbanization in China.

Three important facts about the urbanization process are mentioned by the author. The first is that changes in national economic sector composition determine urbanization which occurs in the early and middle stages of development. The second is that urbanization doesn't cause growth, which is suggested by Henderson (2003a). However, the evidence is only limited so far. The third is that there exists a simple concave relationship between the level of urban population and GDP per capita which is found by Davis and Henderson (2003).

As for the form of urbanization in terms of the degree of spatial concentration, a series of empirical papers find an inverted *U*-shaped relationship where urban-concentration first increases, peaks, and then declines with economic development. Apart from documenting the concentration-deconcentration process, the empirical literature also pays attention to two sets of issues. First concerns the role of political economy and government policies in the process and empirical work reveals that both democracy and fiscal decentralization are helpful to level the playing field across cities. Second concerns the relationship between concentration and growth, empirical work finds that there is an optimal degree of primacy at each level of development that declines as development proceeds.

Theoretically, based on Krugman (1991), a series of papers try to explain the development of a core-periphery structure across regions of a country. The following conclusions are obtained in these papers: (1). when the transport cost is relatively high, only a symmetric equilibrium is stable; (2). when the transport cost is low, only a core-periphery structure will appear; (3). when the transport cost is in the intermediate range, multiple equilibria will appear. Both symmetric equilibria and core-periphery structures are stable. Admittedly, the drawback of the models is they all focus on the way the core-periphery develops as transport costs between regions decline. However, technological advance is out of the picture, let alone endogenous technological development. The reversal of core-periphery also appears when the economists such as Helpman, Junius, and Tabuchi introduce the congestion into the model. Two extensions of the core-periphery model are mentioned by Henderson (2003b). First extension is to reformulate the core-periphery model in a growth context. Second extension is the introduction of reduced barriers to international trade into the core-periphery model to analyze it-

s impact on peripheral, or hinterland regions. The core-periphery model, being more a regional model, however, has limited urban implications. In contrast, urban models, in light of the fact that economies are composed of many cities, pay more attention to the city formation process in which both the numbers and sizes of cities are endogenous. In addition, urban model also takes account of distinct city types and the case in which within a region there is a wide size distribution of cities. Finally, urban models, unlike regional models, carry out more welfare, policy and institutional analysis. In terms of the basis of agglomeration, urban models depend on Marshall's s-scale externalities and local knowledge accumulation rather than, like regional models, market linkages.

Key spatial agglomerating force which is intrinsic to urban models is scale externalities. The original urban system model (Henderson 1974) looks on localized own industry scale externalities as the basis for agglomeration. Since path-breaking work by Fujita and Ogawa (1982), urban economists devote much of their work to examine Marshall's (1890) hypothesized urban externalities such as information spillovers, search and matching externalities in labor market, and intra-industry plant specification. The externalities in these models are, however, static in the sense that information spillovers today increase local industry efficiency today. Certainly, there are also studies dealing with dynamic externalities. Henderson (2003) also introduces some empirical work examining both static and dynamic externalities.

Henderson(2003b) reviews empirical evidence and models for larger countries or regions with urban systems composed of many cities. A series of research show that there is a wide size distribution of cities in any large economy, in which relative size distributions are remarkably stable over time. In considering the size distribution of cities, especially in a cross-sectional context, many literature are on Zipf's Law which assumes city sizes follow a Pareto distribution. While Black and Henderson (2003) show that the assumption can't be verified by the data for the USA for 1900-90, the assumption may be a good first approximation. What about urban specialization and industry concentration? Evidence on a variety of countries show that cities are relatively specialized. In an extremely important paper, Ellison and Glaeser (1999) show that almost all industries display some degree of spatial concentration due to either natural advantage or spillovers. Apart from what have been mentioned above, a variety of recent studies also examines the role of geography in the spatial configuration and growth of cities.

