Econometric Analysis of the Relationship between Economic Growth and Rural Income Distribution in China

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Contents

Abstract

The increasing trend of income inequality in rural China has been an ongoing issue. Since economic reforms in 1978, China has been achieving an unprecedented and impressive growth, with the average per capita GDP growth rate approximately 9.2% per annum during the past three decades. However, economic performance coincides with an inevitable problem, i.e., the increasing inequality of income distribution. In China, national income inequality has drawn considerable attention due to rural-urban income gap and regional income disparity, since the uneven development of regions and urban-rural sectors are the hot spot of social problems in current stage due to the persistent urban biased policy and "open-door" reform policy initiated in 1978.

Rural income inequality has also been a concern in the literatures, most of which focus on the measurement of rural inequality. Rural China plays an important role in the development of Chinese economy. On one hand, industry-oriented development exploits the resources of rural sector and squeezes agricultural surplus for investments in heavy industries by price scissoring, specifically, by lowering agricultural prices paid to rural residents while raising the price of industrial products sold to them. On the other hand, there has been rural labor force surplus with the rapid development of rural sector under the implementation of persistent urban biased policy.

Migration in China contains two kinds of conception: the "formal" migration and the "informal" migration. Formal migration is those mobile populations who officially changed their *hukou* status. The "informal" migration, i.e. rural-to-urban labor force mobility, is those mobile populations who move to live at a new place without changing their *hukou* status. The latter is the conception of rural-to-urban labor mobility which is the main concern of this paper. Their incomes are also classified into rural group, although their incomes are relatively higher than that of rural residents with no mobility. Comparing with the families with no mobility, the total income of the family with labor force mobility is higher about 16%-43% (Taylor *et al.*, 2003). According to "The 2005 Sample Survey on 1% of China's Population", monthly net income per capita is up to 1038 yuan, which is higher than those of rural residents in the same period (Duan and Yang, 2008). If one family member transfers from rural to urban labor force, the family income will increase to 3509 Yuan (Zhao, 1999). 90% of labor force mobility in the urban area increases their annual income considerably, to 8783 Yuan on average (Li, 2003). Based on above statistic data comparison, rural-to-urban labor force mobility resulted in the inequality of rural China.

However, there are few studies focused on the effect of rural income inequality on economic growth. Obviously, the importance of rural economic development has been ignored for a long time by both academics and policy makers. "Three rural issues", namely stagnation of agricultural growth, peasantry poverty and less developed country, propelled the central government to abolish

agricultural taxes and increase investment in the agricultural sector since 2004. However, the income distribution of rural China hasn't been widely concerned, especially its impact on the economic performance and its determinants. Undoubtedly, high speed of economic growth contributes to the income inequality of rural sector. However, to what extend does economic growth contribute to rural income inequality? Those above concerns lead this study to pay attention to the relationship between rural income inequality and economic development.

There are four contributions of this paper. Firstly, Dagum (1977) distribution is introduced to measure rural income inequality. For the case of China, the calculation of Gini coefficient is mostly concentrated on decomposition. The most popular studies devote to inequality decomposition by the means of subgroups. There are some drawbacks by using Gini coefficient, which is hard to define and interpret surplus term R (Mookherjee and Shorrocks, 1982). Another argument is that the subgroups decompositions have variable types on weight. But parameter estimation can solve above problems well. There is a great amount of literature concentrating on model specification from two parameters to five parameters, even more. Two-parameter function is too simple to reflect the impact of economic fluctuation on the size distribution, whereas, five-parameter model is easy to loss simplicity. Thus, Dagum (1977) distribution (four-parameter model) is applied to estimate Gini ratio on Chinese family income data due to its various merits compared with other models. The Dagum distribution provides better fit to income data than the closely related Singh-Maddala distribution.

This paper employs household level data of rural China for the period of 1985-2010 to calculate income inequality of rural China. Two methods including Iterative I and maximum likelihood are employed to estimate the parameters of Dagum model. Through calculation, it is found out an increasing trend of rural income inequality since 1985. Dagum distribution fits household data well in the case of rural China. Maximum likelihood prefers to offer a higher Gini ratio since it avoids the approximate problem in Iterative I method. However, both of the methods provide an increasing trend of income inequality in rural China. Moreover, comparing Dagum distribution with naive study, it's found that Gini coefficient calculated by Dagum distribution is higher than native estimation by traditional paths. That is, Gini coefficient might be underestimated by the native estimation.

Secondly, the data of the period from 1978 to 2010 has been used to study the effect of rural income inequality on the growth of China economy. Empirical study shows there is a significant negative impact of rural income inequality on the economic growth in China. This finding is consistent with the theory of Persson and Tabellini (1994) and Alesina and Rodrik (1994), and also supports the conclusion that there is a negative relationship between growth and income inequality in poor countries held by Barro (2000).

Thirdly, the impact of economic performance on rural income inequality in China is investigated

by time series data of 1978 to 2010. The effect of rural-to-urban labor mobility is also included from 1998 to 2010 due to data unavailability. It can be concluded that economic growth, structural change and fiscal expenditure have significant negative impact on rural income inequality. However, migration and educational input show a significant positive relationship with rural income inequality. With distinguishing intra- and inter- provincial labor mobility, the effect of rural-to-urban labor mobility on rural income inequality is also taken into consideration, since there is significant disparity in occupation, income and social security between inter- and intra- provincial labor force mobility. Empirical study shows that both inter-provincial labor force mobility and intra-provincial labor force mobility increase income inequality of rural China. Comparatively, the effect of intra-provincial labor force mobility on rural income inequality is larger (6.258) than that of inter-provincial labor force mobility (0.891).

At last, this study concentrates on the fundamental determinants of rural income inequality by applying regression-based decomposition due to the shortcomings of traditional decomposition, such as by population sub-groups and factor components. Individual level data collected by Chinese General Social Survey (CGSS) is used to decompose. CGSS, which started in 2003, covers from 2003 to 2008 for the first stage. The years of 2003, 2005, 2006, and 2008 are taken to analyze the determinants of rural inequality. Measurement results show that rural income inequality is extremely unequal with a rising trend. Gini coefficient in 2003 was 0.5383, while in 2008 it increased to 0.5878. The estimation coefficients of income generation function show that the coefficients of gender, happiness and regional disparity of eastern provinces are significant positive in all selected year. Political status, marriage, health have significant positive effect on personal income except 2003. Religious belief, the education of father and the political status of father are insignificant. The coefficient of age is significant positive in all selected year except 2005. Other variables show the inconsistent effect (with positive effect on income inequality if it is significant) in different years. Decomposition results show that age, education, gender, eastern dummy, political status, marriage, health and happiness are determinants of rural income inequality.

In general, this study offers empirical evidence for policy makers to look at the development in rural China. The increasing trend of rural income inequality is harmful to the economic growth in China. Reduction of rural income inequality is one of main concerns for policy makers. If the central government can put more resources into developing rural areas, such as fiscal expenditure budget, educational resources, agricultural policies, and so on, income inequality will certainly be greatly alleviated.

Keywords: Rural Income Inequality; Economic Growth; Rural-to-urban Labor mobility; Regression-based Decomposition

Chapter 1: Introduction

1. Introduction

1.1 Background Information

Since economic reforms in 1978, China has been achieving an unprecedented and impressive growth, with the average per capita GDP growth rate of approximately 9.2% per annum during the past three decades. Economic performance should not focus solely on income growth, but also take into account income distribution. Coinciding with rapid economic growth is a marked increase in income inequality. Rising national inequality is contributed to regional inequality, rural-urban inequality, within rural and urban inequality. In recent years, China has had alarmingly high income disparity levels and has become one of the countries with most unequal income distribution in the world.

A considerable great amount of literature has been paid attention to national inequality, regional inequality, rural-urban inequality, urban inequality. However, rural income inequality and its impact on economic growth are ignored. Several reasons urge this study focusing on rural areas (Zhong, 2011). Firstly, the majority (about 75%) of the population in the developing countries reside in rural areas (Anríquez and Stloukal, 2008). As for China, this proportion is approximate 82% in 1978 and 50.05% in 2010. Thus, such a study might be more useful to the policy makers making effective plan to develop rural economy. Secondly, there are compelling reasons to anticipate that the impact of population aging may be more pronounced in a rural setting. There is a substantial danger of underrating the distributional significance of an aging population if the critical role of age-related redistributive tax transfer systems is ignored, such as public pension schemes and health care systems, which are usually non-existent or very poorly established in rural areas compared with those for the urban population. Moreover, for those rural workers in a developing country like China, they are more likely to exit the labor force before reaching the official retirement age in urban areas due to a combination of factors including the nature of the work undertaken by the majority of workers, i.e. agricultural or low skilled labor-intensive work, and the poorer physical health of workers compared to developed countries. Thirdly, aging in developing countries usually occurs earlier and proceeds more rapidly in rural areas than in the urban sectors (Stloukal, 2004), which is mainly caused by rural-to-urban migration which comprises mainly younger adults and thus increases the proportion of older persons in the villages. Therefore, the consequences of aging are felt most by the rural population.

The primary motivation for China's economic reforms was to increase economic growth, and raise living standards after nearly twenty years of stagnation. In rural China, significant grains in income

growth during the late 1970s and early 1980s resulting from the introduction of HRS[1] pulled tens of millions out of poverty. Further reductions occurred through the early-to-mid 1990s, but there was deterioration the last half of the 1990s, that may have reversed in only the last year or two. There remain reasons for concern, at least as far as Benjamin *et al.* (2005) shows, for a significant number of households, incomes have remained flat or fallen for a decade or more, and the very poor may be worse off.

Although economic reforms have achieved impressive growth, rising income inequality is considered one of the effects of the economic reforms. In rural areas, increased inequality is primarily related to the dis-equalizing role of non-agricultural self-employment income and slow growth in agricultural income from the mid-1990s onward. Poverty persists, and tied in part to slow growth in agricultural commodity prices. In a long term, China implements "urban-biased" policy to promote the development of secondary industries and exploit rural resources in the same time. A large scale of rural-to-urban labor force mobility, caused by widening rural-urban income gap, accelerates the process of worsening rural income inequality. Both inter-provincial mobility and intra-provincial mobility are significant positive link with rural income inequality.

1.2 An Illustration of Rural Income Inequality

As it refers to income inequality in Rural China, three major policy areas that have adversely affected rural incomes are mentioned, namely, the restrictions on rural-to-urban migration, the less accessibility of education in rural areas, and the urban-biased allocation of investment and credit (Johnson, 2000). Several special development pattern of rural China should be illustrated, including "urban-bias" policy, "price scissors" system, rural workforce mobility and *hukou* system[2].

1.2.1 Household Registration System

The special Household Registration System, i.e. "*hukou*" system, which originated in 1951, was not intended to control the mobility of the people. It was built to tie farmers to the land in order to stabilize agricultural production (Davin, 1999). However, from the mid-1950s, the government repeatedly introduced measures to stem rural outflows. The *hukou* system turned to be an instrument to control population mobility. Since then, for more than half a century, the *hukou* system in China has segregated the rural and urban populations, initially in geographical terms, but more fundamentally in social, economic, and political terms.

The industrialization strategy led China to create two different catalogs of society. On the one hand the rural residents, who were tied to the land to produce an agricultural surplus for

[1] HIS is Health and Retirement Study for short, which is a longitudinal study of health, retirement and aging sponsored by the National Institute on Aging.
[2] For detailed information of "*hukou*" system, please refer to Chan (2010).

industrialization and who had to fend for themselves. On the other hand the urban citizens, who worked in the priority and protected industrial sector and had access to (at least basic) social welfare and full citizenship. It is difficult for rural residents change status from the rural to the urban category, since their *hukou* was tightly controlled and permitted only under very limited conditions, commonly when needed for the state's industrialization objectives. It is indeed an important ascribed attribute in determining one's social and economic circumstances. To some degree, the *hukou* system was not merely a means of limiting rural-urban population and labor mobility, but also a system of social control aimed at excluding the rural population from access to state-provided goods, welfare, and entitlements. It is like a kind of invisible door to keep rural migrants outside and strengthen rural-urban divide in China. Under this system, people with rural status are treated as second-class citizens, deprived of the opportunity to settle legally in cities and of access to most of the basic welfare and state-provided services enjoyed by regular urban residents.

Special "*hukou*" system of China is often attributed to the main cause of China's urban-rural income inequality for inhibiting labor mobility except for "*pull*" and "*push*" factors. Whatever how long the peasants work in the city, they cannot have an urban *hukou*, hence have no chance to get access to urban social services. Specifically, rural migrant workers are treated legally as part of the rural *hukou* population, even though they may have worked and lived in an urban area for many years. For example, although a cleaning worker with rural status has employed in state-owned enterprise for 36 years, she is still a temporary worker with salary of RMB 700. She cannot change her status from rural to urban class and have no right to participate in social ware and high income like formal workers.

As a whole, the *hukou* system is integral to China's socioeconomic structure and development strategy. It is necessary to reform such an uneven system, especially abolish, since it entails breaking down China's current dualistic structure, universalizing state-provided social security and some other social services(such as affordable health care) that are currently enjoyed by less than half of the population. Although The State Development Planning Commission announced in 2001 its aim to abolish the *hukou* system in the following 5 years (China Reforms Residence Registration System), however, registration still continues to play an important role in Chinese society.

1.2.2 Urban-biased Policy

Urban-biased policy which accounts for enlarging rural-urban income gap has long been the dominant economic policy in China. Following the development model of the former USSR, China gave priority to the development of heavy industry at an early stage of industrialization. While industry mainly located in urban China, the path of China's development became "industry promotion by agriculture", i.e. all agricultural resources, including grains, labor force, capital, policy

biases and so on, supply from rural to urban, to support the development of industry. Therefore, the urban biases that existed before the reform era seem to have become more serious. The sharing tax system reform initiated in 1994 strengthened the urban biased policies. Nowadays, China is still experiencing increasing urban bias.

In the history of Chinese economic growth, cities were always endowed prior to develop by Chinese government; meanwhile, rural areas played an important role of offering all the resources cities needed. That is, cities exploited rural resource in a long time. The extreme urban bias leads to severe social problems such as the stagnation of agricultural output and the less developed country. The situation still sustains, which causes nowadays the backwardness of rural development. In result, the agricultural sector failed to provide the government with sufficient resources to preferentially develop the industrial sector and to fulfill the government's objective for catch up.

It has been shown that the urban biased policies contribute to the evolution of the rural-urban income gap in China (Cheng and Li, 2007). The persistent urban bias leads to a severe rural-urban income gap and diverts physical as well as an effect of diverting the rural resource out of agricultural sector, and thus is detrimental to agricultural growth. The development of agricultural sector is important for rural residents since it is the main source of income for most of the peasants. It is admitted that the persistent agricultural growth results in shrinking rural-urban income gap, given the prices of agricultural products and urban residents' income.

"Three rural issues", namely stagnation of agricultural growth, peasantry poverty and less developed country, propelled the central government to abolish agricultural taxes and increase investment in the agricultural sector since 2004. However, there is no obvious evidence showing that the local governments are inclined to reduce urban bias especially when they expropriate farm lands for the non-farm use (Gao, 2010).

1.2.3 Rural-to-urban Labor Force Mobility

Rural labor force mobility is the biggest contribution to income inequality in rural China. "Urban-bias" policy is attributed to the main cause of big scale of rural labor force mobility from rural to urban China. After economic reform, China is now the largest recipient of foreign investment, mainly as a result of increasing interest in its internal market and the availability of cheap labor. Coastal urban cities developed with a surprising speed owing to FDI inflow, policy bias and so on, which caused large amount of labor force demands. The uneven economic development of rural and urban areas combined with a large pool of surplus labor has been the main driving force behind the world's largest internal migration of rural residents to the cities in China.

By the mid-1990s, labor force with rural status had become the backbone of the manufacturing

sector and export industry. Rural-to-urban migration deeply transformed the structure of household incomes in rural China. Remittances gradually became an important source of income for rural households and served as an engine of growth for rural areas (de Brauw and Giles, 2008). In coastal export centers such as Shenzhen and Dongguan, migrant labor now accounts for by far the greater part, almost 80% of the labor force (Chan, 2009). Rural migrant labor's contribution to the GDP was estimated at about 30 and 31 percent of the GDP of Beijing and Shanghai respectively in 2007 (Cai, 2009).

"Rural migrant labor" (*Nong Min Gong*) has a specific meaning in China, which refers to industrial and service workers with rural *hukou*. Rural-to-urban labors, though working on urban jobs and residing for the most part in towns and cities, are not considered legally to be urban workers since rural migrant is not a temporary status but permanent. Clearly, they are not eligible for regular urban welfare benefits and other rights that are available to those without urban *hukou*.

Rural labor force also came to staff most of the low-end services in urban areas. The migrant labor market has remained a secondary labor market "of unskilled jobs, poor wages, and insecure employment" (Schmitter, 2000), showing no signs of integration with the local urban labor market (West, 2000). In many cities and export zones, local decrees have forbidden migrants from taking up jobs other than those in the low-skilled 3-D ("dangerous, dirty, and demeaning" and often physically demanding) category. Other artificial barriers include high housing costs and regulations making it harder for migrants to rent housing in the cities, pushing them to suburban areas where the lack of social services and police protection is pervasive (Zhao, 1999). In recent years the government has carried out reforms of the *hukou* system so as to allow greater mobility, but substantial barriers remain (Wang, 2004).

Migration enlarged the income distribution of rural China due to an increase of non-farm income in total income for the following reasons: (1) distribution of non-farm income is more unequal than that of farm income; (2) richer households have higher chances to participate in migration and local non-farming activities; (3) households with higher income are characterized by a higher participation rate in non-farming activities and a higher share of non-farm income in total income (see, for example, Zhu, 1991).

1.2.4 Price Scissors System

Price scissors system enlarges the income inequality of rural China. Before the economic reform in 1978, China adopted a heavy-industry-oriented development strategy. As is known, heavy industries were capital-intensive and required huge capital inputs and long gestation. However, at that time, China was almost a closed economy, which caused capital scarce. Therefore, the only way left for the government was to squeeze agricultural surplus for investments in heavy industries by

lowering agricultural prices paid to peasants while raising the price of industrial products sold to the peasants. Under this strategy, it is common for the government to select the price scissors against peasants in favor of industrial development (Lin and Yu, 2008).

Furthermore, rural collectivization tightened the links between farmers' income and their daily work-participation in collective agriculture: a farmer earned "working-points" proportionately to the time spent on the collective land. The real income of farmers was artificially lowered through the socialist price system, which over-priced manufactured products to raise profitability in industry while squeezing agriculture through the "price scissors". Low grain price and high cost accelerate rural residents flow into urban sector and increase rural income inequality further for lower income in rural sector.

1.3 Research Objectives and Significance

There are two reasons that more attention should be paid to rural China. Firstly, about 82% population is from rural areas, i.e. population with rural household registration status (simply, rural *hukou*), who live in the rural China in 1978. Even with the acceleration process of urbanization in 2009, this proportion in rural areas still takes up more than a half of the total population. Rural income inequality increased rapidly from 0.33 in 1978 to 0.42 in 2009 with the max value at 0.43 in 2008 and the min value at 0.25 in 1981. Secondly, a large scale of rural-to-urban labor force mobility makes income inequality in rural China more special due to stringent *hukou* system. Rural-to-urban labor force also has impact on the rural income inequality. As a special group, rural residents share urban resources such as education, job opportunity, housing and so on. However, their statuses are still rural "*hukou*" and have no rights to enjoy social welfare that is offered to urban residents.

Domestic scholars have also paid great attention to the rising income inequality by family grouped data. However, rural income inequality is far from being concerned, especially its impact on economic development and how economic growth affects rural income inequality. The central theme of this paper is to study the relationship between economic growth and personal distribution of income in rural China. Does inequality in the distribution of income increase or decrease in the course of China's economic growth? Does economic growth affects personal income distribution of rural China? What kinds of factor determine the secular level and trends of income inequalities? In order to search for the answers, this paper will employ time series data to investigate the relationship between economic growth and rural income inequality. At last, rural income inequality will be decomposed by income sources according to micro individual-level survey data.

The rest of this paper is arranged as follows. Chapter 2 is the previous studies of income distribution and economic growth. In Chapter 3, I would like to introduce the measurement of rural income inequality by Dagum (1977). Rural income inequality impact on economic growth will be

discussed in Chapter 4. Chapter 5 displays how economic growth affects rural income inequality in China. The decomposition of rural income inequality by applying regression-based approach will be explored in Chapter 6. At last, I will demonstrate the conclusions of this paper in Chapter 7.

2. Previous Studies

2.1 Income Distribution and Economic Growth

The literature on the relationship between inequality and growth is large and still growing. In classical economic theory, income inequality was thought to influence economic growth rates through savings and consumption. Economic growth was possible only when there were enough rich people in society since only rich people saved (Smith, 1811). Keynes (1936) argues that income inequality leads to slower economic growth. Demand is the basis of investments, while inequality lowers aggregate consumption, thus inequality of incomes will diminish economic growth. Kuznets (1955) suggests the inverted U-shaped relation between income inequality and economic growth. In poor countries, economic growth increased the income disparity between rich and poor people. In wealthier countries, economic growth narrowed the difference.

2.1.1 Theoretical Literature

The study of the relationship between income distribution and economic growth has been paid great attention in the academic literature since 1990's. The relationship between income distribution and economic development was first identified by the seminal work of Kuznets (1955) as the famous inverted U-shaped relationship between income and inequality. As the study continues, Kaldor (1960) and Kalecki (1971) first discusses the role of inequality in determining economic growth.

Theoretical literature on income distribution and growth can be classed into four broad categories in relation to the main feature stressed (Perotti, 1996; Panizza, 1999), including endogenous fiscal policy (Meltzer and Richard, 1981; Persson and Tabellini, 1992, 1994; Bertola, 1993; Perotti, 1993; Alesina and Rodrik, 1994; Krussell *et al.*, 1997; Acemoglu and Robinson, 1996; Bénabou, 1996a, 1996b; Bourguignon and Verdier, 1997; Chang, 1998), Socio-political instability (Benhabib and Rustichini, 1991; Grossman and Kim, 1996), imperfect capital markets and investment in education (Benerijee and Newman, 1991; Galor and Zeira, 1993), and endogenous fertility(Barro and Becker, 1989; Becker *et al.* 1991; Perroti, 1996; Dahan and Tsiddon, 1998).

Endogenous Fiscal Policy

The taxation level and government expenditure is a result of the voting process in which income is the main determinant of a voter's preferences. Poor voters, who will either pay a lower share of taxes or disproportionately benefit from government spending, prefer a higher level of taxation (Romer, 1975; Roberts, 1977; Meltzer and Richard, 1981). Therefore, if there are large amount of poor agents with income inequality in a society, they will vote for higher taxation, which will negatively affect the investment and therefore growth. There are three contributions in the literature on the fiscal

channel: public investment, redistribution from capital to labor, purely redistributive transfers.

The first one is public investment (Alesina and Rodrik, 1994). The political mechanism is that the higher the ratio of capital income in total income for one individual, the higher the price the individual has to pay for the benefits of public investment and therefore the lower the individual's preferred tax rate. According to the median voter theorem, the level of taxation preferred by the median agent in the distribution of resources will prevail over all the other proposed tax rates when agents vote on the tax rate. The economic mechanism is that public investment is financed by proportional taxation of capital income. If taxes increase in order to finance more public investment, the after-tax return from private capital investment decreases. This effect tends to decrease the rate of investment and therefore economic growth. In terms of income distribution, the poorer the median voter in relation to the voter with average income, the higher the equilibrium tax rate and the lower the growth rate. Therefore, this kind of model implies a negative relationship between growth and inequality in income or wealth.

The second one is redistribution from capital to labor (Bertola, 1993). The political mechanism is also similar to that of Alesina and Rodrik. However, the economic mechanism is different since revenues from taxation are used for redistribution, not for infrastructure investment. Capital income is taxed, and the proceeds are directly redistributed to agents who derive their income from labor. The higher the proportion of capital income to labor income, the more an individual has to lose from a proportional tax rate on capital that is redistributed to the individual in proportion to the individual's labor income. This implies a positive link between the income of the median voter and the growth rate of the economy.

The third one is purely redistributive transfers (Persson and Tabellini, 1991), which mainly focuses on redistribution from rich agents to poor agents, rather than from capital to labor. In the political mechanism, poor voters pay a relatively small amount in taxes but receive the same benefits as rich voters because taxes are redistributed lump-sum. The implication is that the poorer the median voter relative to the average, the higher the tax rate and again the lower the rate of investment and growth since tax rate favored by an individual is inversely related to the individual's income. In the economic mechanism, agents work and investment in human capital, while taxes are proportional to income that one receives. The revenues are redistributed in a lump-sum to all agents. Therefore, higher tax discourages investment in human capital and therefore reduces economic growth. Other contributions in this field see Perotti (1993b) and Saint-Paul and Verdier (1991).

Political Instability

The distribution of resources is linked to large incentives for the poor to engage in rent-seeking activities, which hinder investments and growth (Ben-Habib and Rustichini 1991). The more

unequal the distribution of income, the larger the number of people who engage in illegal activities that pose a threat to property rights (Fay, 1993). If the mean income in an economy is bigger than the median income in an economy, it tends to favor redistribution of resources from rich to poor. Redistributions may involve explicit transfer payments but can also involve public expenditure programs (such as education and child care) and regulatory policies.

A greater degree of inequality motivates more redistribution through the political process. Consequently, the transferring payments and the associated tax financing distort economic decisions so as to reduce investments. Inequality reduces growth as greater amount of inequality induces more redistribution. Moreover, the effects of transfers through the political process arise if the distribution of political power is uniform and the allocation of economic power is unequal. If more economic resources translate into correspondingly greater political influence, the positive link between redistribution and inequality would not apply. The rich may prevent redistributive policies through lobbying and buying votes from legislators, which would consume resources and promote official corruption. Thus, it is also possible that there is negative relationship between inequality and growth even if no transfers are observed in equilibrium.

The political instability channel also emphasizes the effect of income inequality on social unrest. This hypothesis stresses two links. One is from income distribution to political instability; the other one is from political instability to growth. A large group of poor citizens, facing a small but very rich group of well-off individuals, is likely to become dissatisfied with the existing socioeconomic status quo and demand radical changes. Inequality of wealth and income motivates the poor to engage in crime, riots, and other disruptive activities. The participation of the poor in crime represents a direct waste of resources since it wastes the time and energy of the criminals which could have been devoted to production. At the same time, defensive efforts by potential victims represent a further loss of resources. Furthermore, property rights threats prohibit investments. Thus, inequality tends to reduce the productivity in a society as a result of various dimensions of socio-political unrest.

Imperfect Capital Markets

The credit-market imperfections typically reflect asymmetric information and limitations of legal institutions. Specifically, in imperfect credit market, lenders do not have the complete information about the borrowers, whether they have the capacity to pay back the debt or whether they are willing to pay (asymmetric information).The limited ability to borrow means the returning rate on investment opportunities are not necessarily equated at the margin. Lender needs to trust the borrower to commit and to pay back the debt or there needs to have a third party to enforce the contract as it is more difficult to enforce contracts ex post (limited commitment). For example, creditors may have difficulty in collecting on defaulted loans because law enforcement is imperfect.

Collection may also be hampered by a bankruptcy law that protects the assets of debtors. Moreover, since the exchange does not happen at the same time, there is always space for renegotiation.

Imperfect information about individual abilities and imperfect enforcement of loans severely restrict the option of borrowing for education due to imperfect capital markets. Most people mainly depend on their own resources to invest in education. Therefore, the exploitation of investment opportunities mainly depends on the assets and incomes of individuals' levels. The initial distribution of personal resources determines how many agents can invest. Poor households tend to give up human-capital investments that offer relatively high rates of return. In such a situation, redistribution of assets and incomes from rich to poor tends to improve the opportunity which the poor get access to investment and raise average productivity of investment. As a consequence, the growth rate of the economy decreases (Galor and Zeira, 1993; Banerjee and Newman, 1991). With this respect, reduction of inequality increases the growth rate of economic development.

If legal institutions and capital markets tend to improve as an economy develops, the effects of capital-market imperfections are more important in poor countries than in rich ones. Therefore, the predicted effects of inequality on economic growth would be larger for poor economies than for rich ones.

Endogenous Fertility

Some economists hold the view that endogenous fertility, especially individual saving rates, increases with the level of income. That is, the redistribution of resources from rich to poor tends to slow down the aggregate rate of saving in an economy. Through this channel, increasing inequality tends to raise investment. Under such a situation, more inequality would be preferred to promote economic growth. The aggregate saving rates provide a positive effect of income inequality on economic growth.

2.1.2 Empirical Studies

Despite the great success of theoretical literature on this topic, the progress of its empirical side has been much slower due to the obstacles of data availability and the difficulty of finding measures of redistribution that are comparable across countries. Empirical studies on the effect of income distribution on economic growth are quite controversial. Most studies concur on the view of negative relationship and insist that inequality is harmful for growth. Alesina and Rodrik (1994) regress the average growth rate over 1960-1985 on Gini coefficient of income by OLS and Two Stage Least Square (2SLS). The estimated coefficients imply that income inequality is negatively correlated with subsequent economic growth. Persson and Tabellini (1994) regress the average growth rate of GDP over the same period on the income share accruing to the third quintile of the income distribution for a cross-section of developed and developing countries by Ordinary Least Square (OLS). They

conclude a significant and large negative relationship between income inequality and economic growth theoretically and empirically employing both historical panel data and postwar cross sections by using. Similar results are obtained by Perotti (1996) for a larger cross-section of countries by OLS and 2SLS. The following work by Panizza (1999) use the cross-state data-set from US states to confirm the negative relationship between income inequality and growth by the method of OLS. Related contributions also see the work of Aghion *et al.* (1999). However, Deininger and Squire (1996) fail to find a systematic link between income inequality and growth by using a new and improved cross-country data set on inequality. The main reason for the lack of relationship appears to be that, whether average incomes are increasing or declining, changes in the Gini coefficient of inequality tend to be small. But there is a strong negative relationship between initial inequality in the asset distribution and long-term growth by OLS (Deininger and Squire, 1998).

A few other studies challenge the belief that income inequality has a negative effect on economic growth. These findings stand in sharp contrast to the negative association between inequality and growth. By focusing on a generalized method of moments (GMM) technique, Forbes (1998) suggests that in the short and medium term, an increase in a country's level of income inequality has a significant positive relationship with subsequent economic growth. Li and Zou (1998) show that income inequality is positively, and most of the time significantly, associated with economic growth employing the panel data (covering 112 developed and developing countries) and applying both fixed and random effects, OLS and 2SLS technique.

On the other hand, according to data on income inequality come from the extensive compilation for a large panel of countries in Deininger and Squire (1996), Barro (1999) provides evidence for a negative relationship between growth and income inequality in poor countries and a positive relationship in rich countries by the estimation is by three-stage least squares (3SLS). However, this relation does not explain the bulk of variations in inequality across countries or over time. Fallah and Partridge (2007) show that the impact of inequality on economic growth is opposite in rural and urban settings. Kuznets (1955) states the relationship between income distribution and the level of economic development is likely to be the inverted U-shape. At the same time, many studies state economic growth reduces absolute level of poverty depending on the economy's income distribution (Goudie and Ladd, 1999). Despite above existing debate, most empirical studies support the conclusion of negative link between income inequality and economic growth. Countries where income was more equally distributed tended to have longer growth spells (Berg and Ostry, 2011).

Other studies insist income inequality may also affect economic growth rates more indirectly. Murphy *et al.* (1993) demonstrate that property crimes, vandalism, theft and corruption in particular can harm economic growth by discouraging investments and lowering productivity by inflicting additional costs on companies. Income inequality can also increase corruption and illegal

rent-seeking (Jong-Sun and Khagram 2005).Other factors, human capital, division of labor, and taxation have also been linked to economic growth through income inequality by fixed effects technique (Forbes, 2000).

It may seem counterintuitive that inequality is strongly associated with less sustained growth. Hence, the focus of the recent literature on this topic is to look at over the long term and pay attention to efficiency, equality and sustainable growth (Berg *et al.*, 2011), since igniting growth is much less difficult than sustaining it (Hausmann *et al.*, 2005). Chaudhuri and Ravallion (2007) stress that some inequality is essential to the effective functioning of a market economy and the incentives needed for investment and growth, but too much inequality might be destructive to growth.

Most of the researches dealing with the inequality-growth relationship have either concentrated on the effect of income inequality on economic growth (Fallah and Partridge, 2007) or the impact of various socio-economic variables on inequality. However, studies assessing whether economic growth affects income inequality have been few. Chambers (2007) makes effort to study past growth impact inequality by using a broad panel dataset and semi-parametric methods. Majumdar and Partridge (2009) aims to see how economic growth affects income inequality and tries to study the impact of economic growth on income inequality using the country-data from 48 countries, but there is still no accomplished version.

2.2 The Relationship between Income Inequality and Economic Growth in China

The income inequality impact on economic growth in China has been an ongoing issue. Widening gap in China's national inequality is due to increase in regional inequality, within-urban and within-rural inequalities, and the inequality between urban and rural sectors. Hence, most of the studies connecting with economic growth concentrate on regional inequality, rural-urban inequality, urban inequality and rural inequality.

Regional Inequality In the past 25 years, the coastal areas have experienced phenomenal growth while the interior areas have lagged behind. Regional income inequality, which is mainly caused by abundant speculations such as globalization, policy biases, decentralization, and different endowments of geographical or other resources (Yang, 1999), has been significantly concentrated (Yao and Zhang, 2001; Kanbur and Zhang, 2005; Hao and Wei, 2010). A large number of studies exist on the measurement of regional income inequality in China and its increasing trend (Tsui, 1991; Lee, 2000), which is also followed by income inequality decompositions for finding out regional contribution to inequality (Kanbur and Zhang, 1999; Wan *et al.* 2007) and the effect on economic growth (Chen and Fleisher, 1996). Li *et al.* (2000) report the intra-provincial per capita income Gini ratio to have been rising almost consistently from 0.32 in 1978 to 0.42 in 2000. The main perspective of these studies is the measurement of regional disparity and the channel to affect economic growth,

instead of stressing on economic growth directly.

Rural-Urban Income Inequality The most striking feature of the rising inequality in China is the increasing income gap between the rural and urban areas. The urban-rural gap is the main driving force for increased national inequality (Tsui, 1993; Sicular *et al.*, 2007).Widening rural-urban income inequality has attracted considerable attention from both policy circles and academics. To date, a large range of studies have examined China's urban-rural income gap based on variable data sample with the similar results of rising trend, see for instance Knight and Song (1999) and Wan *et al.* (2006).

Urban Income Inequality Cities have always been focal points for economic growth, innovation, and employment (Cohen, 2006). Urbanization is the main engine of economic growth with the urbanization rate over 50%. The process of urbanization accelerates with urban income inequality. A variety of studies have examined within-urban income inequality of China (Khan *et al.*, 1999; Xu and Zou, 2000; Meng, 2004; Okushima and Uchimura, 2005; Démurger *et al.*, 2006). Jin (2007) empirically denotes that economic growth has positively significant (but not robust) impact on the urban income inequality. However, few studies concentrate on the effect of urban income inequality on economic growth.

Rural Income Inequality Income inequality in rural China has also been paid great attention. The main concern concentrates on the measurement of inequality (see Wan, 2001; Gustafsson and Li, 2002; Wan and Zhou, 2005). Targeting on the inequality on household economic growth, empirical works have been done. Using a detailed household-level data set from rural China, Benjamin *et al.* (2006) find robust evidence that initial inequality is negatively related to subsequent household income growth.

In general, income inequality in China has been attracted a considerable considerations. There are a great number of studies concerning about regional inequality, rural-urban inequality, urban inequality and rural inequality, concentrating on measurement. However, the effect of inequality on economic growth is lack of empirical evidence. The existing studies mainly focus on the relationship between local rural inequality and the growth of household incomes. There are few studies contributing to the link between macroeconomic growth and rural income distribution. Turning to opposite side, studies assessing whether economic growth affects income inequality have been few. There is no related literature focusing on this topic, especially rural income inequality. This study will provide empirical evidence for the relationship between income inequality and economic growth in rural China.

3. Measurement of Rural Income Inequality

3.1 A Review on Measurement of Personal Income Distribution

The distribution of income has been a central concern in academics since 1990s. The history of study on income distribution follows two mainstreams, that is, the functional distribution of income and the measurement of inequality in income (Dagum, 1999). The functional distribution of income, which deals with the income distribution among the owner of the factors of production and the price determination of each productive factor, stems from Ricardo (1815, 1817). It accounts for the factor prices formation (e.g. rent, wage and profit) and the share that the corresponding factors of production (e.g. land, labor and capital) have in national income. The measurement of inequality in income, which is called the size or personal distribution of income, stems from Pareto (1895) and studies the shape of income distribution and measurement of inequality. It is mainly concerned with the size distribution of income among individual, household and other unites. The total income received by each economic unit is considered, regardless of the factors of production that contributed to its amount or the income components (e.g. wages, investment income). The first topic has been focused on for a long time. However, the present concerns concentrates on the size or personal distribution of income.

3.1.1 Stem of Personal Income Distribution Theories

For explaining the size of income distribution, the various theories have emerged from two schools of thought. The first is called the theoretic statistical school proposed by Roy (1950), Champernowne (1953), Aichinson and Brown (1954a), Rutherford (1955) and so on, which is known as stochastic models and contributes to explain the generation of income. The partial explanation of income generation process and the lack of highlighting on economics of the distribution process make stochastic models critical. To overcome the shortcoming of stochastic models, the second school is called the social-economic school, which contributes to seek the explanation of income distribution with the help of economic and institutional of income distribution. This school has three groups of authors. Firstly, the approach initiated by Mincer (1958) followed with human capital path on the basis of the hypothesis of lifetime income maximization. Subsequently, this theory developed by Becker (1962, 1967), Chiswick (1968, 1971, 1974), Husen (1968) and De Wolf and Van Slijpe (1972). However, human capital approach mainly deal with the supply side of market which provides labor of various levels of education and cannot deal with the demand side of market. Secondly, to solve the above problem, education planning school by Tinbergen represented by Bowles (1969), Dougherty (1971, 1972) and Psacharopoulos and Hinchliffe (1972) emerged. This group denotes that demand for various kinds of labor is derived

from production function. Finally, the supply and demand school, which considers income distribution as a result of the supply and demand for different kinds of labor, is suggested by Tinbergen (1975). This theory applies not only to labor income but also to incomes from other factors of production.

3.1.2 Development of Models

The present study of personal distribution focuses on several domains: income distribution function; measurement of degree of income inequality and poverty; government policies affecting personal distribution of income. Major concerns for academics and social reformers are the statistical measurement of inequality and analysis of income distribution since the phenomenon of income inequality has been a source of worldwide social upheaval. Since Pareto (1895) started to explore the field of income distribution and proposed famous models known as the first, second and third Pareto laws with the assumption of "normal distribution" or "the Gaussian distribution", a successive surge of literature on probability functions appeared. A variety of probability functions were proposed as suitable in describing the distribution of income by size using both a combination of known statistical distributions (Nirei and Souma, 2004) and parametric functional forms for the distribution of income as a whole. These functional forms can be grouped in the following three main categories by Dagum (1977).

Stochastic Process The first category is functional forms proposed to describe the generation of income distribution by the means of a stochastic process. A statistical description of income distribution was defined by Aichinson and Brown (1954b) as follows. Given for each value of income x, the proportion $F(x)$ of persons in a given population who have an income not greater than x, where $F(x)$ should be given a precise mathematical expression through known or unknown parameters, including four criteria, that is, the economic meaning of the estimated parameters of the description; the relationship between theoretical description and practical evidence; the tool employed to analyze the data; the consistence between statistical description shown to rest on assumptions and common knowledge if the way in which incomes are generated.

This kind of model was initiated by Kapetyn (1903) who attempted to be at once a popular presentation of statistical methods and a mathematical derivation of a new theory regarding skew frequency curves. Gibrat (1931) was the first to popularize the idea of stochastic process with the contribution of showing that the distribution of the logarithms of some economic variates, such as the firm size distribution (FSD), is approximately normal, which is known as lognormal distribution or Galton distribution by academics. The following work was done by Kalecki (1945) to question the implications and underlying assumptions of Galton distribution and modify the model. To examine applicability of the lognormal model, Aichinson and Brown (1969) find that the lognormal

distribution fit the whole range of income distribution but is quite poor in describing both the upper and lower tails of the actual distribution. By studying 12 examples, Roy (1950) demonstrates that the evidence is favor of the log-normal distribution rather than normal distribution judging by the criterion of asymmetry. Rutherford (1955) suggests a modified lognormal which provides a better fit than the lognormal, however, this does not appear to give so good an approximation to observed distributions as Champernowne's distribution, particularly in the tails. Simon (1955) discusses a number of related stochastic processes that lead to a class of highly skewed distributions (the Yule distribution) possessing characteristic properties that distinguish them from such well-known functions as the negative binomial and Fisher's logarithmic series.

To overcome the assumption of constant stochastic matrix through time, Champernowne (1953) develops models which can deal with enumerable infinity of income ranges by applying Markov chains following Solow (1951). Fisk (1961) suggests a special case of Champernowne's distribution function known as Log-logistic distribution or Fisk distribution, which may prove useful when examining distributions of incomes which are homogeneous. Following the structure of Arnold and Laguna (1977) calling a Feller-Pareto distribution, Arnold *et al.* (1986) provide a characterization of the Fisk distribution known as a Preto (III) distribution. Empirical study by Fisk (1961a) concludes that the Fisk distribution may prove useful when income distributions that are homogeneous in at least one characteristic are examined.

A successive surge of research, the field has been stimulated by studies on a reflected a multiplicative process (Levy and Solomon, 1996; Manrubia and Zanette, 1999; Gabaix, 1999) or a closely related Kesten process (Sornette and Cont, 1997; Takayasu *et al.*, 1997) which have revealed the effect of a reflective lower bound on the tail of the stationary distribution. Wagner (1977) builds a CHANCE-model which is a special type of a stochastic process which serves as descriptive models. However, stochastic models have been critized for not providing an explanation for distribution processes in terms of economic variables. Empirical contributions on this category include Gabaix (1999), Levy (2003), Feenberg and Poterba (1992) and Souma (2002).

Goodness of Fit The second type is functional forms proposed solely by the practical bearing upon the encountered empirical distributions on the grounds of presenting a satisfactory goodness of fit. The Pareto law was confirmed to hold for incomes as well as various other economic variables. Subsequently, Benini (1906) suggests a distribution function known as Benini distribution, size-of-loss distribution (Head, 1968), approximate lognormal distribution, or the quasi-lognormal distribution (Shpilberg, 1977). By fitting the model to UK fire losses, it is preferable to Pareto distribution (Ramachandran, 1969). Later, Winkler (1950) empirically suggests that a higher-order term may provide an even better fit that Pareto and original Benini distributions.

The Gamma model was applied to fit income data and further promoted by the work from Salem and Mount (1974) and Bordley *et al.* (1996) for USA and Bartels and van Metelen (1975) for the Netherlands showing that empirical evidence favors the Gamma over the lognormal distribution. The generalized Gamma distribution deduced by Amoroso contains the special case of the Gamma and Pearson Type V distributions. The models proposed by Amoroso and Vinci partly overlap with the first category. An outstanding synthesis by D'Addario specifies a differential equation which includes the particular cases among the Pareto, the Lognormal, the Gamma and the Pearson Type V models (Chotikapanich, 2008). In the study of Brachman *et al.* (1996) shows that the gamma distribution emerges as the best two-parameter model by utilizing German household incomes data.

The Beta distribution (three-parameter model) was proposed by Thurow (1970) and by Kakwani and Podder (1976) is very versatile. The following works on extending the beta distribution offered three non-nested generalizations including the Gauss hyper geometric distribution (Armero and Bayarri, 1994), the generalized beta distribution (McDonald and Xu, 1995), and the confluent hypergeometric distribution (Gordy, 1998). The most well-known in the literature is the generalized beta distribution (GB, five-parameter distribution) encompassing both the first (GB1) and second (GB2) kind. Relatively, the generalized beta distribution of the first kind (GB1), for which Johnson *et al.* (1995) and Gupta and Nadarajah (2004) offer detailed basic properties is more flexible. However, Empirical studies appear to suggest that GB1 or B1 did not provide a better fit, see e.g. Brachmann *et al.* (1996) estimate German income data using both the B1 and GB1 distributions and concluded that both models tend to underestimate the mean for the data because the ML estimation of the GB1 proved to be rather difficult since the gradient of the log likelihood in the parameter *b* was rather small. McDonald (1984) fits the models including gamma, beta, Singh-Maddala (or Burr), Pareto, Weibull, and generalized beta of first and second kinds to the income data and concluded that the generalized beta of the second type provided the best relative fit and that the Singh-Maddala (SM) distribution provided a better fit than the generalized beta of the first kind.

Moreover, Nadarajah and Kotz (2006) make contribution to GB2 distribution. The Lomax distribution, originally proposed as Pareto II distribution by Lomax (1954), is a further two-parameter special case of GB2 distribution. A generalization of the Lomax distribution was recently suggested following the approach proposed by Stoppa (1990a, b) leading to a generalized Pareto I distribution. Empirical work, such as Hogg and Klugman (1983) fit the Lomax distribution on malpractice losses, shows which is preferable over lognormal, Weibull, Singh-Maddala and the beta II distributions. In recent investigation, Burnecki *et al.* (2000) obtain a tail index q in the vicinity of 2.7 by applying a Pareto type II. However, on the basis of application on two sets of liability data, Cummins *et al.* (1990) debates the performance of Lomax distribution is not impressive since it ranks only 12th and 13th out of 16 distributions of gamma and beta type.

A number of size distributions, which may not be in the mainstream of current research, definitely offer potential applications. In this category are included the hyperbolic distribution proposed by Champernowne (1952); the Weibull distribution proposed by Bartels and van Metelen (1975); the log *t* (where t is the Student distribution) studies by Kloek and van Dijk (1976); Paralogistic distribution proposed by Klugman *et al.* (1998); Davis distributions proposed by Davis (1941) which is not merely the upper tail of the distribution of income named. Moreover, two new loss models is discussed, where one is following from lognormal distribution (Watson and Wells, 1961) and Weibull distribution for the other one (Beirlant and Teugels, 1992).

Specification Specification of differential equations that purport to capture the characteristics of regularity and permanence observed in the empirical distributions of income. The functional form is the solution of the corresponding differential equation. The contribution of this field is initiated by Pareto (1896). The apparent attractions of the Pareto distribution evaporate somewhat when one considers its implications for the distribution of income amongst the population as a whole (Clementi *et al.*, 2008). However, empirical studies showed that the Pareto distribution accurately models only high levels of income, but do a poor job in describing the lower end of the distribution since the income distribution is right-skewed and has a fat right-hand tail.

To find a satisfactory parametric form which can be fitted income distribution better, Singh and Maddala (1976) present a celebrated model and paid impressive attention on academic. The Singh-Maddala distribution is also known as the Pareto IV distribution (Arnold, 1983), Burr VII distribution (Hogg and Klugman, 1983, 1984), the beta-P distribution (Mielke and Johnson, 1974) or as a generalized log-logistic distribution (El-Saidi *et al.*, 1990). Empirical works have been done to test if the model can be suitable in describing family incomes. For U.S. case, comparing with the gamma distribution employed by Salem and Mount's (1974), Singh and Maddala (1976) shows that Singh-Maddala model provides a better fit than either lognormal or the gamma functions. Dagum (1983b) also gives the same comments. Mcdonald and Ransom (1979) represents that Singh-Maddala distribution generally outperforms the logmormal, gamma, and beta type I models, with only the beta type I being slightly better in a few cases. However, Cronin (1979) questions the conclusion of Singh and Maddala (1976) since the implied Gini indices almost always fall outside the Gastwirth (1972) bounds calculated by Salem and Mount (1974) for their data. Furthermore, MacDonald (1984) states that Singh-Maddala distribution ranks second out of 11 considered models being inferior only to GB2 distribution.

Successively, Dagum (1975) experiments with a shifted log-logistic distribution which is a generalization of a distribution previously considered by Fisk (1961) and represents a three-parameter specification (the Dagum type I distribution). This type of distribution can be derived as a special case of the Generalized Beta II (GB2) distribution (a generalization of the Beta

prime distribution) with the shape parameter p=1. Under certain assumptions on its infinitesimal mean and variance, and Mielke (1973), and later Dagum and Lemmi (1989) arrive at Dagum distribution as the equilibrium distribution of continuous time stochastic process, independently.

Following McDonald (1984) and a Dagum Type I distribution over the positive half-line, Dagum (1977, 1980) introduces two further variants of four-parameter generalizations (the Dagum type II distribution) by adding a point mass at the origin and refers to his system as the generalized logistic-Burr system, which was proposed as a model for income distributions with null and negative incomes. This approach was further developed in a series of papers on generating systems for income distributions (Dagum 1980b, 1980c). To seek an appropriate representation of sample income distribution of total income receiver, Dagum (1983) proposes a Type III distribution starting accumulating income of a population with initial positive earnings. Dagum distribution is also known as the inverse burr distribution (Klugman, Panjer, and Willmot, 1998), the three-parameter kappa distribution (Mielke, 1973), beta-K distribution (Mielke and Johnson, 1974), income distribution (Fattotini and Lemmi, 1979), Burr III distribution (Burr, 1942) and Dagum distribution in the income distribution literature (see as, Kleiber, 2007).

To investigate model flexibility to observed family income data, Dagum (1977, 1980a) applies his models (Type II) to U.S. family incomes and concludes that the model outperforms the lognormal, gamma and the Singh-Maddala distributions. In the following work, Dagum (1983) applies his types I and III to U.S. family income data and stated that the performance is as well as the lognormal, gamma and the Singh-Maddala distributions. By fitting French data, Espinguet and Terraza (1983) verifies that Dagum type II distribution is superior to the Weibull, Singh-Maddala, the Box-Cox-transformed logistic and three-parameter lognormal distributions, as well as a four-parameter beta type I model (Dagum, 1999).

Dagum type I distribution is improved upon all other two- and three-parameter models by Majumder and Chakravarty (1990) modeling U.S. income data. The conclusions are also confirmed by McDonald and Mantrala (1993, 1995). Only four-parameter GB2 and a five-parameter generalized beta distribution outperformed the Dagum type I (MacDonald and Xu, 1995). Studying on UK household income case shows a better fit of Dagum Type I distribution which is preferred over the gamma distribution. Bantilan *et al.* (1995) fitting the Dagum type I distribution to Philippines family income data find that the model fits the data very well, particularly in tails. Dagum type I distribution is turned to be the best three-parameter model for all data, outperforming three- and four-parameter models (such as the generalized gamma and GB1 distributions) and being inferior only to the GB2 distribution (Bordley *et al.*, 1996).

Dagum and Lemmi (1989) achieve a quite satisfactory fit in general by empirically studying

Italian income data using Dagum type I-III distributions. Dagum type I-III distributions were proved to outperform the lognormal and Singh-Maddala distribution. Furthermore, the log-Gompertz distribution appears to be used mainly in income and size distributions and was noticed by Dagum, which has been proved to be an excellent two-parameter model by Cummins *et al.* (1990).

3.1.3 The Measurement of Size Distribution

The measurement of personal income distribution is also main concern in the literature. Various kinds of index have been employed to analyze income inequality including generalized entropy index, Atkinson index, Gini coefficient, Hoover index, Theil index, Income inequality metrics, Suits index, Wealth condensation, Diversity index and so on. Among the "satisfactory measures", the Gini coefficient proposed by Gini (1912), the two Theil indexes (the Theil income-weighted and the Theil population-weighted) proposed by Theil (1967) and the Atkinsons (1970) index have been the more widely recommended. Each one emphasizes in a different way the income changes at various points in the income distribution. Consequently, the picture provided by these inequality indexes can be not coincident.