Henderson (2003b) outlines the model in Black and Henderson (1999) as

an example to introduce the theoretical status quo of systems of cities models. The analysis in Black and Henderson (1999), which is an endogenous growth model of cities in which growth and urban are directly connected, comprises two parts. The first examines the system of cities at a point in time, with the focus on city formation and the determination of the sizes, numbers, and industrial composition of cities in an economy at a point in time. The second adds on the growth part. The solution of equilibrium city sizes in the first part implies: (1). Henry George Theorem, in which the transfer per worker/firm exactly equals the gap between social and private marginal of labor to the city, and that externality subsidy is exactly financed out of collected land rents, holds; (2). the efficient size is the point where real income per worker available in equilibrium in national labor markets under free mobility peaks as an inverted  $U$ -shape function of city size. As for specialization, the conclusion is that any specialized city out-competes any mixed city if there are no costs of inter-city trade. In addition, in a static context, at the national level there are constant returns to scale. If national population is doubled, it follows that the numbers of cities of each type and national output of each good double, with individual city sizes and real incomes remaining unchanged. In the second parts, Black and Henderson (1999) consider a dynamic growth model in which the only capital is human capital and there is no market for it. Under such assumptions, each dynamic family spreads its members across cities as a response to the absence of capital market. The properties of growth model imply that: (1). each type of cities has parallel growth in numbers and sizes, therefore, the relative size distribution of cities is unchanged over time; (2). the economy will either converge to a steady state level or experience endogenous steady-state growth. Henderson (2003b) also introduces two extensions to the basic systems of cities models. They are the following: (1). individuals are heterogeneous in terms of inherent productivity or endowments; (2). small highly specialized cities and large diversified metro areas play different roles in economy.

The last part of Henderson (2003b) applies the urbanization and economic geography models to China. Chinese urban system has some features which are shaped by some historical and current policies affecting urbanization. Its special features and policies include: (1). low urban concentration implies by Chinese spatial Gini shows that there is generally insufficient spatial agglomeration in both the urban and rural areas in China; (2). under the hukou system, migration is limited and geographic urban dispersion of population is maintained; (3). there is a sense of hierarchy both in govern-

ment structures and economic policy. Larger cities are to lead smaller ones and rural areas, the coast is to lead the center and west. As a result, in terms of agglomeration economics and city sizes, cities in China may be too small.

#### 4. Determinants of economic growth

Using an empirical framework in which cross-country panel regressions are performed, Barro (2003) relates the real per capita growth rate to two types of variables. The first category includes initial levels of state variables, such as the stock of physical capital and the stock of human capital in the forms of educational attainment and health. The second group comprises policy variables and national characteristics which include the ratio of government consumption to GDP, the ratio of domestic investment to GDP, the extent of international openness, the fertility rate, indicators of macroeconomic stability, and measures of maintenance of the rule of law and democracy. The sample comprises 87 countries and time span is divided into three ten-year periods 1965-75, 1975-85, and 1985-95. The regression results for growth rate are as follows: (1).the coefficient on the initial level of per capita GDP (initial levels are respectively of the values for 1965, 1975, and 1985) represents the rate of convergence and the estimated coefficient on  $\log(GDP)$ ,  $-0.023$  ( $s.e. = 0.003$ ) shows that the conditional convergence can have important influence on growth rates; (2).the school-attainment variable is described as the average years of male secondary and higher schooling (referred to as upper-level schooling), observed at the start of each period, 1965, 1975, and 1985. And it tends to be significantly related to subsequent growth; (3). the estimated coefficient on life expectancy is  $-5.3$  ( $s.e. = 0.8$ ) which is highly significant and shows that better health predicts higher economic growth; (4).the estimated coefficient on fertility rate is negative and significant:  $-0.013$  ( $s.e. = 0.005$ ); (5). when estimating the effect of government consumption, the author subtracts the expenditures for defense and education and define government consumption ratio as the remaining government spending divided by real GDP. The estimated coefficient on the government consumption ratio is negative and significant:  $-0.068$  ( $s.e.0.028$ ); (6). the estimated coefficient of rule of law is positive and significant:  $0.020$  ( $s.e.0.006$ ); (7). the estimates on the effect of democracy on growth imply that, starting from a fully totalitarian system, increases in democracy tend to promote growth. However, the positive influence tapers off with the increase of democracy and reaches zero when a mid-range value representing

democracy is achieved; (8). the estimated coefficient on international openness is positive but only marginally significant: 0.0080 (*s.e.*0.0046); (9). the estimated coefficient on the terms of trade is positive and highly significant: 0.30 (*s.e.*0.05); (10). the estimated coefficient on investment ratio is positive and statistically significant: 0.053 (0.023); (11). the estimated coefficient on inflation rate is negative and statistically significant:  $-0.022$  (*s.e.*0.010); (12). the regression also includes an overall constant term and a separate time dummy for the two later periods, 1975-85 and 1985-95. The result that two time dummies are significantly negative implies that the world's growth rate seems to have experienced decline from 1965 to 1995. In addition, Barro (2003) also tests the stability of coefficients and runs the regression for some additional explanatory variables.

In a short paper, Wen (2001) investigates whether household's residential investment is main engine of economic growth. Contrary to both the conclusion of De Long and Summers (1991, 1992) that the rate of capital formation in the form of equipment investment determines the growth rate and that of Blomstrom et al. (1996) that per capita GDP growth leads to rapid capital formation, Wen (2001) empirically suggests that capital formation in the household sector unambiguously and unilaterally Granger-causes GDP growth, which in turn Granger-causes capital formation in the business sector, based on post-war U.S. data.

Using recent OECD 30 member countries' and US state-level per capita output and per capita patents data, Ashraf and Mohabbat (2010) test the hypothesis that failure to control for an economy's R&D activity results in a biased estimates on the initial output in a growth regression equation. The number of per capita patents is used as proxy for an economy's R&D level. The results support the hypothesis and imply that after controlling for R&D level the estimated coefficient on initial output increases both in magnitude (in absolute terms) and in significant levels. It means output convergence to an economy's own steady state becomes much stronger after R&D activity is controlled for. In addition, the results are robust to the dataset used or the estimation procedure.

Meng and Ye (2009) introduce human capital externality and endogenous labor supply decision into growth model studied by Uzawa (1965) and Lucas (1988) and draw the following conclusions from the analysis: (1). if the time preference of the representative household is high, the short-run increase of output growth and the improvement of education level will be achieved at the expense of the accumulation of human capital, sustainable economic growth

as well as the growth rate of education expenditure in the long run; (2). if the representative household values leisure, the short-run increase in output will be followed by the decline of human capital and long-run growth; (3). if the representative household values knowledge, the increase of time spent on the accumulation of human capital will lead to a higher long-run output growth rate and the steady state growth rate of educational investment; (4). the increase of technological parameter which affects human capital formation will result in the improvement of social welfare and education level; (5). since there exists human capital externality, social optimal allocation can't be supported by decentralized economy equilibrium, under this circumstance, the government can induce the decentralized economy to achieve social optimal allocation by imposing lump-sum output tax, education tax or subsidy.

Chambers and Guo (2009) incorporate renewable natural resources, which are both a factor of production and measure of environmental quality, into an otherwise standard one-sector endogenous growth model. The analysis shows that sustained economic growth and a non-deterioration environment can be simultaneously present along the economy's BGP. Furthermore, growth rate along BGP is positively related to the steady-state level of natural-resource utilization in production. Empirically, Chambers and Guo (2009) use the Ecological Footprint series as aggregate proxy for natural-resource utilization in the economy's production process and regression shows that the estimated coefficient on the Ecological Footprint is positive and statistically significant at the 1% level. The empirical result support the key prediction of the authors' theoretical model that more intensive utilization of natural resources in production results in an increase in the economy's output growth rate.

## **5. Other topics concerning growth**

### *5.1. Inequality and growth*

Benhabib (2003) constructs a political economy model of inequality and growth in which there are two classes of agents. If the degree of inequality is high, the agents will choose non-cooperative solution in which political interference is invited and the growth rate will be low and remain as a constant. With the decline of the degree of inequality, the agents will choose cooperative solution and the growth rate will jump to a high level, thereafter, with the movement to the perfect equality, the growth rate will decline as



the more productive agents have less incentives to supply labor. The relationship between growth and inequality is, therefore, hump-shaped. In order to achieve maximal growth, the best bet for the social planner to pursue is to maintain a moderate level of inequality to elicit more labor effort from the productive agents in the economy.

Using the new data set by Deininger and Squire (1996), Li and Zou (2002) analyze empirically the impact of inflation on income distribution and growth. The empirical results reveal that inflation has the following several repercussions: (1). it exacerbates income distribution; (2). it increases the income share of the rich; (3). it decreases the income shares of the poor and the middle class substantially; (4). it harms economic growth.

Chen and Guo (2005) extends Li and Zou (1998) to obtain a theoretical synthesis on the relationship between inequality and growth. Unlike Li and Zou (1998), Chen and Guo (2005) postulate CRRA preferences for both private and public consumption goods in the period utility function. The postulation results in two modifications to the conclusions of Li and Zou (1998). First, negative relationship between inequality and the tax rate on capital income in Li and Zou (1998) turns to be indeterminate. Second, the conclusion that income inequality can help generate faster economic growth in Li and Zou (1998) doesn't hold definitely. With the distribution of income becoming unequal, the after-tax return to capital can remain unchanged or lower/higher compared to that obtained in the perfect equal circumstance as a result of the same or a higher/lower tax rate on capital income chosen by the median voter. It follows the relationship between income inequality and growth is ambiguous. The calibration of Chen and Guo (2005) divides the parameter space into regions that show a positive relationship between inequality and growth as in Li and Zou (1998) or a negative relationship as in Alesina and Rodrik (1994). Theoretical results on the relationship between inequality and growth are, therefore, synthesized.