More popularly, Theil index and Gini coefficient are widely used in the literature. The Gini coefficient is more sensitive to the income changes occurred at the middle of the income distribution, treating symmetrically the lower and the upper tails of the incomes ranking. On the other hand, the Theil population-weighted index is more sensitive to the transfers occurring at the bottom of the income distribution. The Theil income-weighted index is, however, less sensitive to the lowest observations than the previous index (Duro, 2004).

Comparing to Gini coefficient, there are some advantages of Theil index such as the solution of income inequality is sole; it is easier decomposable than the Gini Coefficient; it is a weighted average of inequality within subgroups, plus inequality among those subgroups. However, the most widely used tool for measuring inequality is the Gini coefficient, for which is more intuitive since it is based on the Lorenz curve (Lorenz 1905; Kleiber, 2008). Traditional calculation of Gini coefficient exist several problems, for instance, it is hard to define and interpret surplus term R (Mookherjee and Shorrocks, 1982), although many scholars tried to give reasonable interpretation for R (Siber, 1989; Yitzhaki and Lerman, 1991; Lambert and Aronson, 1993). Another debate of Gini coefficient is that the subgroups decompositions have variable types on weight, such as Rao (1969) demonstrates weights should be population share of subgroup, while Mangahas (1975) suggests that it is proper to use income share of subgroup for weights. Moreover, the Gini index only reflects some aspects of the underlying income distribution: A large amount of information is lost. Two Lorenz curves with the same Gini value may have different shapes. Thus, welfare implication from comparing Gini coefficients (or other summary statistics) may be ambiguous (Wu and Perloff,

2004).

Due to the indices are directly related to the proposed models, such as The Pietra index and the (first) Theil coefficient are associated with the B1 distribution (McDonald, 1981; Pham-Gia and Turkkan, 1992). Using some aspect of the general statistical concept of a probability distribution, the specification forms of distribution models offer a convenient path to analyze and visualize income inequality by the means of the Lorenz curve and correspondingly calculate Gini coefficient accuracy.

3.1.4 A Judgment to Choose Suitable Model

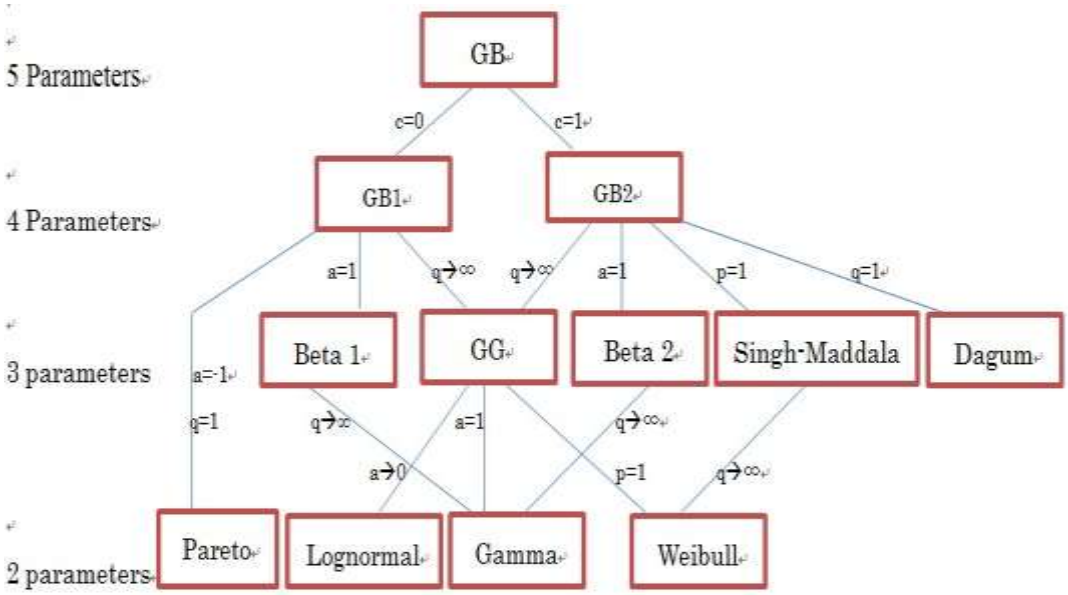
The problem of choosing a suitable model for describing the distribution of income over a population has been frequently considered in the literature. To apply to fit personal income data, the models most frequently chosen are the classical distributions including Pareto, the lognormal, the beta family, the Gamma, Singh-Maddala and Dagum distribution. The Pareto model is proved to be the best one to describe high income groups with the limitation of only being useful in describing the lo tail of the distribution according to the criterion of functional simplicity, goodness of fit and the economic interpretation of its parameters. The lognormal and the Gamma fit the whole range of income distributions but are poor in describing both the upper and lower tails of the actual distribution. Judging by goodness of fit, empirical evidence, such as Salem and Mount (1974) and Bartels and van Metelen (1975), favors the Gamma over lognormal distribution. Comparing with gamma, beta, Singh-Maddala (or Burr), Pareto, Weibull, and generalized beta of first and second kinds, the generalized beta of the second type provided the best relative fit (McDonald, 1984).

Not satisfied with the classical distributions used to summarize empirical income and wealth distributions, Singh and Maddala (1976) and Dagum (1977) devote to look for a model accommodating the heavy tails present in empirical income and wealth distributions as well as permitting an interior mode. Singh-Maddala distribution and Dagum type I distribution are closely related models (Rodriguez, 1983; Tadikamalla, 1980) since both distributions allow for various degrees of positive skewness and leptokurtosis, and even for a considerable degree of negative skewness.

As far as the goodness of fit is concerned, the model deduced by Singh and Maddala (1976), more widely known as Singh-Maddala distribution, outperforms both the lognormal and the Gamma distributions. Singh-Maddala (SM) distribution also provided a better fit than the generalized beta of the first kind (McDonald, 1984). The new model of personal income distribution proposed by (Dagum, 1977) is preferable to the Lognormal, the Gamma, and the Singh-Maddala models in applications to income data. However, Dagum distribution is less widely known due to the language barrier. In recent years there are indications that the Dagum distribution is proved to be a more appropriate choice in many applications.

For better visualizing the relationship among various models, Bandourian *et al.* (2003) offer a convenient way by drawing a relationship tree in Figure 3-1, where GB denotes the generalized beta model and GG denotes the generalized Gamma model.

Figure 3-1 Relationship Tree among Various Models



Data source: Bandourian *et al.* (2003).

In summary, it would seem that most data on size distribution require a more flexible distribution. Although there have been a number of models proposed to fit personal income distribution, which Ord (1975) and Dagum (1983b) offer a summary, none seems to have provided much of an improvement in terms of explanatory power. More recent works, taking Bordley *et al.* (1996) and Dagum (1996) for example, have eschewed process modeling. Instead, they focus on finding alternative parametric distributions which provide a good fit to wide range of observed data. Exceptions are the studies of Parker (1999) and Solomom and Richmond (2001).

On the methodological side, there are still some unresolved issues including aspects of likelihood inference (Chotikapanich, 2008). When the distribution celebrates its golden jubilee in economics, these problems no doubt will be solved. Further studies should conclude other relevant social and economic characteristics of the population, such as education, sex and race in order to explain more accurately the movements in the mass of the personal income distribution of individuals.

3.2 Measurement of Rural Income Inequality by Dagum Distribution

Inequality has been an issue of concern of social scientists and policy makers in China. China has achieved high economic growth for over 20 years with rising income inequality (Rozelles, 1994; Yao *et al.*, 2004, Wan and Zhang, 2006). To describe the income inequality in China, different

inequality indices have been employed such as Theil index (Akita, 2003; Cheng and Li, 2006) and Gini coefficient (Yao, 1997a, 1999; Wan, 2001). More popularly, the measurement of inequality is Gini coefficient, which is more intuitive to many people since it is based on the Lorenz curve.

For the case of China, the calculation of Gini coefficient is mostly concentrated on decomposition by direct calculation. Attempt on geographic targeting (Wagstaff, 2005), spatial decomposition has firstly been drawn attention since the coastal areas experienced phenomenal growth due to the open policy in 1978 (Yao, 1997b; Yang, 1999; Shorrocks and Wan, 2005). Moreover, regression-based decomposition has also been applied to estimate Gini ratio by Zhang and Zhang (2003), Wan (2004), Wan and Zhou (2005) and Deng and Li (2009). The most popular studies devote to inequality decomposition by the means of subgroups. However, there are drawbacks based on subgroups to calculate Gini coefficient. One is that it is hard to define and interpret surplus term R (Mookherjee and Shorrocks, 1982), although many scholars tried to offer reasonable interpretation for R (Siber, 1989; Yitzhaki and Lerman, 1991; Lambert and Aronson, 1993). The other debate is that the subgroups decompositions have variable types on weight, such as Rao (1969) demonstrates weights should be population share of subgroup, while Mangahas (1975) debates it is proper to use income share of subgroup for weights. Targeting above issues of estimating Gini coefficient, parameter estimation can solve well. The key point is to choose an effective model to fit the family income data.

There are a great mount of studies concentrating on model specification from two parameters to five parameters, even more. Two-parameter function is too simple to reflect the impact of economic fluctuation on the size distribution, whereas, five-parameter model is easy to loss simplicity. Thus, the purpose of this chapter is to estimate Gini ratio by applying Dagum (1977) distribution, a four-parameter model, on Chinese family income data for its various merits comparing with other models. Related studies, such as Bandourian *et al.* (2003) find that, in a study utilizing 82 data sets, the log-logistic model (Dagum, 1975) is the best 3-parameter model in no less than 84% of the cases. The Dagum distribution often provides a better fit to income data than the closely related Singh-Maddala distribution, which Kleiber (1996) provides a heuristic explanation.

As a whole, the purpose of this chapter is to apply a 4-parameter model proposed by Dagum (1977) on Chinese family income data by employing. In China, the statistical data is separated to rural and urban parts. Family income data in rural part will be used since rural income inequality is emphasized by this topic. Two methods proposed by Dagum (1977) are also applied for comparison.

3.2.1 Properties of Reasonable Mathematical Model

The specified model may be governed by its capacity to account fairly well to a set of economic, econometric, stochastic and mathematical properties. Dagum (1977) proposed a personal income

distribution model which supports intersecting Lorenz curves and convergence to the weak form of Pareto distribution[3] and satisfies all the properties as follows.

Firstly, requirement for the parameter set. The mathematical form of the distribution function, which must be simple from a technical point of view and fundamental from the point of view of model-building, can be derived from an elementary set of logic-empirical postulates or assumption. For the setting of unknown parameters, the principle is to make use of the smallest possible number of parameters for adequate and meaningful representation. The number of parameters should not be either too simple to empirically corroborated with data or too complicated to loss simplicity. Thus, three- or possible four- parameter function is taking into consideration. Furthermore, all the parameters should have well-defined economic meaning and simple and efficient of parameter estimation, which is always an advantage from the point of view of computer cost and the acceptance of model in applied economics.

Secondly, concerns on model flexibility. Specified model solves the problem of the model being identified and the actual observation, and provides a good fit of whole range of the distribution. An ideal model is able to deal with a positive, and not predetermined, minimum income without truncating the distribution. Especially, the existence of negative and nil income, which strongly restricts the descriptive power, is considered. Furthermore, the properties considered, such as the shape of distribution though changes in parameter values, unimodal and strictly decreasing (non-modal) income distribution, are also important.

Thirdly, conditions on the parameter estimation. Cumulative distribution function approach was chosen by Dagum to overcome the assumption of equal distribution within each interval of income required when dealing with the method of parameter estimation. Dagum distribution gives the explicit solution for Lorenz curve and Gini concentration ratio, which allows computing Gini coefficient directly and verifying whether it is proposed as a goodness of fit test.

3.2.2 The Four-Parameter Dagum Distribution

Dagum (1977) shows the model from the empirical observation that the income elasticity of the cumulative distribution function (CDF) of income (x) is a decreasing and bounded function of F. Starting from the differential equation

$$\frac{d\log[F(x)-\alpha]}{d\log x}=\beta\delta\left[1-\left(\frac{F-\alpha}{1-\alpha}\right)^{1/\beta}\right] \tag{3-1}$$

[3] For details about the interpretation of intersecting Lorenz Curves and convergence to the Pareto distribution, please refer to Dagum (1977).

where $x > 0$ if $0 \le \alpha < 1$ and $x > x_0 > 0$, where $F(x_0) = 0$, if $\alpha < 0$, subject to

$$\beta > 0,\ \alpha < 1, \text{ and } \beta\delta > 1$$

The solution of function (3-1) can get cumulative distribution function (c.d.f)

$$F(x;\alpha,\beta,\lambda,\delta) = \alpha + \frac{1-\alpha}{(1+\lambda x^{-\delta})^{\beta}},\quad \lambda > 0 \tag{3-2}$$

where λ is a scale parameter and strictly positive because it is the antilog of the constant of integration. α, β and δ are dimensionless parameters. α is an inequality parameter and β and δ can be called equality parameters because the Gini ratio is an increasing function of the former and a decreasing function of the latter.

The corresponding probability density function (p.d.f) for all $x > 0$ is given by

$$f(x;\alpha,\beta,\lambda,\delta) = \beta\lambda\delta(1-\alpha)\frac{x^{-\delta-1}}{(1+\lambda x^{-\delta})^{\beta+1}}$$

3.2.3 Gini Concentration Ratio

Cumulative distribution function (3-2) associated with the Lorenz curve argued by Dagum (1977b) can be noted as

$$L(y) = \frac{B(y^{1/\beta};\beta+\frac{1}{\delta},1-\frac{1}{\delta})}{B(\beta+\frac{1}{\delta},1-\frac{1}{\delta})},\ \beta\delta > 1, 0 \le \alpha < 1 \tag{3-3}$$

where

$$y = \frac{F(x)-\alpha}{1-\alpha}, y \in [0,1]$$

and its corresponding Gini concentration ratio is

$$G = (2\alpha - 1) + (1-\alpha)\frac{\Gamma(\beta)\Gamma(2\beta+\frac{1}{\delta})}{\Gamma(2\beta)\Gamma(\beta+\frac{1}{\delta})} \tag{3-4}$$

where $\Gamma(\cdot)$ denotes the complete Gamma function.

3.2.4 Methods of Parameter Estimation

In order to estimate the parameters of the above model, there are five methods proposed, including iterative method I, II and III; unconstrained function minimization and the method of maximum likelihood. For comparison, this chapter will choose iterative method I and maximum likelihood to apply on Chinese data.

Iterative method I: According to the transformation of equation (3-2), it can be derived

$$\log F(x) = -\beta \log(1+\lambda x^{-\delta}) + \sum_{k=1}^{\infty} \alpha^k \frac{1-F^k}{kF^k} \tag{3-5}$$

Equation (3-5) can be approximated by the following linear form

$$\log F(x) \approx \alpha \frac{1-F(x)}{F(x)} - \beta \log(1+\lambda x^{-\delta}) \tag{3-6}$$

In order to estimate the parameter vector (α, β, λ, δ) in equation (3-2), the calculation starts with an initial value of α, β, λ and δ by nonlinear least square using equation (3-6) to search for convergence by the iterative procedure.

The method of maximum likelihood (ML): According to Wold (1961, 1963), assume F(x) in equation (3-2) be an unbiased predictor of the sample realization $\eta(x)$. Let ε is the purely random variable and normally distributed, Hence,

$$\eta(x) = F(x) + \varepsilon, \quad \varepsilon \overset{d}{=} N(0, \sigma^2) \tag{3-7}$$

The log of the likelihood equation is

$$\log L = -\frac{n}{2}\log 2\pi - \frac{n}{2}\log \sigma^2 - \frac{1}{2\sigma^2} \sum (\eta(x) - \alpha - (1-\alpha)(1+\lambda x^{-\delta})^{-\beta})^2 \tag{3-8}$$

The ML estimator $\hat{\mu}$ of μ is obtained by solving the likelihood equation $\frac{d\log L}{d\mu} = 0$, where μ= (α, β, λ, δ).

3.3 Application of Dagum Distribution on Household Income Data in Rural China

3.3.1 Data Explanation

Dagum distribution will be applied on household income data of rural China for the time period from 1985 to 2010. Net income is taken as income variable. Income data is gathered from "China

Statistical Yearbook" and "China Rural Household Survey Yearbook", which grouped by the percentage of households. Hence, it is need to transfer household proportion to population proportion, since the known variables provided by "China Rural Household Survey Yearbook" are "Average population of each family in each group" and "The percentage of families in each group". To simplify the mathematical expression, the variables defined are as follows.

***PP$_i$*:** Population proportion in each group

***SHE$_i$*:** The surveyed households of each group

***TSH*:** Total surveyed households

***APE$_i$*:** Average population in each group

***TAP*:** Average population in total surveyed households

Household population is transferred to individual population proportion by the function:

$$\mathrm{PP}_i = \mathrm{SHE}_i * \mathrm{APE}_i / \sum_{i=1}^{20}(\mathrm{SHE}_i * \mathrm{APE}_i) = \mathrm{SHE}_i * \mathrm{APE}_i / \mathrm{TSH} * \mathrm{TAP} \quad (3\text{-}9)$$

where i denotes income class. The data structure in Yearbook is arranged by "Percentage of Households Grouped by per Capita Annual Net Income (%) " that can be denoted as *PH*. Thus, equation (3-9) can be expressed as:

$$\mathrm{PP}_i = \mathrm{PH}_i * \mathrm{APE}_i / \mathrm{TAP} \quad (3\text{-}10)$$

3.3.2 Estimation of Gini Coefficient

The methods of Iterative I and Maximum Likelihood will be used to estimate the parameters and calculate Gini ratio. RATS software of version 7 is employed to compute the parameters.

The sum of squared residuals of the observed cumulative distribution function F(x) from their corresponding predicted probabilities are denoted by

$$\sum \varepsilon^2 = \sum \left(F(x) - \hat{F}(x) \right)^2 \quad (3\text{-}11)$$

The estimated parameter vector (α, β, λ, δ) by the method of Iterative I lists in Table 3-1. The values of all parameters are positive and significant. β and δ are significant at the level of 1%. λ and α are at least in the significant level of 10%. It also can be seen that the sums of squared residuals show a satisfied goodness fit.

Table 3-1 Method: Iterative I

Year	Estimated Parameters				$\sum \varepsilon^2$	No. of intervals	Gini Ratio
	α	β	λ	δ			
2010	0.045565***	1.446203***	508440452.6205***	2.604936***	0.049	20	0.38891
2009	0.011531*	0.933395***	589092908.5638**	2.57269***	0.296	20	0.40117
2008	0.016225**	1.08566***	321354871.8979***	2.368953***	0.284	20	0.42535
2007	0.013959**	1.049960***	787985030.3516***	2.524381***	0.822	20	0.40091
2006	0.012265**	1.083269***	534952376.2205***	2.537924***	0.685	20	0.39554
2005	0.019391**	1.108717***	507402433.8652**	2.562319***	0.652	20	0.39461
2004	0.011069***	1.194235***	332116907.2456**	2.568267***	0.431	20	0.38357
2003	0.014224***	1.127675***	335336537.0454***	2.606515***	0.191	20	0.38377
2002	0.01384***	1.21635***	241181256.4741*	2.595083***	0.230	20	0.38019
2001	0.013315***	1.021964***	1499020270.0358***	2.817006***	0.141	20	0.36198
2000	0.007069***	1.082874***	243540044.8901**	2.603951***	0.064	20	0.38251
1999	0.004360***	1.222829***	278013552.4498**	2.643996***	0.053	20	0.36688
1998	0.005991***	1.273749***	331088981.7561***	2.683727***	0.041	20	0.35990
1995	0.007274***	1.072681***	562480884.9372***	2.859753***	0.024	20	0.34938
1990	0.005364***	1.228693***	4223896822.4205***	3.631742***	0.129	12	0.26690
1985	0.021245***	1.338987***	3526068765.6278***	3.980777***	0.026	12	0.25151

Note: ***, ** and * represent at the significant level of 1%, 5% and 10%, respectively.

Of special interest are methods fitting to the same data, with an eye on relative performance. To avoid the approximation in equation (3-6), Table 3-2 represents the estimation results of maximum likelihood. Comparing with Iterative I, the estimated values of all parameters in Table 3-2 are significant at the level of 1% except parameter α.

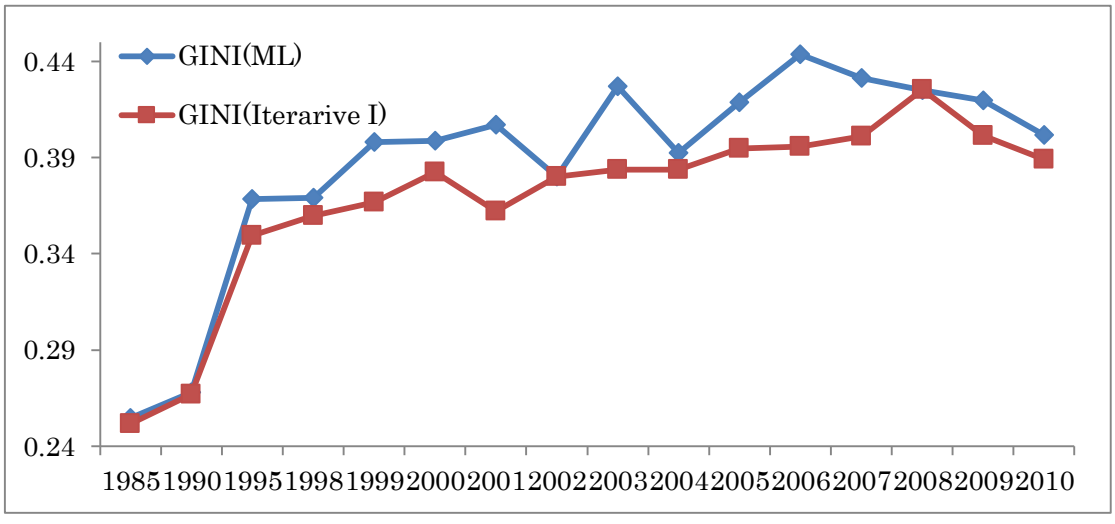
The last column of Table 3-1 and Table 3-5 reports the Gini concentration ratio applying the formula deduced from equation (3-2) and presented in equation (3-4). Gini ratio in rural China shows an increasing trend from 0.25151 in 1985 to 0.40117 in 2009 which was over the international warning level of 0.4. In 2010, Gini coefficient is slow down. Whatever, high Gini coefficient shows high income inequality and serious social problem in rural China.

Table 3-2 Method: Maximum likelihood

Year	Estimated Parameters				*VAR*	No. of intervals	Gini Ratio
	α	β	λ	δ			
2010	0.05418***	42.82797***	613891.1279***	2.2247***	0.00075***	20	0.40182
2009	-0.1774**	0.2120***	3036135267.1528***	3.3065***	0.000302***	20	0.41978
2008	0.001009***	0.749105***	9424441158.0709***	2.7285***	0.000163***	20	0.42509
2007	0.009424***	1.186072***	88371679.6301***	2.2802***	0.000132***	20	0.43138
2006	0.005718**	1.312848***	23136484.8371***	2.1749***	0.000088***	20	0.44364
2005	0.005896**	1.105807***	101718795.0429***	2.3644***	0.000069***	20	0.41879
2004	-0.022947***	0.741795***	1077813740.4201***	2.6314***	0.000122***	20	0.39248
2003	0.006358**	1.234549***	26455317.8100***	2.2795***	0.00006***	20	0.42708
2002	-0.015134**	0.612957***	7588416842.9366***	2.9048***	0.000230***	20	0.38008
2001	0.007084**	1.184264***	60223193.5812***	2.4082***	0.000078***	20	0.40712
2000	0.002252*	1.107039***	88424121.0815***	2.4690***	0.000081***	20	0.39879
1999	0.014402***	2.177649***	11318825.7531***	2.3067***	0.000157***	20	0.39796
1998	0.005275*	1.265124***	214724501.5825***	2.6185***	0.000062***	20	0.36895
1995	0.004793**	1.127685***	145360478.6224***	2.6746***	0.000121***	20	0.36824
1990	-0.0128***	0.564200***	1.2334e+012***	4.3199***	0.000030***	12	0.26784
1985	0.009374*	1.277819***	1545345040.0909***	3.8216***	0.001768***	12	0.25467

Note: ***, ** and * represent at the significant level of 1%, 5% and 10%, respectively.

Figure 3-2 The Comparison of Gini Coefficient between Iterative I and Maximum Likelihood

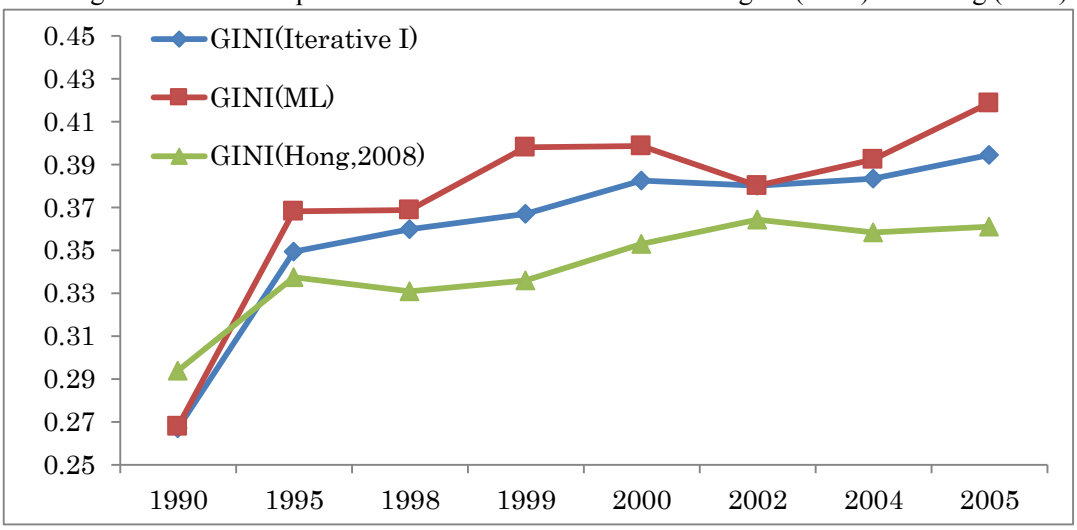


Furthermore, Gini ratio calculated by maximum likelihood is higher than that of Iterative I correspondingly, which is can be seen in Figure 3-2. The line of maximum likelihood is above iterative I. The possible reason accounts for approximate value in equation (3-6). As a result, the

Gini ratio estimated by both methods show the increasing trend.