### *5.2. Public expenditures and growth*

Gong and Zou (2002a) construct a stochastic model to analyze the relationship between the the growth and volatility of various government expenditures and the economic growth, the theoretical analysis is then followed by empirical evidence. Theoretically, when the elasticity of intertemporal substitution in consumption is relatively low, a rise in the volatility of government expenditures will result in a higher economic growth by eliciting more savings and investment. By comparison, when the elasticity of intertemporal

substitution in consumption is relatively high, a rise in the volatility of government expenditures will bring about a lower economic growth. As far as the effect of the mean of the growth rates of public expenditures on economic growth is concerned, when the elasticity of intertemporal substitution in consumption is relatively low, a rise in the mean of the growth rates of public expenditures will lead to a lower economic growth. On the contrary, when the elasticity of intertemporal substitution in consumption is relatively high, the increase of the mean of the growth rates of public expenditures will produce a higher economic growth. The author's empirical analysis consists of two parts since they distinguish the government expenditures by the economic purpose on the one hand and by the function purpose on the other. When the public expenditures are of economic type, empirically, the mean growth rate of current expenditures and output growth are positively and significantly correlated. However, the mean growth rate of capital expenditure has no relationship with output growth. The volatilities of both the growth of current expenditures and that of capital expenditures affect significantly and negatively output growth. On the other hand, when the public expenditures are of function type, the mean growth rate of general public services and output growth are negatively, but not significantly correlated, the variance of its growth rate and output growth are, however, positively and significantly correlated. Empirical results also reveal that while the estimated coefficients on the growth rates of spending on defense, education, human welfare, and economic services are all positive, only the estimated coefficient on the growth rate of economic services is statistically significant. In addition, growth in transportation and communication and output growth are negatively, however almost insignificantly correlated. Finally, the variance of the growth in transportation and communication and output growth are positively and weakly significantly correlated.

Gong and Zou (2002b) extend Barro (1990) to the case in which there are both federal and local governments. The revenue of the federal government, as described by Gong and Zou (2002b), is from its collection of capital income tax and consumption tax. Its disbursement involves the purchase of its own public consumption and its own investment on the one hand, and the transfers to the local government to subsidize its investment and consumption on the other. By comparison, the local government can receive revenue not only from its own collection of income tax, consumption tax and property tax but also from the federal government's transfer. Surely, the local government also purchases its own consumption and invests. Both

the federal government's and the local government's consumptions bring the representative agent utility, so do both the federal government's and the local government's capital. Furthermore, both the federal government's and the local government's capital are introduced into the production function in the new classical form. Gong and Zou (2002b) mainly analyze the way that federal taxes, local taxes, and federal transfers affect capital accumulation and consumption of the representative agent, the federal government and the local government. The outcome that the balanced growth rate is a nonlinear function of various taxes, federal transfers, technology and preference parameters induces the authors to turn to simulation. The simulation results reveal that local property tax has the greatest impact negatively on the rate of economic growth, by contrast, both the federal and local consumption taxes are beneficial to growth. In addition, the transfers to subsidize the local government to undertake the public investment always promote economic growth, the transfers to subsidize the local government to purchase public consumption, however, is harmful to growth.

### *5.3. Financial sector and growth*

Gupta (2011) develops a dynamic general equilibrium monetary endogenous growth model to analyze the growth effect of a tight monetary policy. The model comprises consumers, firms, a Cournotian monopolistically competitive banking system, and an inflation-targeting monetary authority. The analysis shows that it's possible to have multiple equilibrium and the stable equilibrium in which both growth and welfare are higher cannot be achieved unless financial sector development reaches a critical level. As for the effect of a lower inflation target on growth, the result is ambiguous in the sense that the ultimate effect depends on the following factors. They are respectively the initial level of growth, the individual bank size, thus, the level of financial sector development and the degree of competition, the degree of risk aversion and the elasticity of output with respect to capital or labor, besides, the size of the discount factor, the depreciation rate, the production scalar and the reserve requirements. However, the analysis tends to imply that once the financial sector development overtakes the critical level, it's possible that a tight monetary policy will promote growth when both financial sector development and growth are at their intermediate levels. When initial growth and financial sector development are both at high levels, however, a lower inflation target is more likely to promote growth if only the agent's risk aversion is relatively lesser.