Local studies also estimated Gini coefficient by different methods. For example, Hong (2008) developed a new decomposition method to estimate Gini coefficient of China. With increasing trend, Gini coefficient estimated by Hong (2008) is lower than either of the methods proposed by Dagum (1977) except the year of 1990, which demonstrate that the Gini coefficient is probably underestimated by traditional calculation method (see Figure 3-3).

Figure 3-3 The Comparison of Gini Coefficient between Dagum (1977) and Hong (2008)



3.3.3 Lorenz Curve

Lorenz curve offers an intuitive path to identify inequality. Excel program is employed to draw Lorenz curve by original data. To investigate the trend of change, take the years of 1990, 2000, 1995, 2000, 2005 and 2010 for example.

At the beginning of drawing the graphs, it's necessary to calculate cumulative proportion of income. It can be seen from Figure 3-4 to 3-9 that the shapes of the Lorenz curve are changing through the time period. The situation of income inequality is worsening. In 1990, approximate 50% of the population own 20% of the income. High income class, about 1% of the population takes up 10% of the income which caused by the reform of open policy in 1978. Income inequality began to increase. In 2000, the condition of low income class improved, almost 34% of the population has 20% of the income. For high income class, about 10% of the population has 30% of the income.

The following years, income inequality increases gradually for the labor flows from rural areas into urban areas. In 2005, about 18% of the population has 21% of the income for the lower class. A series of policies are prone to rural China and surplus labor force forcing farmers flowing back to rural areas, the situation of income inequality become well in 2009. In 2010, situation becomes better for a series policies bias to develop rural areas. On the whole, the income inequality in China

is an increasing trend. For all time range, high income class owns the majority of the income. Income inequality with increasing trend in rural China is an issue for policy makers.

Figure 3-4 Lorenz Curve in 1980

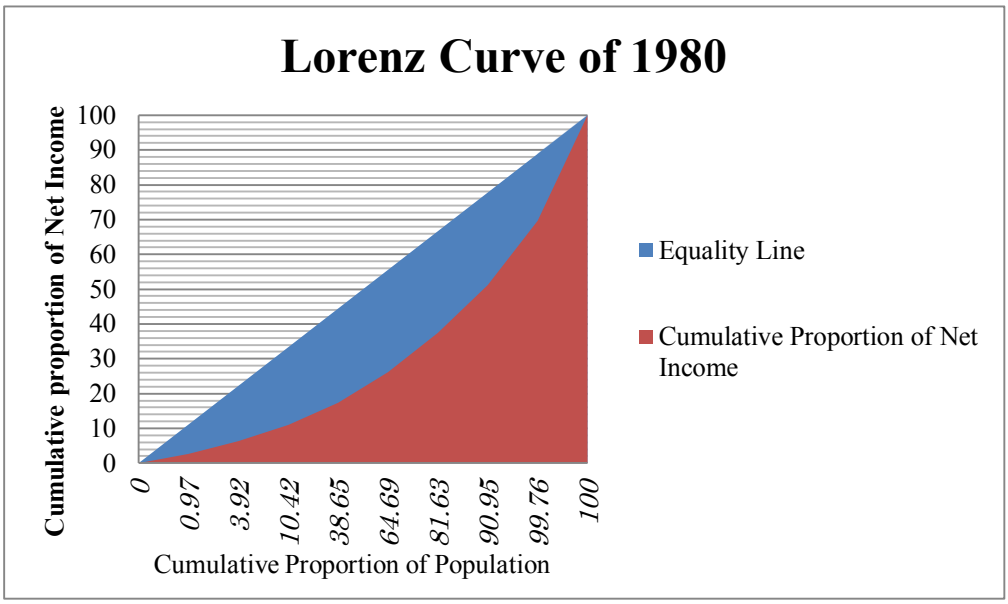


Figure 3-5 Lorenz Curve in 1990

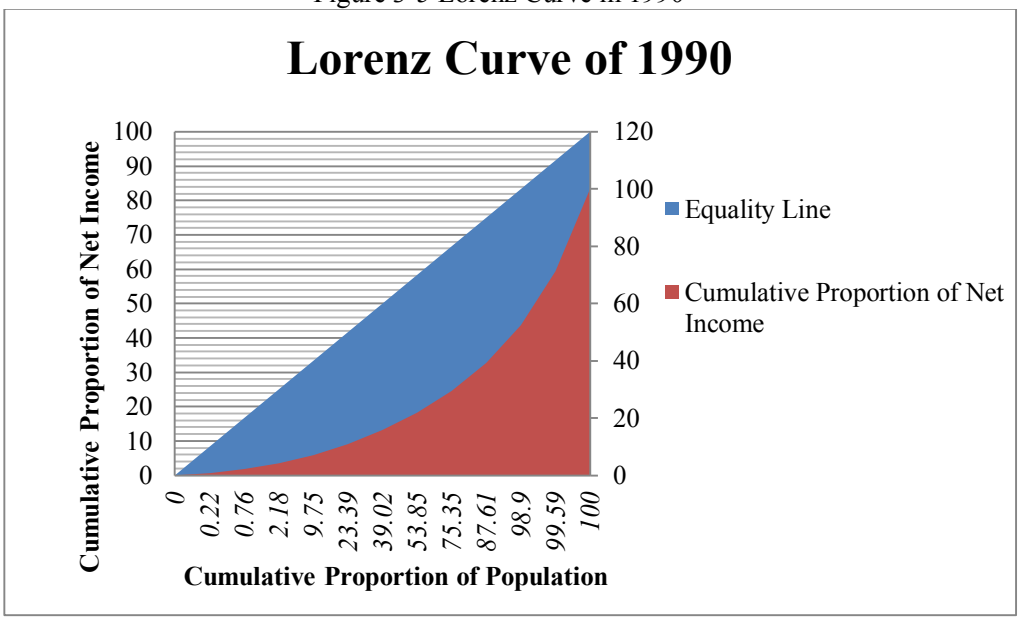


Figure 3-6 Lorenz Curve in 1995

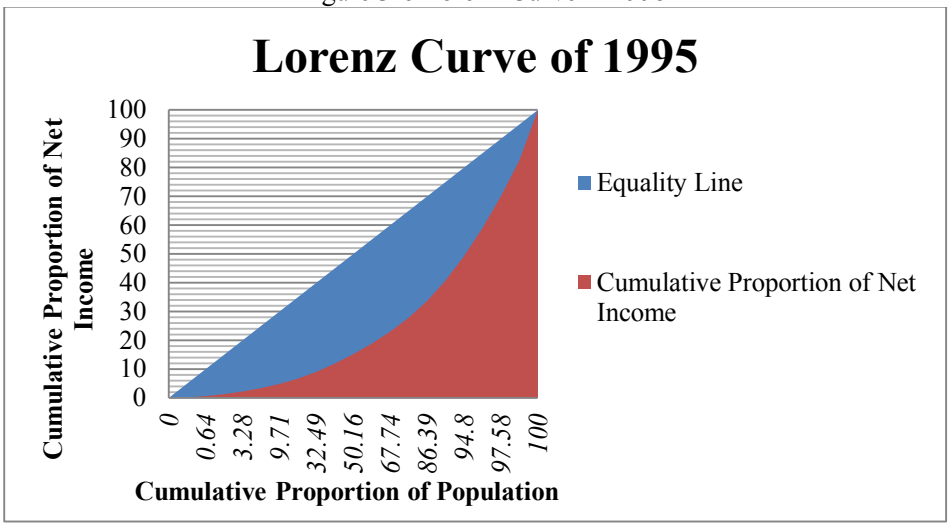


Figure 3-7 Lorenz Curve in 2000

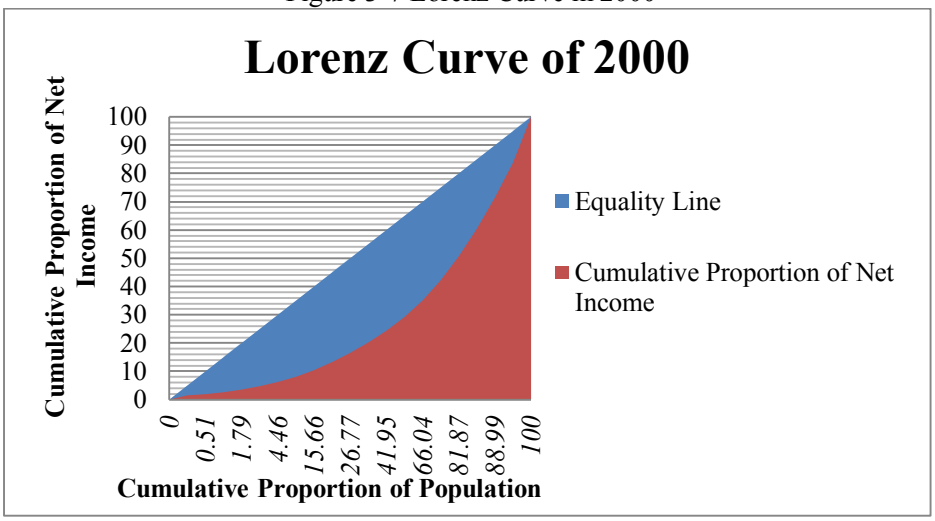


Figure 3-8 Lorenz Curve in 2005

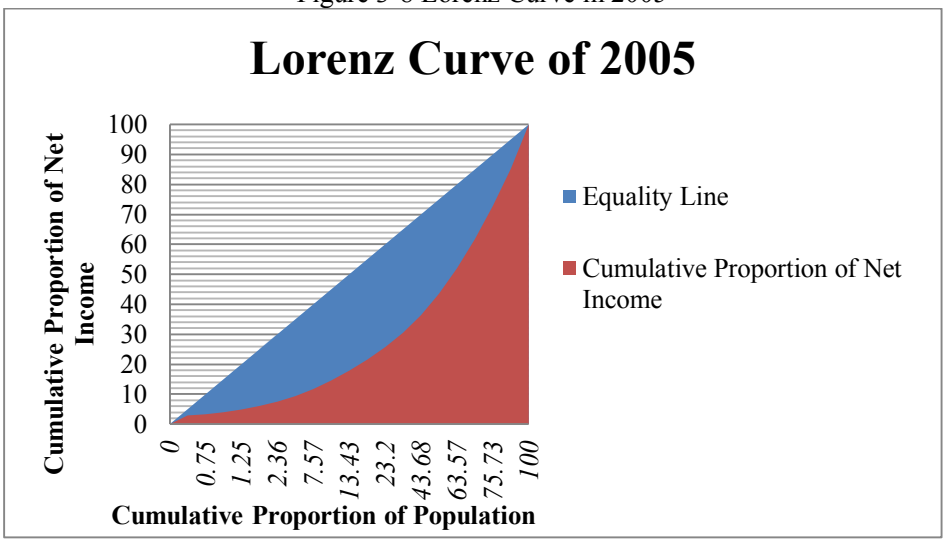
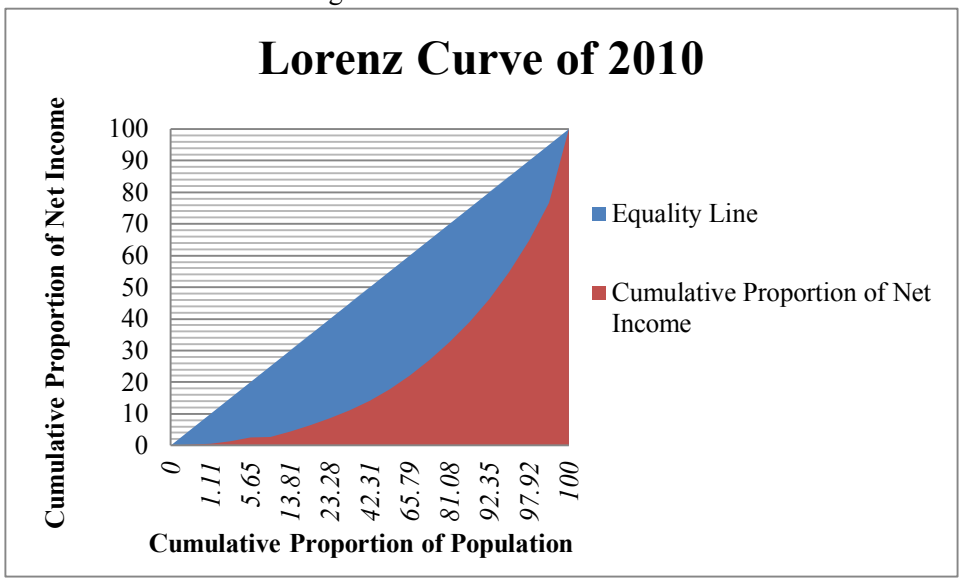


Figure 3-9 Lorenz Curve in 2010



3.4 Conclusion

This Chapter has provided a brief introduction to the development of models for income distribution and applies Dagum (1977) distributions to household data in rural China for the time period of 1985 to 2010. Two methods including Iterative I and maximum likelihood are employed to estimate the parameters of Dagum model. It can be concluded that Dagum distribution fits household data well in the case of rural China. Maximum likelihood prefers to offer a higher Gini ratio since it avoids the approximate problem in Iterative I method. However, both of the methods provide an increasing trend of income inequality in rural China.

Moreover, comparing Dagum distribution with local study, it is found that Gini coefficient calculated by Dagum distribution is higher than local estimation by traditional paths. That is, Gini coefficient might be underestimated by the naive estimation. This study shows that Gini coefficient is mainly decided by the method applied. Various models offer many kinds of results. It is necessary to choose the suitable model to fit different types of data.

4. Rural Income Inequality Impact on Economic Growth

The central theme of this chapter is to study rural inequality in the distribution of personal income increase or decrease in the course of economic growth in China, since there is growing consensus that assessments of economic performance should not focus solely on income growth, but also take income distribution into account. Since China started its economic reform in 1978, China's GDP has grown significantly accompanied by income inequality with the average growth rate of approximately 10% per annum. According to the National Bureau of Statistics, China's GDP has grown from 364.5 billion RMB (Chinese currency) in 1978 to 39, 798 billion RMB in 2010. The income gap ratio (rural to urban) has grown from 2.57:1 in 1978 to 3.23:1 in 2010.

Meanwhile, widening income inequality in rural China has also attracted considerable attention from both policy circles and academics because of large scale rural to urban population transfer (see Zhao, 1999; Knight and Song, 1999; Seeborg *et al.*, 2000; Zhang and Song, 2003), due to long-standing urban-bias policy, "price scissors" between industry and agriculture and special civil status system called "*hukou*". It can be seen from Figure 4-1 that Gini ration of rural China has risen from 0.252 in 1982 to 0.425 in 2008 which is over the international warning line with 0.4 under high economic growth rate.

Figure 4-1 Gini Coefficient of Rural China and Growth Rate of Real GDP per capita

Data source: Rural Gini coefficients of 1978-1997 are collected from Cheng (2007) which used the same data structure and data source as Chapter 3 with the sample size of 1998-2010. The growth rate of real per capita GDP is from National Bureau of Statistics of China.

The following study focuses on a very narrow theme and offers an empirical work studying the effect of rural income inequality on economic growth in China. To what extent rural income inequality affect economic growth? To search for the answer, the following work employs time

series data from 1978 to 2010 to investigate the effect of rural income inequality on economic growth in China.

4.1 Theoretical Basis

According to Cobb-Douglas production function, economic growth (y) is decided by labor input (L), capital input (K), international trade (T) and total factor productivity (A) in an open economy. Let α, β and γ denote the output elasticity of labor, capital and trade, respectively. The empirical model can be denoted as

$$\ln y = \ln A + \alpha \ln L + \beta \ln K + \gamma \ln T \tag{4-1}$$

Total factor productivity (A) is assumed to be constant. In order to build endogenous model including rural income inequality, whether rural income inequality (I) is an endogenous variable in economic growth model should be investigated at the first stage. Unit Root Test and Granger Causality Test will be exploited to identify the endogeneity of rural income inequality.

4.2 Unit Root Test and Granger Causality Test

4.2.1 Rural Income Inequality: An Explanation

Hereafter, Gini coefficient will be employed as the measurement of rural income inequality to analyze the effect of economic growth on inequality from 1978 to 2010. In section 3, the work has been done to calculate rural Gini coefficient for the year of 1998 to 2010. For the data availability, it's necessary to give explicit illustration about this variable since I intend to combine Gini coefficient of 1998-2010 with other researcher's study (1978-1997) in order to extend study period, since the data in previous chapter is not only discontinuous from 1980 to 1997 but also missing 1978 and 1979. As for the data structure, income ranges of Chinese statistical data are grouped by family average income. It can be transformed into individual average income according to average family member of each class. Usually, earning, disposable income and net income are employed to calculate Gini ratio. There are great disparities among different income source. Meanwhile, net income for the time period of 1997 to 2010 is used to measure Gini coefficient in previous section.

Income inequality has been paid great attention by academics and the measurement of inequality has accumulated a large number of literatures in China. Early studies mainly concentrated on regional inequality for the reason of uneven regional development of China. The stepwise researches contributed to urban inequality, rural inequality and decomposition by urban and rural sectors since China is strictly divided into rural and urban sectors, while urban sector is the main engine of economic growth. As a result, both overall inequality and urban inequality of China have been attracted great concerns in the previous studies. Through literature review, there are few studies

directly concentrating on rural income inequality yet. The studies on decomposition by rural and urban sectors often report the Gini ratio of urban and rural areas separately and combine to Chinese Gini coefficient by weight such as by population sub-group. To complement this blank, chapter 3 provide rural income inequality for the period of 1980 to 2010 by applying the method of Iterative I to estimate the parameters of Dagum distribution.

With respect of inequality measurement, data resource and structure are important since different kind of data would cause disparity of measurement. Cheng (2007) also applied net income as the basis of rural parts calculation for the time period of 1978 to 2005. Per capita income of each family is grouped by the percentage of household. The author transferred family grouped income data according numbers of family member to Per capita income of each person in each income group. The procedure is the same as what I did when I calculated rural Gini coefficient by Dagum distribution. His results are quite similar to mine for the overlapped periods of 1998 to 2005. With this respect, I would like to extend my time period of rural income inequality by employing Cheng (2007) from 1978 to 1997.

4.2.2 Unit Root Test

Many economic and financial time series data exhibit trending behavior or non-stationary in the mean. An important econometric task is determining the most appropriate form of the trend in the data. If the data are trending, then some form of trend removal is required. Unit root tests can be used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. Moreover, economic and finance theory often suggests the existence of long-run equilibrium relationships among non-stationary time series variables. If these variables are I (1), then co-integration techniques can be used to model these long-run relations.

Before Granger causality analysis is applied, it is essential to investigate the time series properties of the data. It is well known that non-stationarity in any of the variables calls for a different approach to the econometric model specification. The unit root tests are first performed to examine the univariate time-series properties of the model series. Unit root tests include three kinds of method among several others: The Dickey-Fuller test; Augmented Dickey-Fuller test (Dickey and Fuller, 1981) and Phillips-Perron tests (Phillips and Perron, 1988). In the following work, Augmented Dickey-Fuller (ADF) test is performed to examine the univariate time-series properties of the model series, which can be defined as

$$\Delta Y(t) = \mu + \gamma Y(t-1) + \theta T + \sum_{i=1}^{k} \delta(i) \Delta Y(t-i) + e(t) \tag{4-2}$$

Table 4-1 reports result of ADF tests. Test for unit root in level including individual intercept and trend respectively. It can be seen from Table 4-1 that the entire variables with level series are

stationary. Both ln*GINI* and lnper*GDP* are integrated with order 0.

Table 4-1 Tests for Unit Roots

Variable	T-Statistic	Integration
lnper*GDP*	-3.487 (-3.229)*	I(0)
ln*GINI*	-3.956 (-3.558)**	I(0)

Note: ***, **, * denote the statistical significance and the rejection of null at 10%, 5% and 1%, respectively. The values in parentheses are ADF critical value. I (0) represent the series is stationary. The truncation lags (max lag=7) in ADF test are selected by the Akaike Info Criterion (AIC). The value of economic growth is the annual growth rate of real per capita GDP (ln*perGDP*).

With stationary series, a specification test is necessary to examine whether or not the casual directions of ln*perGDP* and ln*GINI* are associated initially. The standard Granger causality test is employed and conducted with 7 lags, and the results are reported in Table 4-2. Granger causality test accepts null hypothesis of "ln*perGDP* does not Granger Cause ln*GINI*". That is, economic growth is not Granger Causality of rural income inequality. "ln*GINI* does not Granger Cause ln*perGDP*" is at 10% level of significance, which demonstrates that rural income inequality is Granger Causality of economic growth. It can be concluded that rural income inequality is an endogenous variable.

Table 4-2 Granger Causality Test

	Null Hypothesis	Obs.	F-Statistic	Prob.
ln*perGDP*, ln*GINI* Lag=7	ln*perGDP* does not Granger Cause ln*GINI* $\ln GINI_t = \alpha_0 + \sum_{i=1}^{7} \alpha_i \ln GINI_{t-i} + \sum_{j=1}^{7} \beta_j \ln perGDP_{t-j} + u_t$	26	1.791	0.186
	ln*GINI* does not Granger Cause ln*perGDP* $\ln perGDP_t = \alpha_0 + \sum_{i=1}^{7} \alpha_i \ln perGDP_{t-i} + \sum_{j=1}^{7} \beta_j \ln GINI_{t-j} + u_t$	26	2.568*	0.079

Note: Max lag (=7) selected according to Akaike Info Criterion (AIC) by building VAR model. "*" denote the level of significance at 1%.

4.3 Data and Methodology

Granger causality test shows rural income inequality is an endogenous variable in economic growth model. Let δ denotes the output elasticity of rural income inequality, then the relationship between economic growth and rural income inequality can be expressed in logarithm as

$$\ln y = \ln A + \alpha * \ln L + \beta * \ln K + \gamma * \ln T + \delta * \ln I \tag{4-3}$$

Table 4-3 Variables: Definition and Explanation

Variable	Definition	Explanation
perGDP	Economic Growth	The annual growth rate of real per capita GDP
Labor	Labor Input	The proportion of the employed population to total population
Trade	International Trade	The proportion of total foreign trade volume to GDP
GINI	Rural Income Inequality	Calculated on the basis of Dagum (1977) by Iterative I in Chapter 3:1998-2010; Cheng (2007) :1978-1997
K	Capital Input	Including human resource investment and fixed asset investment
Kh	Human Resource Investment	The proportion of fiscal expenditure on education to GDP
Kf	Fixed Asset Investment	The proportion of fixed asset investment to GDP

Therefore, economic growth will be chosen as dependable variable, rural income inequality, labor and capital input, international trade as independent variables. To avoid nonlinear problem, all the variables are taken logarithm value. To investigate various kinds of capital impact on economic growth, capital is divided into two parts, including human resource investment and fixed asset investment (Lucas, 1988). The definition and explanation of each variable are reported in Table 4-3.

The following work is to study the effect of rural income inequality on economic growth by using China's time series data over the period of 1978-2010. The data comes from "China Statistical Yearbook". Rural income inequality is from chapter 3 which offers two kinds of paths to measure income inequality. The results of Iterative I method will be chosen since it is in the middle comparing with maximum likelihood and local estimation. On the basic hypotheses of linear estimation and equation (4-3), empirical model can be written as

$$\begin{aligned}\ln perGDP_i = c(0) + c(1)*\ln Labor_i + c(2)*\ln Kh_i + c(3)*\ln Kf_i \\ + c(4)*\ln Trade_i + c(5)*\ln GINI_i + \varepsilon_i\end{aligned} \tag{4-4}$$

where i is time period from 1978 to 2010, $c(0)$, $c(1)$,…, c (5) are estimation coefficients, ε_i is the error term.

Table 4-4 presents summary statistics of the selected variables. This table provides the list of all the variables, means, standard deviations, minimum and maximum values. Average rural income gap was 0.33 with the maximum value of 0.43 and minimum value of 0.25. The significant variations provide useful information for the following analysis. Economic growth increases 8.84% on average.

Both of the rising trends of rural income inequality and economic growth are incentive to investigate their inner relationship.

Table 4-4 Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
perGDP	0.088444	0.090744	0.136742	0.023261	0.028111	33
GINI	0.330727	0.3349	0.42535	0.2504	0.050332	33
Labor	0.526903	0.564577	0.571314	0.417125	0.056571	33
Trade	0.344293	0.333376	0.651709	0.097388	0.160395	33
Kf	0.346685	0.321925	0.658835	0.196459	0.118903	33
Kh	0.001188	0.000537	0.004706	8.71E-05	0.001365	33

4.4 Estimation of the Model

In order to explore the link of income inequality with economic growth, previous studies commonly use the techniques of Ordinary Least Square (OLS), see as Persson and Tabellini (1994), Alesina and Rodrik (1994), Perotti (1996), Deininger and Squire, (1998), Li and Zou (1998) and Panizza (1999); Two-Stage Least Square (2SLS), such as Alesina and Rodrik (1994), Li and Zou (1998) and Perotti (1996); Generalized Method of Moments(GMM), for example, Forbes (1998). Therefore, I will estimate equation (4-4) by OLS, 2SLS and GMM using China's data. The estimated coefficients are reported in Table 4-5.

It can be seen from Table 4-5 that the results estimated by three methods are similar. Sargan test accepts the validity of instrumental variables in all the models. AR (1) and AR (2) test can reject the null hypothesis of autocorrelation except OLS. The coefficient of rural income inequality is significant and negative. Labor input is insignificant in three models. Besides, International Trade is insignificant by OLS. All of other control variables are significant. However, adjusted R square of OLS procedure is quite small in model (3). AR (1) and AR (2) test cannot reject the null hypothesis of autocorrelation. The goodness of fit improves in model (4) when 2SLS is applied. Delete the insignificant variable in model (4), the data fit well in model (5). GMM estimation is supposed to be the best for its highest goodness of fit. Adjusted R square increases to 0.655 in model (2) by excluding the insignificant variable in model (1). With this respect, the results in model (2) will be used to analyze hereafter.

According to model (2), GMM estimation shows that the coefficient of ln*GINI* is negative and significant at 1% level, which demonstrates that there is a statistically significant negative relationship between rural income inequality and economic growth in China. This finding is consistent with the viewpoint provided by Persson and Tabellini (1994) and Alesina and Rodrik

(1994), and also supports the evidence for a negative relationship between growth and income inequality in poor countries held by Barro (1999). Rural residents earn high wage in urban areas though population mobility and these high income flows back to rural areas for special household registration system. [4] Generally, this kind of rural income inequality will promote economic growth, that is, it is supposed to have positive relationship. However, empirical work of this chapter shows contrary conclusion. Concerning this issue, several key points should be mentioned.

Table 4-5 Estimation Coefficients

Method	GMM		OLS	2SLS	
Variable	(1)	(2)	(3)	(4)	(5)
ln*GINI*	-2.741***	-2.318***	-1.955*	-4.612*	-4.121**
	(-4.076)	(-3.812)	(-1.966)	(-1.873)	(-2.369)
ln*Trade*	1.371**	1.474***	0.313	1.515**	1.593***
	(2.813)	(4.937)	(0.709)	(2.403)	(2.911)
ln*Kh*	-0.897***	-0.932***	-0.476**	-0.758**	-0.779**
	(-3.004)	(-3.473)	(-2.356)	(-2.416)	(-2.666)
ln*Labor*	0.791		-0.017	0.683	
	(0.606)		(-0.011)	(-0.295)	
ln*Kf*	2.799***	2.779***	2.428***	2.900***	2.786***
	(3.200)	(3.936)	(3.834)	(3.285)	(3.661)
constant	-6.949***	-7.149***	-5.066***	-7.761***	-7.838***
	(-4.833)	(-6.537)	(-4.177)	(-4.944)	(-5.290)
Adj-R^2	0.622	0.655	0.329	0.438	0.485
AR(1) test (p-value)	0.043*	0.035**	0.074*	0.038**	0.049**
AR(2) (p-value)	0.232	0.428	0.046*	0.239	0.286
Sargan test (p-value)	5.215 (0.734)	5.320 (0.723)		9.981 (0.266)	10.983 (0.203)

Note: "*, **, ***" denote the level of significance at 10%, 5%, 1%, respectively. t statistics are in parentheses. The instrument specification of GMM is the lag values of ln*Labor*(-1), ln*Trade*(-1), ln*Kh*(-1), ln*Kf* (-1), ln*perGDP* lag (1, 4), *lnGINI* lag (1,7) and constant. The instrument specification of 2SLS is the lag values of ln*Labor*(-1), ln*Trade*(-1), ln*Kh*(-1), ln*Kf* (-1), ln*perGDP* lag (1, 2), *lnGINI* lag (1,6) and constant. Sargan test of overidentifying restrictions. H_0: overidentifying restrictions are valid. H_1: overidentifying restrictions are invalid.

Firstly, rural income inequality will worsen inadequate aggregate demand. For rural residents, low income and lack of social security will increase uncertainties of the future and cause to passive

[4] Although rural residents work and get high salary in urban areas, they cannot change their rural status.

future expectations, which will decrease consumption tendency[5] and increase savings. Rising rural income inequality will cause low consumption tendency since social security covers the residents who own urban status only. In China, rural residents tend to have high saving caused by precautionary motive, product motive, speculative motive, transactions motive and so on. High income class will choose to save money after basic necessities of living is satisfied while low income class is lack of purchasing power for uncertainties of the future. Rural population takes account of more than half of total population in China. Inadequate demand of rural residents will affect social aggregate demand and make social aggregate demand curve shift to the left. When social aggregate supply tends to stability, the left shift of social aggregate demand will cause to decrease economic growth.

Secondly, income distribution will affect investment directly (Wan *et al.*, 2006). Urban sector investment increase in a high speed, however, investment in the rural sector is low in a long time. High savings of rural areas are mainly exploited by urban areas since Chinese government emphasizes the development of urban sector. However, investment in urban sector is ineffective for vast waste such as repeated investment. Meanwhile, the economic growth response to investment in urban sector is longer than rural sector. There is frontier of urban investment effect on economic growth. Current social aggregate investment is limited, which is an obstacle to economic growth. As a whole, on the demand side, total output is determined by investment and consumption. Inadequacy of both will decrease potential amount output.

Thirdly, rural income inequality will impact on human capital development. Compared with urban areas, the backwardness of rural education is obvious. Poverty and educational backwardness in rural sector make rural residents confront the underinvestment of human capital. Large scales of rural labor outflows strengthen this problem such as children are left in the rural areas and lack of family education, which will restrict the future development of human capital and rural economy.

Fourthly, rural income will affect agriculture so as to have impact on economic growth. Amount of local scholars paid attention to the relationship between economic growth and agricultural growth. Wang (2010) demonstrates that there has always been a positive relationship between agriculture and economic growth by performing econometric model analysis in China for the year 1952-2007. By addressing how agriculture makes a contribution to economy growth, Wang (2010) states that although the share of agriculture in GDP has declined significantly over time, the contribution of agricultural growth has maintained an upward trend with the elimination of the price index and it has made an important market, foreign exchange, factor (finance and labor), output contributions to nonagricultural growth and then it remains an irreplaceable driving force for economic growth. The

[5] High income classes decrease consumption tendency after satisfying basic demand; low income classes with stronger consumption wants are lack of purchasing power.

role of agriculture in China's growth is particularly important (Cao and Birchenall, 2012) since China's agriculture has to feed the largest and continuously increasing population in the world. Enhancing agricultural contributions need to continue to encourage the transfer of rural labor, raise the level of consumption of rural residents, encourage export and increase farmers' income in order to make the national economy develop rapidly and orderly.

At last, rural income inequality will affect rural labor force reward. Generally, population and economic spatial distribution should be consistent. In China, low wage of rural labor and high reward of urban sector make all industries concentrate on cities with inadequate urban population, while there is only agriculture in rural areas with most of the population. In this case, rural income inequality is enlarged. The development of agriculture and rural regions is lack of "*pull*" factors. Hence, aggregate economic growth potential is unable to be released. As a result, the speed of economic growth slows down. Based on the experiences of majority of developing countries, economic growth will become stable when economic development passes over the low level development trap, namely, developing country will transfer to developed country. In the last 30 years, high economic growth mainly relied on single sector and industry, especially, manufacture, the process of which exacerbated rural income inequality. Conversely, all of those hindered economic growth of China.

Moreover, the coefficients of international trade and fixed asset investment are significant positive, which is the same with reality. International trade and fixed asset investment is the key engine of economic growth in China. Other interesting findings are that the coefficients of human capital investment which supposed to be positively promoting economic growth are significantly negative. The situation of the lack of human capital input should be paid more attention by policy makers. There is also no statistical evidence to support labor input can promote economic growth of China.

4.5 Conclusion

This chapter employs time series data over the period 1978 to 2010 in order to investigate the effect of rural income inequality on economic growth. Empirical evidence shows that there is a negative relationship between economic growth and rural income inequality. That is, rural income inequality will negatively affect economic growth.

GMM estimation is used to explore the relationship between growth and rural income inequality. Empirical study shows a significant negative effect of rural income inequality on economic growth in China. This finding is consistent with the views of Persson and Tabellini (1994) and Alesina and Rodrik (1994), and also supports the evidence for a negative relationship between growth and income inequality in poor countries held by Barro (1999). The conclusion provides the evidence that the rising trend of rural income inequality is harmful to economic growth. Reduction of rural income

inequality is one of the main concerns for policy makers in China.

Other interesting findings, such as the significant and positive coefficients of international trade and fixed asset investment are the same with real economy, since international trade and fixed asset investment is the key engine of economic growth in a long time. Besides, the coefficient of human capital investment which supposed to be positively promoting economic growth is significant and negative. The situation of the lack of human capital input should be paid more attention by policy makers. Furthermore, there is also no statistical evidence to support labor input can promote economic growth of China.

5. How Economic Growth Affects Rural Income Inequality

Rural income inequality has been paid much attention in China since rural-to-urban migration and non-farm income play an increasingly important role in sustainable development and poverty reduction in rural areas (OECD, 2005). With high speed of economic growth, rural income inequality is rising considerably since 1978, over international warning line of 0.4 in several years. Does high economic growth worsen rural income inequality? In order to answer this question, time series data for the period from 1978 to 2010 will be employed to empirically investigate the impact of economic performance on rural income inequality in China. To study the effect of rural-to-urban labor force mobility, time series data of 1998 to 2010 are also considered due to data unavailability.

5.1 Data Availability and Model Specification

5.1.1 Variables and Data Source

The literature review suggests that the basic factors of income inequality are primary industry changes, high returns to education, shifts in labor market and immigration (Majumdar and Partridge, 2009). Taking the preference of this study into consideration, economic growth and fiscal policy are also included into the model. In order to study the impact of rural-to-urban labor force mobility on rural income inequality, both inter-provincial mobility and intra-provincial mobility are considered.

Regarding to economic growth impact on inequality, there is no statistically significant association between inequality and income according to empirical study of Deininger and Squire (1998). Chinese data confirms a linearly increasing trend between economic growth and inequality. In subsection 5.2.1, the detailed descriptive analysis will be displayed. The following work is to check the effect of economic growth on rural income inequality.

Primary industry affects income inequality, at least in the short run (Levernier *et al.*, 1998). Chinese economy has also undergone dramatic and continuing primary industry change since 1978. The share of agriculture in GDP has declined from 28.2% in 1978 to 10.1% in 2010 as the manufacturing and services sectors have grown much faster. The gap between agricultural and industrial labor productivity is considerable large. In 2001, the labor productivity ratio of urban industry, urban services and rural non-farming to agriculture in China is an astonishing 4 to 10 times larger than in other countries. These extremely high ratios as well as their rising trend are symptomatic of the major distortions in the labor markets, especially in its partial against the agricultural sector. The development of agricultural sector will affect rural income directly, since agriculture is the main source of income and employment for rural residents.

Income inequality is often attributed to higher returns of education. For rural-to-urban labor mobility with relative higher income, the educational level of rural migrant employees is higher than rear personnel. Taking Sichuan Province for example, according to the Second Countrywide Agriculture General Investigation in 2006, the illiteracy rate of rural migrant employees is 0.8%, slower than that of 12.9% of agricultural employee. A household survey undertaken by Kipnis (2010) in 2005 and 2006 shows that all of the families surveyed wanted their child to attend university in China, since university represents high income and a door to urban status. Through education, rural residents are also able to change their status from "*rural*" to "*urban*" under Chinese *hukou* system. However, educational resources are concentrated on urban sectors. The backwardness of rural education and low income of rural family make higher education difficult for rural students because of expensive tuition. Thus, education is a very important factor to influence family income in rural China.

Migration, rural-urban migration in particular, as a culturally patterned movement of people, generally interacting with modern urbanization when economic developments expand labor requirements, has for long been an important area of research in development economics. At the end of 2009, urbanization has risen from 17.92% in 1978 to 46.59% in 2009, and urban population rose by 449.41 million. Zhu and Luo (2010) shows that migration tends to have egalitarian effects on rural income for three reasons: (1) migration is rational self-selection-farmers with higher expected return in agricultural activities and/or in local non-farm activities choose to remain in the countryside while those with higher expected return in urban non-farm sectors migrate; (2) households facing binding constraints of land supply are more likely to migrate; (3) poorer households benefit disproportionately from migration.

Fiscal expenditures will reduce income inequality (Muinelo-Gallo and Roca-Sagales, 2011). Fiscal issues have become more prominent in China in several respects in recent years. The rebalancing of the economy and striving to a harmonious society that the government aims for relies considerably on fiscal policy measures (Kuijs and Xu, 2008). As the fiscal revenue situation improved since the mid-1990s, and particularly since 2000, government spending increased as a share of GDP. Public expenditure has traditionally been a component of fiscal policy which is an instrument of the state to influence economic growth.

Rural to urban labor force mobility has been proved to increase in rural income by Zhu and Luo (2010). That is, the increasing share of non-farm income in total income widens inequality. Undoubtedly, rural-to-urban mobility caused by high speed of economic growth increased the non-farm income of rural families. According to the second Agricultural Census China had 130 million rural labor who worked for more than one month outside of their township of residence in 2006. The corresponding data is 74 million in 1997. Labor movement is still restricted by the

household registration system (*hukou*) and associated regulations and policies. Rural labor migration in China is restricted largely to a "floating population". Therefore, the effect of rural-to-urban labor mobility will be investigated. Rural to urban labor mobility include inter-provincial and intra-provincial shifts. Intra-provincial labor force mobility is that the mobility flows from rural to urban sectors within a province, that is, mobility occurs in one province. Inter-provincial labor force mobility is that the mobility flows from rural to urban sectors between various provinces, i.e., from one province to the other province. Both of them impact on the growth of farmer's income significantly.

The definition and explanation of each variable are reported in Table 5-1. The data of inter-provincial labor force mobility and intra-provincial labor force mobility are collected from "Compiled statistics of registered temporary residents in China"; rural income inequality is collected from Cheng (2007) for the sample size of 1978-1997 and calculated in Chapter 3 for the sample period of 1998-2010. Other data comes from website of "National Bureau of Statistics of China".

Table 5-1 Variables and Definition

Variable	Definition	Explanation
GINI	Rural Income Inequality	The sample size from 1978 to 1997 is collected from Cheng (2007); the sample size from 1998 to 2010 is calculated in Chapter 3
perGDP	Economic Growth	The annual growth rate of real income per capita
Str	Primary Industry	The proportion of the production of primary industry to GDP
Edu	Educational Input	The value is the proportion of college graduate to total proportion
Inter_p	Inter-provincial Labor Force Mobility	The proportion of inter-provincial labor force mobility to total population
Intra_p	Intra-provincial Labor Force Mobility	The proportion of intra-provincial labor force mobility to total population
Mig	Migration	The proportion of rural population to total population
Exp	Fiscal Expenditures	The proportion of fiscal expenditures to GDP

5.1.2 Model Specification

GMM technique will be adopted to estimate the impact of economic growth on rural income inequality in the following work. In order to avoid nonlinear problem, all the variables take logarithm value except economic growth. On the basic hypotheses of linear estimation, empirical model can be written as

$$\ln GINI_i = c(0) + c(1) * perGDP_i + c(k) * \ln X_{ki} + \varepsilon_i \quad (5\text{-}1)$$

where i is time period from 1978 to 2010; ln*GINI* is dependent variable; *perGDP* is independent variable; lnX_k are control variables including ln*Edu*, ln*Exp*, ln*Inter_p*, ln*Intra_p* and ln*Str*; $c(0)$, $c(1),\ldots, c(k)$ are estimation coefficients; ε_i is the error term.

5.2 Description between Inequality and Economic Growth

5.2.1 Rural Income Inequality and Economic Growth

China has experienced particularly high rates of economic growth due to a series of reforms which started in the late 1970s. Since 1978, reforms began in the agricultural, industrial, fiscal, financial, banking, price setting, and labor systems. "The Household Responsibility System" which releases rural labor force, "urban-bias" policy which enlarges rural-urban income gap, and "The Open-Door Policy" which causes regional disparity, have played a striking role in economic growth of China.

Before "open-door" policy, collective farming under the Commune system was implemented. Under this kind of agricultural policy, farmers worked as a team consisting of some forty persons. A farmer could not get extra reward by working harder because all members of the team would share the additional output due to his additional labor. Gradually, the drawback became obvious since some farmers realized that if they farmed separately the team could produce more in total and still delivered the same amount of output required by the procurement system for government distribution of agricultural products in the economy. Therefore, in 1978, a new policy was adopted as the national policy called the "household responsibility system", instead of collective farming. The "household responsibility system" served as the foundation of reform in other sectors not only by increasing the supply of food but also by liberating the farmers from the land and offering surplus labor force for coastal areas where practiced "open-door" policy and for urban areas where implemented "urban-bias" policy.

China is strictly divided into two parts: rural and urban areas. In the history of Chinese economic growth, cities were always endowed prior to develop by Chinese government. Urban bias has long been China's dominant economic policy. The path of China's development became "industry promotion by agriculture", that is, all agricultural resources, including grains, labor force, capital, policy biases and so on, supply from rural to urban, to support the development of industry. The persistent urban bias not only leads to a severe rural-urban income gap, but also deepens rural-urban divide. From 1991 to 2003, the average growth rate of GDP per capita in China is 8.2%. The growth rate of per capita net income of rural residents is only 4.3%, while urban residents are 7.7% which is close to the average growth rate of GDP per capita. The widest rural-urban income gap recorded in

2009. According to National Bureau of Statistics, the urban per capita net income stood at 17,175 Yuan ($2,525) in 2009, in contrast to 5,153 Yuan in the countryside, with the urban-to-rural income ratio being 3.33:1.

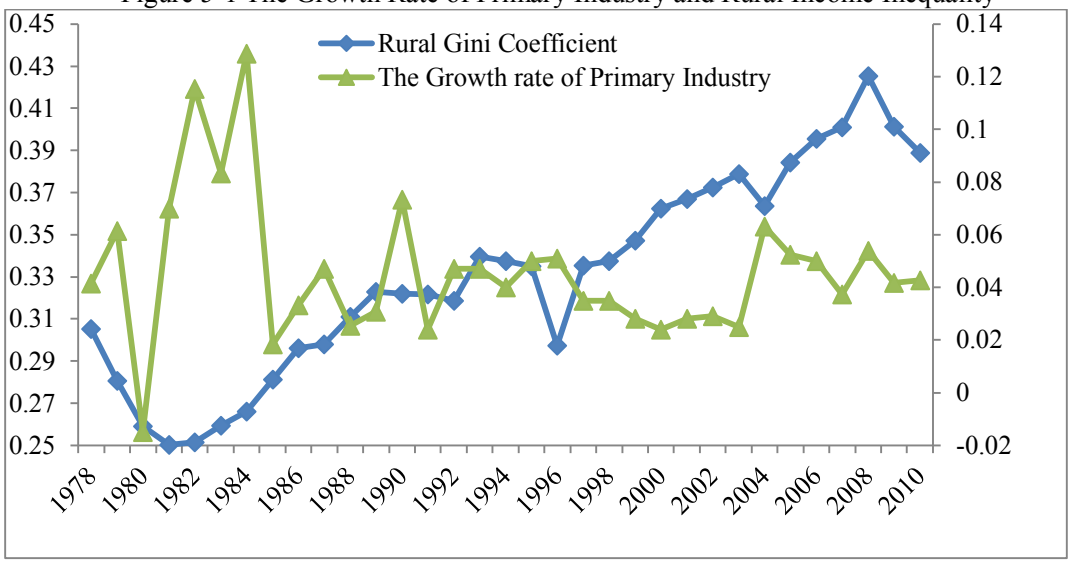
The most important dominant is the open-door policy in 1978, which creates high speed of economic growth about 30 years. China's economy was essentially a closed economy before the economic reform. In 1978, the total volume of its foreign trade, or the sum of the values of its exports and imports, amounted to only 7% of national income. The open-door policy encouraged the development of foreign trade and foreign investment.

Foreign trade The view of exports as an engine of growth has been recognized for long time in both academic and policy circles. The open-door policy encouraged the opening of China to foreign imports and the promotion of exports. In order to earn foreign exchange through export, special treatment, such as export subsidies and export drawback, was given to exporting companies and enterprises to encourage them to export. These exporting companies and enterprises were allowed to retain part of the foreign exchange they earn and to obtain special loans in RMB or in foreign exchange for short-term financing or long-term capital expansion. Additionally, Export Processing Zones have been one of the most important components of export-promotion strategy in developing countries since the 1960s. In China, Export Processing Zones are established in several coastal provinces such as Guangdong and Fujian. There was no import duties levied on materials processed for exports. Foreign investors were encouraged to set up factories with Chinese enterprises independently or jointly to process imported or locally produced materials for export in export-processing zones. The use of export-processing zones to promote exports had been practiced to be successful. By 1998, the volume of foreign trade increased to 37% of gross domestic product. China's foreign trade has grown faster than its GDP for the past 25 years. However, its over-reliance on exports for growth was starkly exposed by the global economic crisis of 2008. Also, joint ventures with foreign investors outside the export-processing zones were established. These developments were relevant not only to China's foreign trade but also to foreign investment in China.

Foreign investment In an effort to attract international capital to spur economic development in China, a decision was made in 1978 to permit foreign direct investment in several small "special economic zones" along the coast. Low labor costs emerged as its main comparative advantage to attract FDI (Foreign Direct Investment) because many observers believed that China was characterized by surplus and underemployed rural labor in the 1980s and 1990s (Bowlus and Sicular, 2003). FDI can take three forms, jointly financed enterprises, cooperative ventures and entirely foreign-owned enterprises. 14 coastal cities and three coastal regions are "open areas" for foreign investment. "Open areas" provide favored tax treatment and other advantages for foreign investment.

Laws on contracts, patents, and other matters of concern to foreign businesses were also passed. As a result, from an almost isolated economy, China has become the largest FDI recipient in the developing world and globally the second largest (next to US) since 1992, which caused to rapid development of coastal areas.

Figure 5-1 The Growth Rate of Primary Industry and Rural Income Inequality

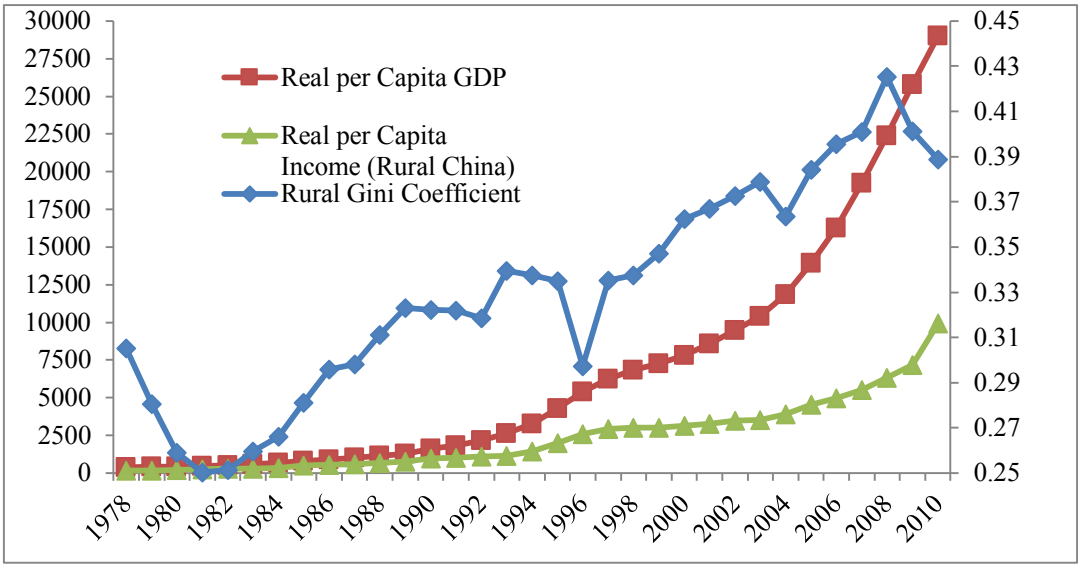


Data source: Rural Gini coefficients of 1978-1997 are collected from Cheng (2007) which used the same data structure and data source as Chapter 3 with the sample size of 1998-2010. The growth rate of primary industry is from National Bureau of Statistics of China.

After "opening up" in 1978, development strategy of China has led to internal and external economic imbalances. The proportion of primary industry to GDP is decreasing rapidly. High cost and low input of agricultural production promote rural residents flow out of primary sectors. Due to expanding labor requirements and relative high income attraction in coastal areas and urban sectors, large scale of labor force in rural areas has been attracted to flow into southern-eastern coastal cities and urban areas and absorbed in manufacturing and service sectors mainly, especially since its labor market reform of the mid-1990s. Massive population flows from rural to urban areas and from western to eastern areas. Rural-to-urban migration and remittances play an important role in transforming the structure of rural household income. Figure 5-1 shows the relationship between deduction of the growth rate of primary industry and relatively rising rural income inequality.

Meanwhile, the rural urban income gap is also rising, which reached its widest in more than three decades in 2009. As of year 2010, income ratio was recorded at 3.23:1 and per capita disposable income of urban households stood at 19109 (Yuan) while rural households' were at 5919 (Yuan) according to data from National Bureau of Statistics of China. It can be seen from Figure 5-2, per capita total income of rural areas taken account to GDP per capita is decreasing rapidly, especially from 1994. Rural income inequality also rises sharply since 1982.

Figure 5-2 Rural Gini Coefficient, Real per capita Income and Real per capita GDP



Data source: Rural Gini coefficients of 1978-1997 are collected from Cheng (2007) which used the same data structure and data source as Chapter 3 with the sample size of 1998-2010. GDP per capita (Yuan) and per capita total income of rural China (Yuan) are from National Bureau of Statistics of China. To eliminate the effect of price fluctuation, Real GDP per capita (Unit: Yuan) is calculated by dividing CPI (Consumer Price Index of Residents). For CPI missing values of 1979 and 1981-84, Retail Price Index is instead.

With striking characteristics of economic growth in China, rural income inequality also increases rapidly. Average rural income inequality is 0.33 from 1978 to 2010 with maximum value of 0.43 in 2008 and minimum value of 0.25 in 1981. Meanwhile, economic growth increases 8.84% on average. Figure 5-2 shows the increasing trend of rural income inequality and real per capita GDP. Although there are fluctuations of rural Gini ratio, the increasing trend also extends. Does this mean that high speed of economic growth raised rural income inequality? To search for the answers, this chapter employs time series data covering period from 1978 to 2010 to investigate the effect of economic growth on rural income inequality in China. Most of the literatures suggest employing the growth rate of real per capita GDP as economic growth indicator to investigate inequality-growth relationship.