A dynamic general-equilibrium model with production is developed by Chen et al. (2008) to investigate the relationships between real and financial sectors with and without credit market imperfections. The model is comprised of households, producers and banks. Each household lives for 2-period and is endowed with a unit of labor in the period when he is young, with the assumption that the household only consumes during the second period, the household deposits his wage income in bank for future consumption. Besides, each household is supposed to possess a fraction of the society's knowledge stock which grows at a constant rate. Each producer is infinitely lived and possess a technology to produce the single final good which uses physical capital and effective labor as inputs. In addition, Chen et al. (2008) suppose fractional loan-in-advance in the sense that each producer's physical investment is converted from bank loans in an efficient way. The financial sector is assumed to use only labor inputs to convert banking deposits into loans. Under some conditions, there exists a perfect foresight balanced growth equilibrium which has the following properties: (1). a cost-reducing banking innovation or a labor-augmenting technical progress increases bank loans per effective unit, enhances capital formation, and lowers the loan and the deposit rates; (2). a more efficient goods production has ambiguous effects on bank loans, capital formation and loan and deposit rates. In contrast with unconstrained case, Chen et al. (2008) also examines another case where there exists moral hazard that causes banks to ration loans. The moral hazard is introduced here parsimoniously in the sense that the bank cannot ensure that the money lent is indeed invested and thus fails to ensure the repayment, which captures Keynes's consideration of the lender's risk. Under some conditions, there exists a perfect foresight balanced growth equilibrium with credit rationing. Furthermore, the presence of credit constraints causes the loan and the deposit rates and the financial spread to increase, and effective bank loans and the effective capital formation to decrease. The comparative statics in the presence of credit rationing imply: (1). an advancement in banking or goods productivity raises the effective bank loans; (2). while an advancement in banking productivity results in a higher deposit rate and a lower financial spread, an improvement in goods productivity has ambiguous effects on them. The above-mentioned results imply that, in the absence of credit constraints, changes in productivity of real and financial sectors generate very different comparative-static outcomes in a steady state. However, the same changes are, when there exist credit-market imperfections, qualitatively similar. In addition, though it is certain that credit rationing causes

the loan rate to rise and the financial spread to become wide, it need not harm the real sector.

#### *5.4. Health and growth*

Gong et al. (2010) extend traditional Ramsey model by introducing health, which is a function of consumption, as a sector of output production. The analysis yields the following results: (1). when a rise in consumption induces the improvement in health capital, the consumption and nutrition driven health capital is not the motivation but the by-product of economic growth; (2). the resulting health capital is able to promote growth driven by exogenous technology; (3). numerical examples imply that there exist multiple equilibria of capital stock, health, and consumption. which is more realistic in the sense that rich countries may end up with higher capital stock, better health, and higher consumption level than poor countries; (4). consumption tax rate has negative effect on the long-run capital stock and the consumption, while the effects of income tax rate on the long-run capital stock and the consumption level are ambiguous.

Gupta and Vermeulen (2010) analyze the growth dynamics in a monetary endogenous growth overlapping generations model which is composed of consumers, financial intermediaries, firms and government. The consumers can endogenously choose their longevity by spending on private health which complements public health spending. The financial intermediaries accept deposits and make portfolio decision (loans and cash reserves choices). In addition, the firms use a Barro-type (1990) production technology which means that government's infrastructure expenditure can affect production. Finally, the government targets the inflation rate which implies that inflation rate remains constant over time. With the above-mentioned characteristics, Gupta and Vermeulen (2010) show that multiple equilibria will result. The low-growth equilibrium is unstable and locally determinate, by comparison, the high-growth one is stable and locally indeterminate. Furthermore, they show that endogenous fluctuation, even chaos can develop around the high-growth equilibrium under certain conditions.

## **6. Conclusion**

This paper has reported on some literature that attempt to analyze, theoretically or empirically, the problems appearing during the growth and development. To be concrete, we make a very preliminary survey on the following

literature on: (1). China's growth; (2). growth and development; (3). determinants of economic growth; (4). other topics concerning growth. They are respectively growth and inequality, public expenditures, financial sector, and health.

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