5.2.2 Rural-to-urban Labor Force Mobility and Rural Inequality

Rural-to-urban labor mobility is an inevitable factor impact on rural income inequality. As a special group, rural residents share urban resources with urban residents such as education, job opportunity, housing purchasing and so on. But whatever how many years they serve in the cities, their statuses are still rural "*hukou*". Therefore, it is necessary to consider the effect of rural-to-urban labor force mobility.

Table 5-2 The Structure of Labor Force Mobility in Guangdong Province

Data Source	Variable	Total Labor Force Mobility	Inter-provincial Mobility	Intra-provincial Mobility
1990 (The Fourth National Census)	Population(million)	3.929	1.258	2.671
	The proportion to total labor force mobility (%)	100.00	32.01	67.99
1995 (1% Sample Survey of Population)	Population(million)	8.042	3.145	4.897
	The proportion to total labor force mobility (%)	100.00	39.11	60.89
2000 (The Fifth National Census)	Population(million)	25.304	15.065	10.239
	The proportion to total labor force mobility (%)	100.00	59.53	40.47

Data Source: The data is calculated according to national censuses.

Migration in China contains two kinds of perceptions: the "formal" migration and the "informal" migration. Formal migration means those mobile populations who officially changed their *hukou* status, data of which is from "Statistic of National Sub-county Municipal Population". The "informal" migration, i.e. rural-to-urban labor force mobility, includes those mobile populations who move to live a new place without changing their *hukou* status, is from "Compiled Statistics of Registered Temporary Residents in China" since 1997. The latter is the conception of rural-to-urban labor flow and main concern of this chapter. According to National Census of Population and Empirical Investigation of Sub-regions, there is significant disparity in occupation, income and social security between inter-provincial labor force mobility and intra-provincial labor force mobility (Li, 2006). Therefore, it is necessary to distinguish inter-provincial labor force mobility and intra-provincial labor force mobility. Table 5-2 shows the structure of mobility of Guangdong Province in China.

Comparing with the families with no mobility, the total income of families with labor force mobility is higher about 16%-43% (Taylor *et al.*, 2003). According to "The 2005 Sample Survey on 1% of China's Population", monthly net income per capita is up to 1038, which is higher than rural the mean net income of rural residents in the same period (Duan and Yang, 2008). If one of the family members transfers from rural labor force to urban labor force, the family income of which will increase 3509 Yuan (Zhao, 1999). 90% of labor force mobility in the urban areas increases their annual income considerably, 8783 Yuan on average (Li, 2003). Based on above statistic data comparison, rural-to-urban labor force mobility caused the increasing income inequality of rural China. The following work will prove this view by empirical evidence.

5.3 Empirical Analysis

5.3.1 Economic Growth and Inequality: 1978-2010

In this subsection, I would like to discuss the impact of economic growth on rural income inequality without taking the effect of rural-to-urban workforce mobility into consideration due to data unavailability.

Table 5-3 Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
perGDP	0.0884	0.0907	0.1367	0.0233	0.0281	33
Str	0.2099	0.1976	0.3339	0.1010	0.0775	33
Mig	0.6853	0.7149	0.8208	0.5005	0.0949	33
GINI	0.3338	0.3349	0.4254	0.2504	0.0481	33
Exp	0.1877	0.1833	0.3155	0.11152	0.05120	33
Edu	0.0012	0.0005	0.0047	8.71E-05	0.0014	33

Table 5-3 presents summary statistics of the above variables. This table provides the list of all the variables, means, standard deviations, minimum and maximum values. Economic growth increases 8.84% on average with maximum value of 13.67% and minimum value of 2.23%. Average rural income inequality is 0.33 with maximum value of 0.43 and minimum value of 0.25. Taking both of the increasing trends into consideration, the following work will investigate whether economic growth impacts on rural income inequality or not. Besides, the decreasing trend of structure change and migration is also noticeable.

Concerning estimation coefficient of equation (5-1) by GMM, control variables are added into the model gradually. After that, the goodness of fit becomes better, which demonstrate the variables used in the model are effective. AR (1) and AR (2) test can reject the null hypothesis of autocorrelation. The goodness of fit is up to 90.9%. Sargan test also accepts the validity of instrumental variables. All of above tests show that the model is robust and the estimation coefficients are reliable. However, the results are unreliable for unstable empirical model setting. The sign of economic growth changed from minus to plus when square term of economic growth includes in the model.

Instead, in order to get robust model, the square term of all the independent variables are employed into equation (5-1). Estimate coefficient presents in Table 5-4. After rejecting the insignificant variables gradually (model (1) to (3) in Table 5-4), a stable empirical model can be built by adding three control variables ($perGDP^2$, $\ln Edu^2$ and $\ln Exp^2$) into equation (5-1). Model (3) in Table 5-4 displays estimation results of stable model.

Table 5-4 Estimation Coefficients

Dependent variable: ln*GINI* Method: GMM Estimation			
Variable	Model (1)	Model (2)	Model (3)
perGDP	-0.010** (-3.649)	-0.013*** (-4.860)	-0.012*** (-4.723)
$perGDP^2$	-0.001 (0.732)	0.0003** (2.602)	-0.0003* (1.800)
ln*Str*	-0.149 (-0.354)	-0.632*** (-8.486)	-0.599*** (-6.704)
$\ln Str^2$	-0.149 (-0.354)		
ln*Mig*	1.336** (2.917)	1.626*** (3.076)	1.124*** (3.659)
$\ln Mig^2$	0.021 (0.041)	0.540 (0.943)	
ln*Edu*	0.723*** (4.620)	0.652*** (3.280)	0.768*** (8.065)
$\ln Edu^2$	0.050*** (4.643)	0.045*** (3.268)	0.053*** (7.569)
ln*Exp*	-2.339*** (-8.928)	-2.234*** (-8.755)	-2.193*** (-9.110)
$\ln Exp^2$	-0.623*** (-9.671)	-0.603*** (-9.252)	-0.592*** (-9.689)
constant	-0.779 (-1.457)	-1.211* (-1.897)	-0.799* (-2.015)
Adj-R^2	0.951	0.954	0.956
Sargan test (P value)	6.931 (0.906)	7.303 (0.886)	6.651 (0.919)
AR(1) test (p-value)	0.056*	0.029**	0.024**
AR(2) test (p-value)	0.271	0.882	0.770

Note: "*, **, ***" denote the level of significance at 10%, 5%, 1%, respectively. t statistics are in parentheses. The instrument specification of GMM in each model is the lag values of one period of each variable except *perGDP* lag (1, 5). Sargan test of overidentifying restrictions. H_0: overidentifying restrictions are valid. H_1: overidentifying restrictions are invalid.

In model (3), residual diagnose shows that Jarque-Bera value is 6.651 with probability of 0.919, which accepts the null hypothesis of normal distribution of error term. AR (2) test of disturbance also rejects autocorrelation of order (2). Significance test of regression equation also rejects null hypothesis at the significant level of 1% ($F= 104.66 > F_{0.1}(8, 24) = 3.36$). Sargan test supports the selection of instrument, and AR (2) test refuses the null hypothesis of autocorrelation. Above tests demonstrate empirical model is stable and the results in model (3) are robust. It can be concluded that economic growth, primary industry change, fiscal expenditure are significant negative impact on rural income inequality, while other variables including migration, and educational input show a significant positive relationship with rural income inequality.

Economic growth will reduce rural income inequality through investment, employment opportunity and transfer payment. The inadequate investment is the main cause of low growth rate of rural sector. Undoubtedly, rural sector will benefit from economic growth by means of policy guidance. In China, investment not only flows into high profit sector, but also flows to the place where policy preference. In order to balance economic development, government has to induce investment into rural sectors. Furthermore, economic growth will increase employment opportunity for rural residents both on farm and nonfarm sectors. With the development of economy, transfer payment to rural residents will also be improved in order to alleviate the social problems caused by rural income inequality, so as to deduce inequality of rural China.

The share of production of primary industry to GDP is decreasing to 10.10% in 2010 from 33.39% in 1978, while rural population takes the proportion of 50.05% to total population in 2010. There are two main reasons that caused rural income inequality. One is location disparity. Rural residents in flat farming lands location such as north of China have promoted agricultural productivity relying on mechanize farming. Other framers, more than half, live in mountain areas have to engage in agricultural production by traditional way. Income of farmers in flat areas is relatively higher than mountain areas. The other is inequality of the per capita land. For the family who own more lands, their poverty is from the land they own, since they are bound by land and income source is only from agriculture. For the people with low per capita land, labor forces are released. They can spend several months to work outside and go back in the busy sowing and harvest season, or even rent land to other person and make money to live in the cities. Hence, the development of agriculture will improve the income of farmers to reduce rural income inequality.

Migration is a central topic at current stage due to high speed urbanization process. Urbanization as a new growth engines connects industry with rural development in order to balance economic growth of rural and urban sectors. Rural population decreases from 82.08% in 1978 to 50.05% in 2010. Undoubtedly, the status changing from rural to urban will benefit from social security, medical care, and educational resources and so on. For rural residents, if possible, it is a prior choice to take

part in urban sectors. Reducing rural population due to urbanization releases a large amount of farming land and causes shortage of rural labor force. As my knowledge of my hometown, the wage of rural labor force increase from 40 Yuan per day in 2003 to 150 Yuan per day in 2011. With high cost of agricultural production, the raising price of agricultural products will increase the income of rural residents who mainly rely on agricultural activity. However, cost increases faster than benefit. That is, rural residents don't benefit from urbanization policy. Migration increases the income gap of rural residents. Therefore, this is a significant positive relationship between rural income inequality and migration.

Educational input is supposed to be negative link with rural income inequality. However, this study shows a significant positive relationship. By explaining this disparity, special "*hukou"* system of China should be taken into consideration. When rural students go to college, most of their status also changed to urban status. After graduation, they usually will work in the city and their incomes belong to urban income class. Besides, the proportion of college students with rural status takes a small account in the whole graduation. In this aspect, educational input enlarges rural income inequality since excellent people who exhaust rural resources flow out to rural areas with nothing contribution to rural department. In the other hand, uneven educational resource distribution make educational input is not enough to have an effect on rural income inequality. Rural students are more difficult to go to college with respect to backwardness of teaching resource, soft and hard ware of educational condition and low income of the families. Most of the students have to leave school after junior high school, even better senior high school. If more educational resources input to rural areas, education will decrease rural income inequality by higher educational return.

Fiscal expenditure is always the main engine of economic growth. Increase in government expenditure on socio-economic and physical infrastructures encourages economic growth. For example, fiscal expenditure on health and education raises the productivity of labor and increase the growth of national output. Similarly, expenditure on infrastructure such as power, communications, roads, and so on, reduces production costs, increases private sector investment and profitability of firms, thus fostering economic growth. Furthermore, economic growth reduces rural income inequality. If fiscal expenditure gives more prior to rural development, it will be an effective instrument to narrow rural income gap.

As a whole, economic growth and primary industry will decrease rural income inequality, while other factors will have a contrary impact on income gap of rural areas. Chinese government should implement appropriate policy to promote economic growth and balance development in order to reduce rural income inequality.

5.3.2 Rural-to-urban Labor Force Mobility and Rural Inequality: 1998-2010

Subsequently, I will study the impact of economic growth on rural income inequality including the effect of rural-to-urban labor force mobility. Table 5-5 presents summary statistics of the above variables. This table provides the list of all the variables, means, standard deviations, minimum and maximum values. Economic growth increases 9.2% on average with maximum value of 13.57% and minimum value of 6.69%. Average rural income inequality is 0.39 with maximum value of 0.43 and minimum value of 0.36.The scale of inter-provincial labor force mobility is larger than the intra-provincial caused by uneven regional development of China.

Table 5-5 Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
GINI	0.3866	0.3838	0.4254	0.3599	0.0179	13
perGDP	0.0920	0.0907	0.1357	0.0669	0.0201	13
Edu	0.0303	0.0307	0.0343	0.0255	0.0029	13
Exp	0.1812	0.1833	0.2240	0.1279	0.0268	13
Intra_p	0.0174	0.0170	0.0280	0.0108	0.0055	13
Inter_p	0.0352	0.0345	0.0623	0.0143	0.0155	13
Str	0.1297	0.1280	0.1756	0.1010	0.0241	13
Mig	0.5832	0.5824	0.6665	0.5005	0.0531	13

Table 5-6 Estimated Coefficients of Rural-to-urban Labor Force Mobility (Intra-province)

Variable	Model (1)		Model (2)	
	Estimate	t-ratio	Estimate	t-ratio
perGDP	-0.015*	-7.630	-0.010**	-4.046
ln*Intra_p*	5.492*	7.714	6.258***	15.379
ln*Mig*	21.080*	6.961	25.575***	13.196
ln*Str*	-2.345*	-6.965	-2.852**	-8.996
ln*Edu*	-0.250*	-6.374	-0.280*	-3.080
ln*Exp*	-0.767	-5.437		
constant	26.161*	6.504	31.822***	16.025
Adj-R^2	0.888		0.748	
Sargan test	1.432		2.990	
(P value)	(0.231)		(0.234)	

Note: "*, **, ***" denote the level of significance at 10%, 5%, 1%, respectively. t statistics are in parentheses. The instrument specification of GMM is the lag values of ln*Str* (-1), ln*Mig* (-1), ln*Edu* (-1), ln*Intra_p* (-1), ln*Exp* (-1), *perGDP* lag (1, 3), ln*GINI* lag (1, 3), and constant. Sargan test of overidentifying restrictions. H_0: overidentifying restrictions are valid. H_1: overidentifying restrictions are invalid.

Table 5-6 and 5-7 report the estimate coefficients of economic growth impact on rural income inequality with intra- and inter- provincial labor force mobility, respectively. In Table 5-6, I estimate the whole sample and found primary industry is insignificant in model (1). In order to get more reliable results, I estimated again without fiscal expenditure in model (2). Economic growth, fiscal expenditure and primary industry show a significant positive link with rural income inequality, while the coefficients of migration and intra-provincial labor force mobility are contrary.

In Table 5-7, empirical model excludes primary industry due to the insignificant coefficient. The results in model (2) show that all the variables are of benefit to decrease rural income inequality except inter-provincial labor force mobility and migration. It can be concluded that that economic growth will decrease rural income inequality in China. Both inter-provincial labor force mobility and intra-provincial labor force mobility increase income inequality of rural China. Comparatively, the effect of intra-provincial labor force mobility on rural income inequality is larger (6.258) than that of inter-provincial labor force mobility (0.891).

Table 5-7 Estimated Coefficients of Rural-to-urban Labor Force Mobility (Inter-province)

Variable	Model (1)		Model (2)	
	Estimate	t-ratio	Estimate	t-ratio
perGDP	-0.009*	-11.078	-0.010***	-13.943
ln*Edu*	-0.669**	-7.570	-0.297***	-11.967
ln*Exp*	-0.506*	-9.132	-0.753**	-6.081
ln*Mig*	2.567*	10.969	2.304***	9.581
ln*Inter_p*	0.909**	16.978	0.891***	37.667
ln*Str*	-0.054	-1.139		
constant	1.349	4.955		
Adj-R^2	0.959		0.967	
Sargan test	1.365		1.812	
(P value)	(0.243)		(0.404)	

Note: "*, **, ***" denote the level of significance at 10%, 5%, 1%, respectively. t statistics are in parentheses. The instrument specification of GMM is the lag values of ln*Str* (-1), ln*Mig* (-1), ln*Edu* (-1), ln*Inter_p* (-1), ln*Exp* (-1), ln*perGDP* lag (1, 3), ln*GINI* lag (1, 3), and constant. Sargan test of overidentifying restrictions. H_0: overidentifying restrictions are valid. H_1: overidentifying restrictions are invalid.

Two aspects can be interpreted as the main reason of the results. One is that inter-provincial mobility definitely improves the income of a large scale of population from poor provinces such as Sichuan, Yunnan and so on, which decreases the number of population in low income class. The top income class also becomes richer. The other is that flow distance has great impact on rural-to-urban mobile cost and integration into the city society. Long distance moving undoubtedly increases flow

and life cost in a strange society, which causes relatively high income but low net income. Henceforth, inter-provincial labor force mobility impact on rural income inequality is lower.

5.3.3 Comparison

The results of two sample period display some differences when rural-to-urban labor force mobility is taking into consideration (see Table 5-8). The sign of economic growth and migration is consistent. It can be concluded that economic growth will decrease rural income inequality, while migration will raise rural income inequality.

In Table 5-6, the effect of educational input and fiscal expenditure on rural income inequality becomes insignificant. Primary industry is significant negative link with inequality, which demonstrates agricultural development will reduce rural income gap. Most famers deny to do farm work due to "price scissors" of industry and agriculture sector, i.e. high cost of farming and low income of grains. Poor infrastructure of rural areas is also a problem to compel rural residents choosing far from farming. According to my investigation in Yunnan, most of the rural resident would like to go back to hometown and engage in farming production. According to sampling survey of Zheng (1999) in Guangdong Province, only 23.0% of inter-provincial respondents want to stay in Guangdong, while 52.8% would like to go back to their hometown.

Table 5-8 The Comparison of Three Models (the Sign of Variables)

Variable	Table 5-4	Table 5-6	Table 5-7
	Whole Sample	Including ln*Intra_p*	Including ln*Inter_p*
perGDP	-	-	-
ln*Edu*	+	-	-
ln*Exp*	-		-
ln*Str*	-	-	
ln*Mig*	+	+	+
ln*Intra_p*		+	
ln*Inter_p*			+

In Table 5-7, the coefficient of primary industry is insignificant. Educational input shows a negative relationship with inequality including the effect of intra-provincial mobility and inter-provincial mobility, which is contrary as Table 5-4. The results illustrate that education is good for rural income inequality reduction when labor force mobility is considered. According to sampling survey of 2010 by National Population and Family Planning Commission, core family migrations together with their spouses have been taken the proportion of 56.2% to labor force mobility. Families' mobility changed the distribution of educational resources of urban sectors. In the

educational input aspect, children of mobile families are able to share better urban educational resources to improve educational level in order to get better job opportunity in the future. Most of the rural migrant labors called the second-class citizen are low educational level. Thus, the rural migrant labors have strong desire to change their children' future through education, even though tuition in urban sector is much higher than rural sector. In this respect, a large part of rural residents can benefit from educational input in urban sector, further to reduce rural income inequality. However, the drop-off rate of mobile children reached at 0.82% of inter-provincial mobility and 0.83% of intra-provincial mobility according to the second countrywide agriculture general investigation in 2006, since these children who are non-native *hukou* students have to pay for a big amount of extra-fees such as school selection fee, transient students' fee, a clothing allowance and so on.

Fiscal expenditure plays a significant role in economic growth in China, especially, the development of urban sectors. A large number of rural residents who move to work in the urban sectors more or less enjoy the benefit from economic growth promoted by fiscal expenditure. Therefore, when rural-to-urban labor force mobility as a control variable is included into the model, fiscal expenditure show a negative relationship with rural income inequality. That is, increasing fiscal expenditure will reduce rural income inequality.

5.4 Conclusion and Policy Implications

The topic of how economic growth empirically affects rural income inequality has been largely unexplored despite obvious equity and policy implications. Especially, the situation becomes more complicated in Chinese case. In order to address this issue, this chapter employs time series data over the period 1978 to 2010 to empirically investigate the impact of economic performance on rural income inequality in China.

It can be concluded that economic growth, primary industry, fiscal expenditure are significant negative impact on rural income inequality, while other variables including migration, and educational input show a significant positive relationship with rural income inequality. Empirical evidence illustrates that the development of economic growth is good for the reduction of rural income inequality.

With distinguishing intra-provincial labor mobility and inter-provincial labor mobility, the effect of rural-to-urban labor mobility on rural income inequality is also taken into consideration, since there is significant disparity in occupation, income and social security between inter-provincial labor force mobility and intra-provincial labor force mobility. Empirical study shows that both inter-provincial labor force mobility and intra-provincial labor force mobility increase income inequality of rural China. Comparatively, the effect of intra-provincial labor force mobility on rural income inequality is larger (6.258) than that of inter-provincial labor force mobility (0.891).

The policy implications of this study direct two dimensions. First of all, transforming economic developing patterns is inevitable. Government decision should give more prior to rural development. After economic reform in 1978, the development of the urban areas has been quite satisfactory, while the rural areas have just been very limitedly developed. If the central government can put more resources, such as fiscal expenditure budget, educational resources, agricultural policies, and so on, to develop rural areas, income inequality will certainly be greatly alleviated, since more than 50% of Chinese population are living in these interior parts. Besides, the process of urbanization, which turned to be positively link with rural income inequality, should not be accelerated prudently. On the other hand, it is necessary to deepen the reform of Country Census Register System (*hukou* system). "*Hukou*" system differentiates the agricultural and the non-agricultural registered permanent residence strictly, resulting in the forming of intersected structure of town and country and large scale of " floating people". "*Hukou*" system reform would break urban-rural division and promote balanced economic growth between rural and urban sectors.

6. The Decomposition of Rural Income Inequality

6.1 Background Illustration

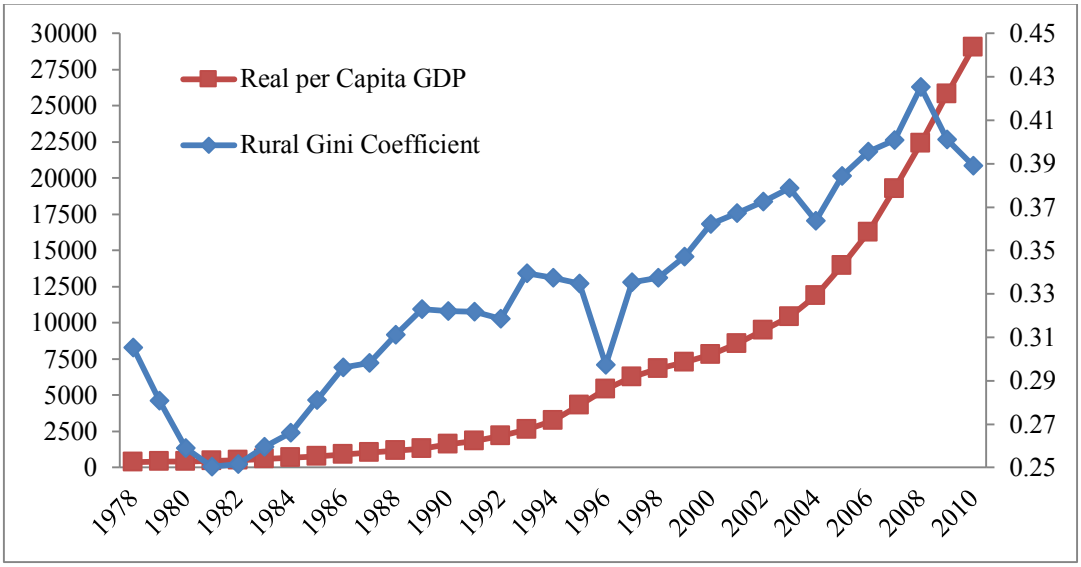
A resurgence of interest in income distribution of rural China has been found in the literature, both in English and Chinese. A consensus that has been reached is the worsening trend of rural income inequality since the reform initiated in 1978. Gini ratio of rural China rises from 0.25 in 1981 to 0.425 in 2008 which is over the international warning line of 0.4. Such a trend has serious implications on China's ability to maintain sustainable growth and, if unabated, will undermine social and political stability. In previous studies, the relationship between rural income inequality and economic growth has been examined. Empirical study shows that rural income inequality is harmful for economic growth, which implies that the policy of reduction rural inequality is required. Empirical works have been done to explore the factors impact on rural income, such as Chen and Liu (2011) show that non-agricultural activities and income, rural education, and industrial structure are critical factors that affect rural income gap. However, these studies do not solve the question how rural income inequality is determined. In order to search for the answer, it's necessary to decompose the determinants of rural inequality.

Given the increase of income inequality in rural China, many researchers have investigated the trends of income inequality among regions or provinces since the late 1980s. The main reasons for this inconsistency are contributed to different geographic scales, time periods, indicators of well-being, and indices of inequality measure. The subsequent works studies the determinants of regional income inequality in rural China at different levels. For example, Yao (1997) calculates and decomposes the inter-provincial per capita income Gini coefficient in rural China from1986 to 1992 and finds that income distribution in rural China became skewed over this period as a result of economic reforms. By using household data of 18 provinces in 1988 and 1995, Bjorn and Li (2002) show that most income inequality in rural China in 1995 was spatial and that the uneven development of mean income across counties stood for most, but not all, of the rapid increase in income inequality. However, these studies are descriptive and do not answer the question that what determinates the rural income inequality.

As for study continued, the following works concentrated on decomposing rural income inequality in order to find out the fundamental determinants. Targeting to decomposition approaches, income inequality can be decomposed in various dimensions. Traditionally, inequality is decomposed by sub-groups, income sources, and causal factors, and by other socio-demographic characteristics. The most common decomposition is by population subgroups (e.g., households headed by males and by females) and income sources, which has been accumulated a considerable study in the literature.

Inequality can also be decomposed at different levels of aggregation. At the national level it can be decomposed into within-subgroup and between-subgroup components. Similarly, at the international level it can be decomposed into within-country and between-country components.

Figure 6-1 Rural Gini Coefficient and Real per Capita GDP



Data source: Rural Gini coefficients of 1978-1997 are collected from Cheng (2007) which used the same data structure and data source as Chapter 3 with the sample size of 1998-2010. GDP per capita (Yuan) is from National Bureau of Statistics of China. To eliminate the effect of price fluctuation, Real GDP per capita (Unit: Yuan) is calculated by dividing CPI (Consumer Price Index of Residents). For CPI missing values of 1979 and 1981-84, Retail Price Index is instead.

Subsequently, a regression-based approach by determinants of income has been applied on the decomposition of rural income inequality, in order to overcome the limitations of traditional approaches. The use of regression-based decomposition is novel in that it allows ranking of these determinants according to any inequality measure. In a recent work, Wan (2004) represents an early attempt to apply regression-based decomposition to identify root sources of regional inequality in rural China by using regional or provincial data for 1992 to 1995 compiled from various issues of Rural Household Survey Statistics, a publication of the National Bureau of Statistics (NBS). The shortcoming of regional analysis is that regional analysis provides limited information on the determinants of income inequality. Moreover, the existing literature is mostly based on aggregate data. Few studies have shed much light on issues concerning household-level data. Morduch and Sicular (2002) illustrate the regression-based method using a small survey of 259 farm household data from rural China for 1990-1993. The relative contributions of three frequent explanations for emerging inequality (regional segmentations, human capital accumulation and political variable) are highly sensitive to the decomposition rule used. Subsequently, Wan and Zhou (2005) apply the regression-based decomposition framework to the study of inequality accounting in rural China to analytically identify the fundamental determinants of income inequality in rural China, according to

the household level data collected by Research Centre for Rural Economy (RCRE) of Ministry of Agriculture of China. His study points out that, during 1996-2002, geography has been the dominant factor but is becoming less important in explaining total inequality. Capital input emerges as a most significant determinant of income inequality. Farming structure is more important than labor and other inputs in contributing to income inequality across households.

Although relevant literature appears in this field, this chapter is motivated by two issues which are neglected or not properly addressed in previous studies. Firstly, Wan and Zhou (2005) covers the time period of 1996-2002. It can be seen from Figure 6-1 that during this period, the Gini coefficient of rural China is increasing sharply, while, relatively, real per capita GDP rises steady. Rural Gini coefficient reaches its maximum value in 2008 and real per capita GDP ascends in a high speed. Since 2003, urbanization becomes a new engine of economic growth in China. Under new policy indicating, the structure and economic growth pattern have been changed. Therefore, it is necessary to investigate the fundamental determinants of rural income inequality under the new social circumstances.

Table 6-1 per Capita Income in Rural China, by Province (2002)

Eastern Provinces	Yuan	Central Provinces	Yuan	Western Provinces	Yuan
Shanghai	6224	Hubei	2444	Sichuan	2108
Beijing	5398	Heilongjiang	2405	Chongqing	2098
Zhejiang	4940	Hunan	2398	Inner Mongolia	2086
Tianjin	4279	Jiangxi	2306	Guangxi	2013
Jiangsu	3980	Jilin	2301	Ningxia	1917
Guangdong	3912	Henan	2216	Xinjiang	1863
Fujian	3539	Shanxi	2150	Qinghai	1669
Shandong	2948	Anhui	2118	Yunnan	1609
Liaoning	2751			Shaanxi	1596
Hebei	2685			Gansu	1590
Hainan	2423			Guizhou	1490
				Tibet	1462
National Per capita income in rural China				2476	

Data source: China Statistical Yearbook 2003. Per Capita Income is the income of rural residents in each province.

Secondly, Wan and Zhou (2005) use the household level data from three provinces, Guangdong, Hubei and Yunnan to represent south-east, central and western China, respectively.[6] From each

[6] China's provinces have been divided into three regions mainly according to their geographical locations, that is, eastern, middle and western provinces. Usually, Hongkong, Macao and Taiwan are not taken into consideration in academic. Generally, eastern provinces are more developed than middle and western provinces, the least developed areas. The eastern(or Coastal) provinces include Liaoning, Hebei, Beijing, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Hainan; Middle (or Central)

province, three villages are chosen, representing different development status within the county. However, there are giant differences among the provinces located in the same region. Guangdong, is among the richest provinces in south-east China, is not enough to represent eastern region, so as Hubei and Yunnan. Take 2002 for example (Table 6-1). In Eastern Provinces, Per capita income in rural Shanghai was 6224, almost 2.6 times than that of in Hainan. While per capita income in rural Hainan was approximately equal to that of in Hubei which belongs to central provinces. Exactly, per capita income in rural Hubei was slightly bigger than that of in Hainan. The same situation existed in the poorest Anhui located in central and the richest Sichuan located in western China. Hence, it is not enough to choose one province to stand in for a region. Furthermore, disparities also exist in the villages which are involved in the same province. Thus, the results of Wan and Zhou (2005) cannot be convincible. More geography disparities should be taken into consideration.

On the whole, this chapter will extend the work done by Wan and Zhou (2005). To achieve our objectives, individual level survey data from 2003 to 2008, which is from Chinese General Social Survey (CGSS) launched by Renmin University of China, will be employed. There are three contributions in this chapter. Firstly, rural income inequality is decomposed based on regression approach in order to investigate the fundamental determinants of rural income inequality under the new social circumstances. Secondly, geography disparities are taken into consideration. The sample size including 27 provinces is good for analyzing the effect of geography disparities on rural income inequality. At last and the most important, individual data is used, which will offer a precise measurement of rural income inequality and find out the determinants of rural income from the perspective of "individuals".

6.2 A Review on Inequality Decomposition

A renewed interest in income distribution has gained considerable concerns on the academic research agenda. This resurgence of interest re-opens unresolved empirical questions about how to analyze income inequality and its determinants. The most common practice is to calculate, compare, and decompose summary indices of inequality like the Gini coefficient or the variance. In order to draw sharp conclusions, inequality decomposition turned to be necessary since economists are eager to find out different sources of income influence national income inequality across households. The variables which determine income inequality should be ranked in terms of their relative contributions to total inequality for the purpose of setting policy priorities. Therefore, different methods have been developed to decompose inequality (Shorrocks, 1980, 1982, 1984; Fields, 2000;

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provinces are Heilongjiang, Henan, Shanxi, Hubei, Hunan, Jiangxi, Anhui, and Jilin; The rest provinces, Neimenggu, Guangxi, Xinjiang, Ningxia, Gansu, Qinghai, Shaanxi, Sichuan, Chongqing, Yunnan, Guizhou and Xizang, belong to western areas. Guangxi belonged to central provinces is based on the Seven Five Year Plan approved by the 4th session of the 6th National People's Congress in 1986. But now Guangxi is attributing to western province by academic.

Morduch and Sicular, 2002).

Conventional approaches to inequality decomposition are carried out either by population subgroups or by income sources (or "factor components") under the framework of Shorrocks (1980, 1982, and 1984) and Bourguignon (1979). A large theoretical literature has examined possible ways of decomposing inequality indices by factor components, and illustrated the methodologies proposed with some empirical evidence. Usual decompositions methods mostly based on Shorrocks (1982) framework allow for a broad evaluation of the contribution of income sources. These decomposition procedures however suffer from two strong drawbacks: *i*) the share of inequality imputed to any income source is independent of the inequality measure used and, *ii*) the impact of changes in the marginal distribution of income sources cannot be disentangled from the effect of changes in correlation between sources. Decomposition by population subgroups begins by dividing a sample into discrete categories (such as rural and urban income gaps, male-female wage differentials, and so on) and then calculates the level of inequality within each sub-sample and between the means of the sub-samples. This approach produces the so-called "within" and "between" components and has been the leading approach to quantifying how education, age, etc., affect inequality. However, inequality decomposition by population subgroups provides rather limited information on the fundamental determinants of inequality, e.g., differences in human and physical capital, dependency ratios, globalization, and technical change (Wan, 2004). Also, it is likely to produce spurious results (Wan and Zhou, 2004). It can be a useful descriptive tool but has certain limitations such as continuous variables are impermissible, and it is impossible to control for endogeneity (Morduch and Sicular, 2002). Clearly, one must be able to control for other factors in order to identify and measure the contribution of a particular variable. This is not possible with the conventional approaches.

Moreover, Fournier (2001) provides a general framework for inequality decomposition by factor components based on the concept of rank correlation, which has two main advantages over usual decomposition procedures: *i*) it allows for a decomposition of observed changes in the whole income distribution and not just of a specific inequality index and, *ii*) it enables to isolate the specific impact of marginal distribution changes of income sources as well as that of changes in correlation between sources. Even though, this approach still suffers from shortcomings. On the one hand, decomposition by factor components requires complete information on all income sources and an identity that expresses total income as a sum of factor incomes. On the other hand, apart from a data unavailability problem, this approach cannot be used to quantify contributions of fundamental determinants to income inequality either.[7]Decomposition by factor components only allows one to

[7] For example, it is known that income is determined by education, experience and other personal or household characteristics. These fundamental determinants affect all sources of income, including wage, investment returns and transfer income. It would be interesting and useful to decompose total inequality into components associated with each of the fundamental determinants.

attribute total inequality to the income sources, not to the fundamental determinants (Wan and Zhou, 2004).

The restrictions of conventional approaches have naturally led researchers to consider ways to use regression analysis in decomposition[8]. Use of regression estimates in inequality analysis dates at least to Oaxaca (1973) and has generated renewed interest in recent years (Fields, 1998; Bourgignon *et al.*, 1998). The early works mainly focus on explaining differences in income distribution between distinct groups of income recipients (Blinder, 1973; Juhn *et al.*, 1993). The contributions of specific factors to total inequality are not quantified. Hence, only a limited number of inequality-related impacts can be identified, although these impacts could be functions of more fundamental determinants.

To overcome the limitation of the early works, recent advances have relaxed the restriction regarding the number and type of variables that can be considered. The following works impose as little structural assumptions as possible through non-parametric and semi-parametric methods (DiNardo *et al.*, 1996; Deaton, 1997)[9]. However, the findings are less conclusive than economists and policy makers would prefer (Morduch and Sicular, 2002). Subsequently, Fields (2000, 2003), Fields and Yoo (2000) [10]and Morduch and Sicular (2002) proposed regression-based methods of decomposition of inequality by income sources allowing for any number of fundamental income determinants[11]. These methods involve estimation of standard income generating equations written in terms of covariance, but suffer from a number of restrictions. Further, Wan (2004) extends a general regression-based procedure for decomposing any inequality measure, including the Gini coefficient and Theil's measure[12].

Unlike traditional counterparts, regression-based approach allows the contributions of the regression variables to total inequality to be quantified, and permits the inclusion of any number or

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[8] Regression-based approaches to inequality decomposition are appealing because they overcome many of the limitations of standard decomposition by groups.

[9] DiNardo *et al.* (1996) and Deaton (1997) describe and compare the entire distribution of the target variable in terms of the density function, rather than attempting to decompose a summary measure of inequality. Although they impose few structural assumptions, the findings are less conclusive than economists and policy makers would prefer, as Morduch and Sicular (2002) argue.

[10] Fields and Yoo (2000) and Morduch and Sicular (2002) employ conventional techniques to specify and estimate parametric income-generating functions and derive inequality decompositions based on the estimated regression equations. Their conceptual framework allows for any number of fundamental income determinants, but suffers from a number of restrictions. Our paper builds on the work of Fields and Yoo (2000) and Morduch and Sicular (2002).

[11] Fields (2000) and Morduch and Sicular (2002) have proposed regression-based methods of decomposition of inequality by income sources. These methods involve estimation of standard income generating equations written in terms of covariances.

[12] Wan (2004) releases the severe limitations in terms of the functional forms and inequality measures used, involving a constant term and a residual term.

type of variables or even proxies, including social, economic, demographic and political factors[13]. The contribution of the explanatory variables to the distributional changes is determined by the size of the coefficient and changes in the respective variables: elasticities. The flexibility of this approach, particularly its ability to accommodate endogeneity of income determination and random errors, makes it attractive to economists, and policy-makers. With this respect, this chapter will decompose rural income inequality by employing regression-based decomposition in order to investigate the determinants of rural inequality.

6.3 Model Specification

6.3.1 Measuring Inequality

There are many ways of measuring inequality with mathematical appeal. Most popularly, Gini index is used in most literature. Let n denote the number of individuals in the sample, y_i is the income of individual i, $i \in (1,2,...,n)$, which is indexed in non-decreasing order ($y_i \leq y_j$ when $j>i$). The mean income can be written as $y = (1/n) \Sigma y_i$. Gini index is defined as follows (Gini, 1912),

$$Gini = \frac{1}{2n^2 \bar{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right| \tag{6-1}$$

6.3.2 Inequality Decomposition

Assuming that y is the income of household, and income is observed as the sum of incomes from k different sources, $y=\Sigma_k y^k$. According to Shorrocks (1982), the relative factor inequality weights s_k is given by

$$s_k = \mathrm{cov}(y_k, y) / \sigma^2(y) \tag{6-2}$$

Fields (2003) extended the decomposition procedure (6-2) to a regression-based decomposition by determinants of income and proposed an income-generating function estimated by a standard semi-log regression. Define that X is a matrix of explanatory variables, b is a vector of coefficients, and ε is a vector of residuals. Let an inequality index I (lnY) be defined on the vector of log-incomes $\ln Y = (\ln Y_1, \ldots, \ln Y_N)$, income-generating function can be written as,

$$\ln Y = X b + \varepsilon \tag{6-3}$$

Given a vector of consistently estimated coefficients b^*, income can be expressed as a sum of predicted income and a prediction error according to

[13] The regression-based approach provides an efficient and flexible way to quantify the conditional roles of variables like race, marital status, education and age in a multivariate context.

$$\ln Y = Xb^* + e^* \tag{6-4}$$

Applying the theorem of Mood *et al.* (1974) in the context of a single random variable lnY can get,

$$\operatorname{cov}\left[\sum_k b_k^* X_k^*, \ln Y\right] = \sum_k \operatorname{cov}\left[b_k^* X_k^*, \ln Y\right] \tag{6-5}$$

Since the LHS of (6-5) is the covariance between lnY and itself, the variance of lnY can be simply denoted as,

$$\sigma^2(\ln Y) = \sum_k \operatorname{cov}\left[b_k^* X_k^*, \ln Y\right] \tag{6-6}$$

Dividing equation (6-6) through by σ^2 (lnY) on both sides can get,

$$100\% = \frac{\sum_k \operatorname{cov}\left[b_k^* X_k^*, \ln Y\right]}{\sigma^2(\ln Y)} = \sum_k s_k(\ln Y) \tag{6-7}$$

The share of inequality attributed to explanatory variable *k* is given by

$$s_k(\ln Y) = \operatorname{cov}\left[b_k^* X_k^*, \ln Y\right] / \sigma^2(\ln Y) \tag{6-8}$$

The ordinary correlation coefficient is related to the covariance by

$$cor\left[b_k^* X_k^*, \ln Y\right] = \operatorname{cov}\left[b_k^* X_k^*, \ln Y\right] / \sigma(\ln Y) \tag{6-9}$$

Combining (6-6) to (6-9), then have

$$s^k(\ln y) = \operatorname{cov}(b_k^* X_k^*, \ln y) / \sigma^2(\ln Y) = b_k^* \sigma(X_j^*) cor\left[X_k^*, \ln Y\right] / \sigma(\ln Y) \tag{6-10}$$

Equation (6-10) provides the decomposition of the log-variance. It can be seen that equation (6-10) has the same form as equation (6-2) proposed by Shorrock (1982) with Y_k replacing $b_k^* X_k^*$ and Y replacing lnY. In general, s_k is the indicator of how *k* income source contribute to income inequality. It is important for the decomposition of inequality by factor components.

6.4 Income Generation Function and Data Source

6.4.1 Data Source

This chapter employs individual-level survey data to compute various inequality indices and conduct inequality decomposition. Data analyzed were collected by the research project "China General Social Survey (CGSS)" sponsored by the China Social Science Foundation. This research project was carried out by Department of Sociology, Renmin University of China & Social Science Division, Hong Kong Science and Technology University, and directed by Dr. Li Lulu & Dr. Bian Yanjie[14]. CGSS is motivated by National Opinion Research Center (NORC) in 1941[15] and International Social Survey Programme (ISSP)[16] in 1984. Before 2003, there is no long term and standard GSS data which can provide cross-national comparison. Due to above reasons, "China General Social Survey (CGSS)" is implemented by the support of "Project 211"[17]. CGSS registered as the member of ISSP in 2007.

The China General Social Survey (CGSS) is an annual or biannual survey of China's urban and rural households designed to gather longitudinal data on social trends and the changing relationship between social structure and quality of life in China. The objectives of the CGSS are: *i*) to gather longitudinal data on social trends; *ii*) to address issues of theoretical and practical significance; and *iii*) to serve as a global resource for the international scholarly community.

This survey started from 2003 and covered 27 provinces, autonomous regions and municipalities which exclude Hainan, Qinghai and Xizang. Usually, Hongkong, Macao and Taiwan are not taken into consideration in academic. The first period of survey includes the data of 2003, 2005, 2006 and 2008. Both rural and urban residents are involved[18]. Excluding the urban samples and deleting

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[14] The authors appreciate the assistance in providing data by the institutes and individuals aforementioned. The views expressed herein are the authors' own.

[15] The organization was founded in 1941 as the National Opinion Research Center. Since its founding, NORC at the University of Chicago has conducted numerous social research projects involving opinion survey and other data collection, for government agencies, nonprofit agencies, and corporations. Data from surveys are also frequently analyzed in a wide range of social sciences, especially sociology. NORC is best known for its large, national surveys, but has also conducted qualitative and quantitative analyses, and international projects.

[16] The ISSP is a continuing annual programme of cross-national collaboration on surveys covering topics important for social science research. It brings together pre-existing social science projects and coordinates research goals, thereby adding a cross-national, cross-cultural perspective to the individual national studies. The ISSP researchers especially concentrate on developing questions that are meaningful and relevant to all countries, and can be expressed in an equivalent manner in all relevant languages. So far, 47 countries became the members of ISSP.

[17] Project 211 is a project of National Key Universities and colleges initiated in 1995 by the Ministry of Education of the People's Republic of China, with the intent of raising the research standards of high-level universities and cultivating strategies for socio-economic development.

[18] Chinese population is divided into rural residents and urban residents strictly due to the household registration system, i.e. "*hukou*". Wherever they live in the urban sector or rural sector, people with rural

invalid samples, the rest of samples are used for the analysis of this chapter[19].Since the data is discontinuous, thus, the cross-section data will be used to investigate the dominants of rural income inequality by applying regression-based decomposition approach.

4.4.2 Income Generation Function

In order to apply the regression-based decomposition, it is necessary to specify income generation function. Dependent variable is aggregate income of rural individuals. It is crucial to concern about the effect of urbanization on rural income inequality. Urbanization divided rural residents into two groups: one with wage earners and the other not. As for income in 2008, aggregate income of rural individuals is divided into two parts: agricultural income which relies on farming and non-agricultural income such as wage income through rural-to-urban migration. I will investigate the determinants of both and their contribution to aggregate income inequality.

Independent variables of this chapter strongly emphasize how individual disparities determine the income of rural residents. Thus, production theory is not taken as the basis of income determinants, which is different from previous studies (for example, Wan and Zhou, 2004). However, human capital theory should be taken into consideration. Skill variables, such as education, training and experience (often represented by age), which directly influence individual income in rural China, are emphasized by human capital theory. As an accepted practice in the development literature, the education level and age of the household head will be included in income generation function.

Gender is one of the most important factors which determine the rural income. Chinese parents traditionally favor boys over girls, especially for rural residents, since farming favors the physical advantage of male. Naturally, male will get more comprehensive return than female on farming.

Physical health determines farmers' intensity of labor. Rural residents (farmers), unlike wage earners, must use physical labor in deriving their income. In this respect, physical health is much more important for rural residence. Apparently, healthy farmers can afford hard physical labor so as to benefit more from farming than those of sick individuals.

The relationship between income and happiness has accumulated a considerable literature (such as Easterlin, 1995), which mainly concentrate on the effect of incomes on happiness. Whether happiness has impact on income or not? This study will offer the answer, empirically.

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hukou are rural residents who belong to rural sector, and people with urban *hukou* are urban residents who belong to urban sector. *Hukou* is of importance of rural income inequality.

[19] In 2003, there are 9389 samples with 423 rural samples. 267 samples left after deleting invalid samples (Because of limited funds available, CGSS covers urban areas only so that rural samples are small in 2003); in 2005, there are 10372 samples with 4560 rural samples. 3919 samples left after deleting invalid samples; in 2006, there are 10151 samples with 4951 rural samples. 3689 samples left after deleting invalid samples; in 2008, 2046 samples left after excluding the urban samples deleting invalid samples.

Rural income is also affected by family factors, especially the education and political status of the parents since the abilities of parents determines the children's ability. Yang *et al.* (2010) shows that the interaction term of working father and party membership increases children's income. Therefore, the education and political status of the parents are considered in the model.

Political variables are included in the model (Morduch and Sicular, 2002). In China, political status stand for power and the possibility of rent seeking. Therefore, people will benefit from political status, even though in rural sector. Thus, political status is chosen as political variable.

Marriage as a topic of sociological study has always received a substantial amount of attention. This is not surprising given the centrality of marriage in our lives and its continual flux as an organizing social institution. Marriage also plays an important role in economic domain. From a theoretical perspective, the predicted effect of marriage on an individual's income is ambiguous. This study will offer empirical evidence.

Other variables with Chinese characteristics are also employed. Ethnicity: China is a multi-ethnic country. There are 56 ethnic groups in which Han takes account of 90% of the total population. Generally, Ethnic minority is relatively poorer than Han, which drive us to investigate if ethnicity is a determinant factor of rural income; Religious beliefs: Some studies show that religious beliefs of rural residences contribute to raise income (especially non-farm income) and enhance happiness. Thus, religious beliefs are taken into consideration.

Finally, regional effect is chosen to control regional disparities. As is known, regional disparity impacts on income inequality positively, which has been accumulated amount of literature in domestic studies. China's provinces have been divided into three regions mainly according to their geographical locations, that is, eastern, middle and western provinces. Generally, the most developed is the eastern, then the central, and the poorest is western China. Rural income is apparently affected by geography factor for uneven regional development.

Taking rural Guangdong for example, most of the rural residents benefit from the rapid development of economic growth. The development of manufacture and international trade indicate rural labor force mobility out of land cultivation and change the income source from farming into non-farming activity. However, in poor districts, such as Yunnan and Guizhou, farmers have to rely on their land to survive since there is no chance to alter their income structure. Therefore, regional effect will be used to capture the effects of geography for data unavailability of geographic variables. Thus, the variables included in the income generation function and explanations are given in Table 6-2.

Table 6-2 Variables and Definitions

Variable		Definition	Explanation	Year
Dependent Variable	I*ncome*	Total income	The annual total income of interviewee in 2003, 2005 and 2006; in 2008, total income is the sum of the annual farm income and the annual non-farm income of interviewee	2003,2005, 2006,2008
Independent variables(Xs)	*Male*	Gender	=1 for male =0 for female	2003,2005, 2006,2008
	E*du*	Education	Years of completed study	2003,2005, 2006,2008
	E*du_2*	Education squared	The square term of Education	2003,2005, 2006,2008
	A*ge*	Age	Age of individual which is calculated according to birth year.	2003,2005, 2006,2008
	A*ge_2*	Age squared	The square term of Age	2003,2005, 2006,2008
	E*thnicity*	Ethnicity	=1 for Han =0 for Others	2003,2005, 2006,2008
	R*eligion*	Religious belief	=1 for religious belief = 0 for others	2005, 2006,2008
	P_ *status*	Political status	=1 for a member of the Communist Party =0 for public people	2003,2005, 2006,2008
	M*arriage*	Marriage	=1 for married =0 for unmarried	2003,2005, 2006,2008
	H*ealth*	Health	=1 for healthy =0 for unhealthy	2005, 2006,2008
	E*du_f*	Education of father	=1 for senior high school or above =0 for secondary school or below	2003,2005, 2006,2008
	P_ *status_f*	Political status of father	=1 for a member of the Communist Party =0 for public people	2003,2005, 2006,2008
	H*appiness*	Happiness	=1 for happy =0 for unhappy	2003,2005, 2006,2008
	E*du_m*	Education of mother	=1 for senior high school or above =0 for secondary school or below	2003,2005, 2006,2008
	P_ *status_m*	Political status of mother	=1 for a member of the Communist Party =0 for public people	2003,2005, 2006,2008
	Eastern Dummy	Regional disparity	=1 for eastern provinces =0 for others	2003,2005, 2006,2008
	Central Dummy		=1 for central provinces =0 for others	2003,2005, 2006,2008

The choice of the parametric functional form is dictated by the standard Mincer (1974) model, augmented with other variables. I will take the form of semi-log specification which is prompted by the finding that the income variable can be approximated well by a lognormal distribution (Shorrocks and Wan, 2004). Figure 6-2 to 6-5 shows that logarithm total income is approximate to lognormal distribution.

Figure 6-2 Kernel Density Estimate of Logarithm Income in 2003

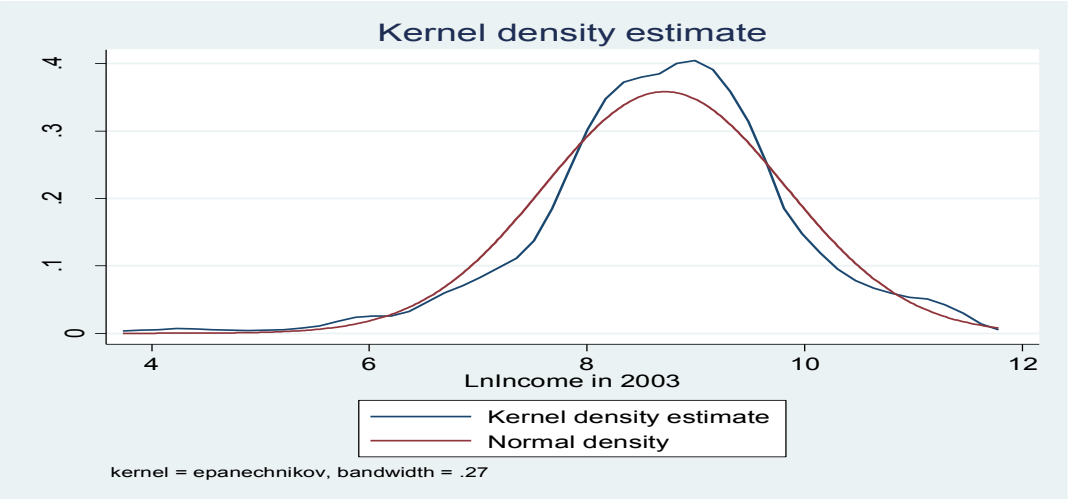


Figure 6-3 Kernel Density Estimate of Logarithm Income in 2005

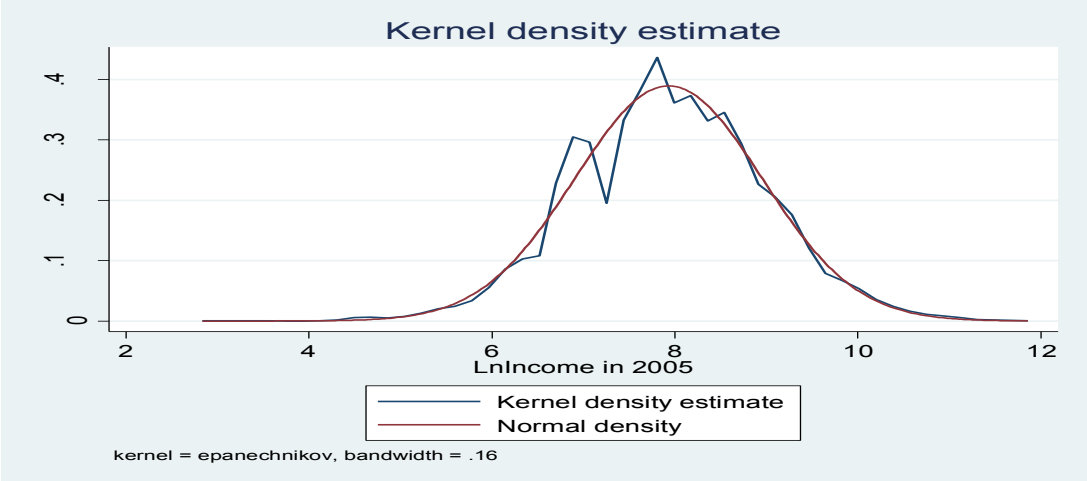


Figure 6-4 Kernel Density Estimate of Logarithm Income in 2006

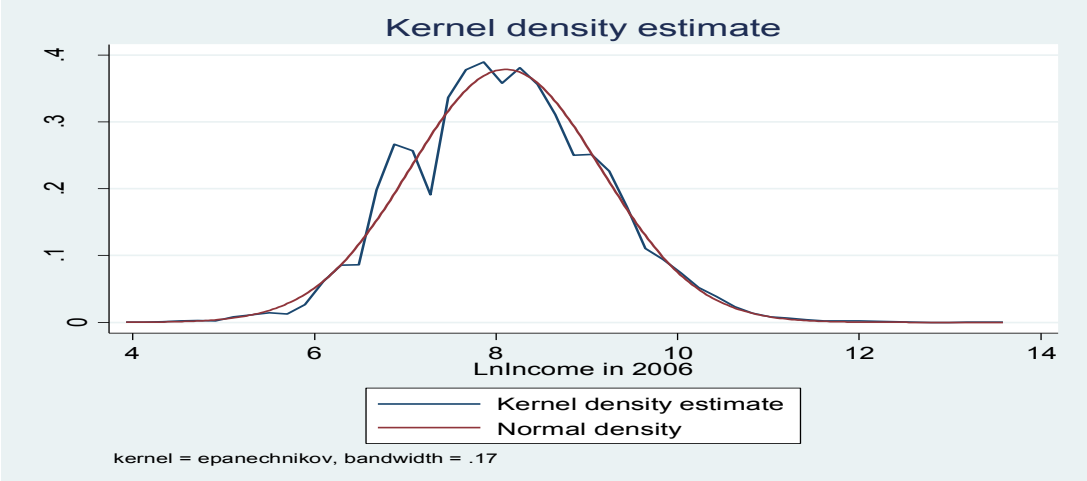
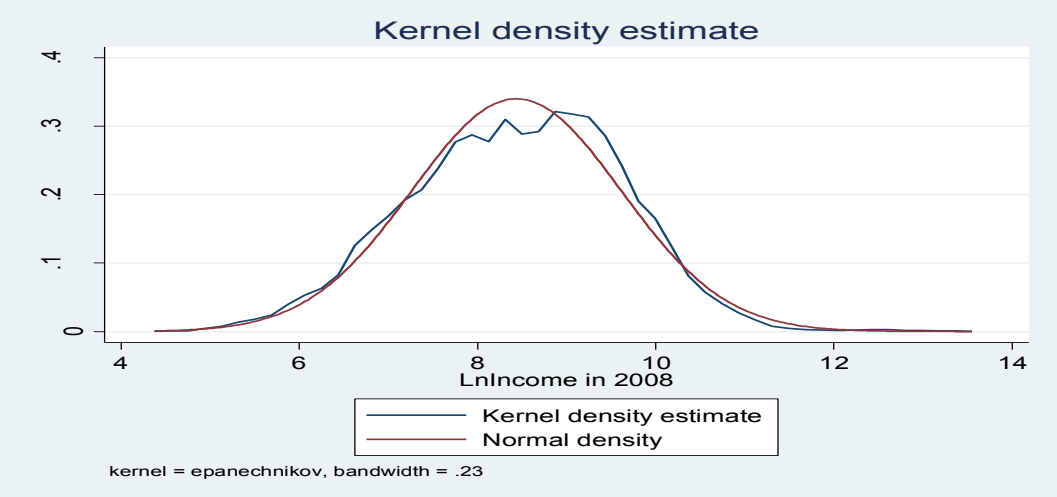


Figure 6-5 Kernel Density Estimate of Logarithm Income in 2008



Let *f* stand for the standard linear function, the income generation function can be written as,

$$Ln\ (Income) = f\ (Edu, Age, Male, Edu\_2, Age\_2, \ldots, Easter\ Dummy) \qquad (6\text{-}11)$$

6.5 Regression-based Decomposition of Rural Inequality

6.5.1 Income Inequality Measurement

Table 6-3 tabulates income inequality by various measures. Gini coefficient in 2003 is 0.5383[20], while in 2008 it increases to 0.5878. Theil index also show the similar results. The results show that that rural income inequality is extremely unequal with a rising trend. Figure 6-6 shows the Lorenz curves in 2003, 2005, 2006 and 2008. Because of limited funds available, CGSS covers urban areas only so that rural samples are small in 2003. Exactly, the sample in 2003 is rural-to-urban labor mobility. Those people live in cities, but with rural "*hukou*". This kind of sample cannot represent the whole rural residents. Thus, there is a reverse between 2003 and 2005 by Gini coefficient. The same situation exists in the contents hereafter. The year of 2003 is for reference only.

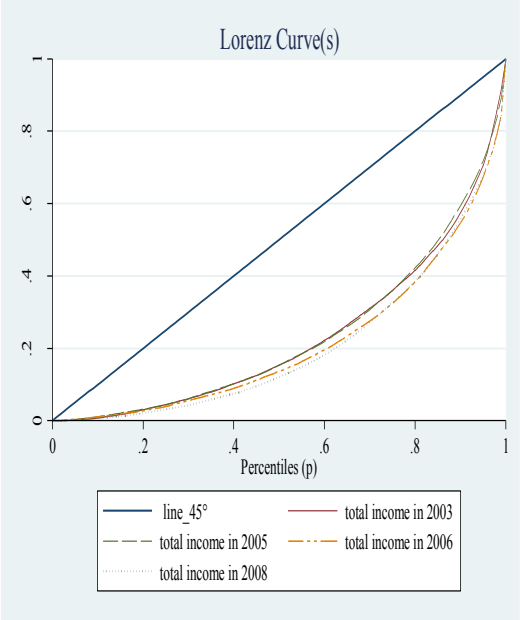
[20] Gini ratio in 2003 is higher than 2005 since the survey in 2003 concentrated on urban sector only. The data of 2003 cannot represent whole rural income class.

Table 6-3 Income Inequality Measurement

Inequality measures	2003	2005	2006	2008
Observation	267	3919	3689	2046
Relative mean deviation	0.3914	0.3931	0.4265	0.4296
Coefficient of variation	1.3192	1.4279	2.4653	2.3582
Standard deviation of logs	1.1133	1.0214	1.0534	1.1731
Gini coefficient	**0.5383**	**0.5344**	**0.5752**	**0.5878**
Mehran measure	0.6745	0.6708	0.7047	0.7285
Piesch measure	0.4701	0.4662	0.5104	0.5175
Kakwani measure	0.2417	0.2379	0.2726	0.2832
Theil index (GE(a), a = 1)	**0.5432**	**0.5469**	**0.7328**	**0.7614**
Mean Log Deviation (GE(a), a = 0)	0.5657	0.5308	0.6179	0.6934
Entropy index (GE(a), a = -1)	1.5926	0.9751	1.0871	1.5006
Half (Coeff.Var. squared) (GE(a), a = 2)	0.8668	1.0192	3.0380	2.7791
Atkinson indices	**0.4320**	**0.4119**	**0.4609**	**0.5001**

Note: Atkinson indices are provided by the code of "*ineqdeco*" presented by S.P. Jenkins (1999) in "INEQDEC0: Stata module to calculate inequality indices with decomposition by subgroup", Statistical Software Components S366007, Boston College Department of Economics, revised 24 Feb 2010. Other indices are calculated by the code of "*inequal7*" presented by P. Van Kerm (2007) in "INEQUAL7: Stata module to compute measures of inequality", Boston College Department of Economics. The software used in this chapter is STATA 11.0.

Figure 6-6 Lorenz Curves in 2003, 2005, 2006, 2008



Note: Lorenz Curves are drawn by the code of "*clorenz*" presented by A. Araar (2005) in "CLORENZ: Stata module to estimate Lorenz and concentration curves", Statistical Software Components from Boston College Department of Economics.

6.5.2 Regression Procedure

The variables used to estimate income generation function and their descriptive statistics can be seen in Table 6-4. It's noticeable that the age group is between 23 and 87. Income will rise with the increasing age, and then decrease with the aging. Income gap is also apparent comparing minimum income with maximum income. The mean income is increasing among 2005, 2006 and 2008. Contrarily, the mean age is decreasing. Education is between 0 and 19 years of schooling. The mean value of education is around 6 years, i.e. junior school level. It states that the education level is quite slow in rural China.

Table 6-4 Descriptive Statistics

Year	Variable	Obs	Mean	Std. Dev.	Min	Max
2003	I*ncome*	267	10727.38	14151.17	55	100000
	A*ge*	267	47.35206	10.73553	28	78
	E*du*	267	8.64794	3.006826	0	16
2005	I*ncome*	3919	4744.125	6774.171	20	120000
	A*ge*	3919	51.52437	13.32912	26	86
	E*du*	3919	6.746619	3.0600288	0	16
2006	I*ncome*	3689	6140.336	15137.63	60	670000
	A*ge*	3689	49.6579	12.39501	25	76
	E*du*	3689	6.89428	3.602947	0	19
2008	I*ncome*	2046	9231.824	21770.12	100	612000
	A*ge*	2046	47.77398	12.77234	23	87
	E*du*	2046	5.658847	3.120394	0	9

Then, the model estimation results are reported in Table 6-5. Table 6-5 shows the coefficients of the per-capita income generating function and the resulting inequality contributions. As expected, the coefficients of *Male*, H*appiness* and *Eastern Dummy* are significant positive in all selected years. The coefficient of *Age* is significant positive in all selected years except 2005. Political status, marriage, health have significant positive effect on personal income except 2003. Religious belief (R*eligion*), the education of father (E*du_f*) and the political status of father (P*_status_f*) are insignificant. Other variables show the inconsistent effect (with positive effect on income inequality if it is significant) in different years.

Table 6-5 Estimated Income Generation Function

Variable	Coefficient 2003	Coefficient 2005	Coefficient 2006	Coefficient 2008
Male	0.3634 (2.78)***	0.4058 (13.62)***	0.4081 (12.89)***	0.6024 (13.12)***
Age	0.1068 (2.16)**	0.0092 (1.12)	0.0358 (3.48)***	0.0298 (2.28)**
Age_2	-0.0012 (-2.56) **	-0.0002 (-2.98)***	-0.0005 (-5.27)***	-0.0005 (-4.05)***
Edu	-0.0086 (-0.13)	0.0057 (0.51)	-0.0323 (-2.72)***	-0.0489 (-1.90)***
Edu_2	0.0039 (0.95)	0.0050 (5.51)***	0.0045 (8.05)***	0.0053 (2.04)**
Ethnicity	1.0175 (2.53)**	0.0356 (0.66)	0.0717 (1.32)	0.2441 (3.25)***
Religion		0.0714 (1.01)	-0.0514 (-1.14)	-0.0503 (-0.64)
P_status	0.0899 (0.48)	0.0731 (1.21)*	0.1922 (3.50)***	0.2634 (3.28)***
Marriage	-0.1949 (-0.99)	0.1753 (3.36)***	-0.1222 (-2.46)**	-0.1656 (-2.12)**
Health		0.1243 (3.96)***	0.1350 (3.52)***	0.3872 (8.17)***
Happiness	0.3434 (2.60)***	0.1883 (6.44)***	0.1702 (5.52)***	0.2221 (4.79)***
Edu_f	-0.1943 (-0.81)	-0.1284 (-0.17)	0.0111 (0.12)	0.0906 (0.85)
Edu_m	0.2707 (-0.75)	0.1505 (1.08)	0.2524 (1.36)	0.5091 (2.72)***
P_status_f	-0.0266 (-0.16)	0.0778 (1.54)	-0.0246 (-0.34)	0.0373 (0.48)
P_status_m	0.1513 (0.40)	-0.0763 (-0.59)	0.5231 (2.38)**	-0.0774 (-0.33)
Eastern Dummy	0.3779 (2.35)**	0.4124 (11.70)***	0.3806 (10.12)***	0.5642 (9.88)***
Central Dummy	0.0692 (0.43)	0.0441 (1.21)	0.0413 (1.09)	0.5064 (8.71)***
Constant	5.0478 (4.18)***	7.0287 (33.20)***	6.9759 (28.11)***	7.1901 (23.22)***
F-value	5.18	83.15	78.35	44.17
Adj-R^2	0.1906	0.2628	0.2628	0.2645

Note: "*, **, ***" denote the level of significance at 10%, 5%, 1%, respectively. t statistics are in parentheses.

The nonlinear effect also exists with education except 2003, first negative and subsequently positive, which illustrates that education decrease the income at the beginning, and reach the bottom, then increase. For example, in 2008, the minimum value of education is 9.22, and the mean value 5.66. The significant negative coefficient of education shows that the effect of education on income

is on declining stage in rural China. It states that increasing the education, income will decrease. The result is consistent with regression coefficient. The significant negative coefficient of education is also consistent with domestic studies, such as Wei (2004), Zhang *et al.* (2002). The typical sample of rural resident between the ages of 23 and 87 attended school between 5 and 6 years. It is not enough to affect personal income positively. Firstly, educational input is not adequate because the development of Chinese education solely relies on expenditure. Government emphasizes rapid economic growth, therefore, education input face a slowdown increasing. The result is the lack of educational resource in rural areas. Secondly, there is unequal opportunity in education. The high cost prevents rural students from higher education. Students have to choose dropout because of poverty. In a word, in order to improve personal income, the development of education in rural areas should be paid more attention by policy-makers.

It's worthy to notice that the negative estimates for the quadratic age and quadratic education variables are consistent with standard human capital theory. Age has a nonlinear effect, first positive and subsequently negative, on income. With the increasing of age, the income will increase, and reach the top, then decrease. Taking 2008 for example, the maximum value of age is 59.6, while the mean age of 2008 is 47.8. It can be demonstrated that age will positively affect income in this stage, which is consistent with the regression coefficient.

Excluded the insignificant variables, the results of estimated income generation function modified presented in Table 6-6. All coefficient estimates are of the expected signs except education. Furthermore, all the coefficient estimates are statistically significant at the 1 or 5 percent level of significance.

The regression coefficients of *Male*, H*appiness* and *Eastern dummy* are significant in all selected years, which show that those factors are the crucial elements which decide the income of rural residents. It's noticeable that the development of eastern provinces (*Eastern dummy*) increases the personal income of rural residents. Political status, marriage, health have significant positive effect on personal income except 2003. Religious belief (R*eligion*), the education of father (E*du_f*) and the political status of father (P*_status_f*) are insignificant. The coefficient of *Age* is significant positive in all selected years except 2005. Other variables show the inconsistent effect (with positive effect on income inequality if it is significant) in different years.

Table 6-6 Estimated Income Generation Function Excluding Insignificant Variables

Variable	Coefficient 2003	Coefficient 2005	Coefficient 2006	Coefficient 2008
Male	0.4412 (3.57)***	0.4055 (13.77)***	0.4084 (12.93)***	0.6044 (13.17)***
A*ge*	0.1060 (2.50)**		0.0357 (3.48)***	0.0293 (2.26)**
A*ge_2*	-0.0013 (-3.06) **	-0.0001 (-13.01)***	-0.0005 (-5.25)***	-0.0005 (-4.06)***
E*du*			-0.0313 (-2.64)***	-0.0484 (-1.88)**
E*du_2*		0.0055 (15.24)***	0.0045 (8.09)***	0.0053 (2.05)**
E*thnicity*	1.0395 (2.66)***			0.2490 (3.33)***
P*_status*		0.0758 (2.26)**	0.1900 (3.47)***	0.2710 (3.40)***
M*arriage*		0.2032 (4.33)***	-0.1204 (-2.43)**	-0.1660 (-2.13)**
H*ealth*		0.1211 (3.88)***	0.1365 (3.56)***	0.3919 (8.30)***
H*appiness*	0.3654 (2.83)***	0.1880 (6.45)***	0.1731 (5.62)***	0.2195 (4.74)***
E*du_m*				0.5277 (2.84)***
P*_status_m*			0.5113 (2.39)**	
Eastern Dummy				0.5056 (8.71)***
Central Dummy	0.3788 (2.92)***	0.3942 (13.58)***	0.3612 (11.46)***	0.5608 (9.84)***
Constant	5.1884 (4.83)***	7.3213 (111.71)***	7.045 (29.06)***	7.2034 (23.48)***
F-value	11.54	175.66	120.42	57.95
Adj-R^2	0.1921	0.2629	0.2626	0.2660

Note: "*, **, ***" denote the level of significance at 10%, 5%, 1%, respectively. t statistics are in parentheses.

6.5.3 Decomposition Results

Wan (2002) proposed that alternative approaches can be used to decompose total income inequality for a given income generation function. The constant term, which becomes a scalar once the estimated semi-log function is solved for the original income, can be ignored in inequality measurement or decomposition as long as relative inequality measures are used (Wan and Zhou, 2004).

Usually, inequality for regression-based decomposition is preferred to use Gini and Theil-L. Since

different measures are underlined by different social welfare functions and are sensitive to different segments of the Lorenz curve, there are disparities between different measures. The Gini indicator will be used for decomposition due to its popularity. Both percentage and absolute contributions decomposed by Gini are reported in the Table 6-7.

The decomposition results (Table 6-7) show that the variables of age and eastern dummy are the most significant contributor to rural income inequality, which can explain -22.97% and 30.92% of rural income inequality respectively in 2003. Age, gender, eastern dummy and happiness affect rural income inequality in all selected years.

Table 6-7 Decomposition Results

Ln(I*ncome*)	Gini Coefficient	%	Year
Male	0.0209	3.8881	2003
A*ge*	-0.1236	-22.9696	
A*ge_2*	0.0203	3.7768	
E*thnicity*	0.0150	2.7912	
H*appiness*	0.0141	2.6267	
E*astern Dummy*	0.1664	30.9151	
All Xs	**0.1132**	**21.0283**	
Total	**0.5383**	**100.00**	
Male	0.0242	4.5236	2005
P*_status*	0.0006	0.1037	
M*arriage*	0.0006	0.1199	
H*ealth*	0.0067	1.2537	
H*appiness*	0.0075	1.4063	
E*astern Dummy*	0.0222	4.16	
E*du_2*	0.0485	9.0742	
A*ge_2*	0.0310	5.7966	
All Xs	**0.1413**	**26.438**	
Total	**0.5352**	**100.00**	
Male	0.0254	4.4242	2006
A*ge*	-0.0720	-12.5131	
A*ge_2*	0.1083	18.8245	
E*du*	-0.0227	-3.944	
E*du_2*	0.0728	12.6582	
P*_status*	0.0048	0.8376	
M*arriage*	0.0025	0.426	
H*ealth*	0.0049	0.853	
H*appiness*	0.0059	1.0291	
P*_status_m*	0.0008	0.1414	
E*astern Dummy*	0.0216	3.7468	
All Xs	**0.1523**	**26.4837**	
Total	**0.5752**	**100**	

Male	0.0369	6.2841	2008
A*ge*	-0.0524	-8.9179	
A*ge_2*	0.0930	15.8254	
E*du*	-0.0097	-1.6524	
E*du_2*	0.0110	1.8635	
E*thnicity*	0.0046	0.7757	
P*_status*	0.0051	0.8638	
M*arriage*	0.0033	0.5530	
H*ealth*	0.0284	4.8398	
H*appiness*	0.0081	1.3835	
E*du_m*	0.0027	0.4596	
E*astern Dummy*	0.0255	4.3338	
C*entral Dummy*	0.0027	0.4543	
All Xs	**0.1591**	**27.0662**	
Total	**0.5878**	**100**	

Note: Decomposition procedure is provided by the code "*ineqrbd*" presented by C.V. Fiorio and S.P. Jenkins (2010) in "INEQRBD: Stata module to calculate regression-based inequality decomposition", Boston College Department of Economics.

Leaving 2003 behind, education, political status, marriage and health also contribute a lot to rural income inequality. Education, age and eastern dummy are the most fundamental factors which impact on rural inequality. Relatively, the effect of education and age are impressive. Comprehensively, age, education, gender, eastern dummy, political status, marriage, health and happiness are determinants of rural income inequality.

It's interesting that age is the only equalizing factor of rural income inequality in all selected years. However, the effect of age to inequality should be the sum of age and the square term. Taking the square term into consideration, the contribution of age to rural income is positive except 2003[21]. The sample size of rural residents is around 50 years old. With increasing age, people will accumulate more social experience and relationship, which is the key of income earnings. For physical workers, aged 60 and above will reduce farming income (according to the minus coefficient of Age square term). With the aging of the baby-boomer generation, how to deal with the aging of the population in rural China caused by birth control policy (one-child policy) is a crucial problem, since there is no social security for rural population so far. China's relative lack of social security coverage for rural elders exacerbates the already severe rural-urban economic disparity. Recently, Chinese policy makers are starting to consider whether something can or should be done in an effort to provide broad pension coverage to the rural population in China (Xinhua Net, 2008).

Education is also the equalizing factor of inequality. Similarly, taking the square term into consideration, the contribution of age to rural income is positive. The importance of level of

[21] Since the sample of 2003 mainly concentrates on urban sector, the negative contribution cannot represent the situation of rural China.

education to one's income earnings cause to pay differentials (Amirault, 1994; Schumann *et al.*, 1994). Although National data reveal that people with advanced education generally earn more money (Kominski, 1990) which would increase income inequality, education will benefit most of the population located in low income class so as to decrease income inequality in a whole. However, China's rural education is at risk. Rural schools have been closing their doors at an alarming rate between 2000 and 2010.Taking Sichuan's Butuo County for example. Once upon a time, more than 30% of the county's elementary schools were located in the rural area, whereas that number has now dropped to 10% in a time-span of less than ten years. The closing rates are higher than the decline in number of rural children, which had originally brought on the increase in dropout students. Moreover, other problems of education lie in rural China such as the difficulties in entering school, the lack of capital input and poor faculty. Thus, the national and local governments should provide enough opportunities for rural education and increase budget so as to decrease dropout rates and improve the quality of faculty.

Furthermore, three variables (*Male*, *Happiness* and *Eastern Dummy*) contribute to rural income inequality in all selected years. Regional disparity (*Eastern Dummy*) contributes to income inequality impressively. In 2003, it can explain 30.92% of rural income inequality. Regional disparities are a feature of the world, particularly of low and middle income countries (Fan *et. al*, 2009). Since the start of reforms in 1978, regional inequality in China appears to be persistent and even growing. Infrastructure provision may improve market access for the poor areas, but it could also benefit the rich regions. Apart from its role in determining market access, geography is closely associated with natural resource endowments such as water and land conditions. Neither tradable nor removable natural resources are particularly crucial for farm production activities. In response to rising regional inequalities, in 2005 the Chinese government has adopted an explicit objective of "harmonious development" in order to balance development across regions. A series of policy preference and investment plans have been developed to stimulate growth and improvement of living standards of residents in rural areas and in less developed Western China. So far, reduction of regional inequality is the current concerns of policy-makers because geography will continue to play an important role in constituting rural income inequality.

The next contributor is Gender (*Male*). A persisting pay disparity between men and women in the work force is well documented. Gender with positive sign is an important indicator in rural China. The historical and social phenomena of male-preference in China is very common, which mainly involves in such discriminations and unfair treatment against women as demonstrated in the wrong concept of fertility, education, social and family status and marriage. The situation is much serious in rural China because male is good at physical work, although women are achieving greater equity in certain labor sectors. Above empirical study proved that to some degree the income of male is higher

than female in rural China.

At last, it's noticeable that happiness is a key factor to affect personal income. Recent years, the life feeling of rural residents has been paid great concerns. The relationship between happiness and income is puzzling. How income affect happiness is controversial. As the happiness–income paradox states that: at a point in time both among and within nations, happiness varies directly with income, but over time, happiness does not increase when a country's income increases. Most people believe that having more income would make them happier, while this study reveal that happiness is also an important contributor to income. Despite the weak relationship between income and life satisfaction or experienced happiness, happiness has positive effect on personal income.

Leaving 2003 behind, political status, marriage and health is also the key factors impact on rural inequality. Health is the most important factor for rural residents. Absolutely, people with good health condition will increase income. However, poor access and high fee are the two major problems in China's health system, especially for rural residents. It not only affects farming production, but also reduces the high costs of medical access. The reform of medical treatment system is emergent. Political status will provide the opportunity of rent-seeking in order to affect personal income. Marriage is connected with family decision and responsibility, which is the most complicated factor to have effect on income. Other variables, relatively, which contribute much smaller to income inequality in some year, are also an important factor to affect personal income, such as ethnicity and family factor (E*du_m*), the effect of which on income cannot be neglected.

The findings of this chapter are similar with the work of Wan and Zhou (2005) leaving sector dummy and village dummy behind. Referring to the second last row of each panel in Table 6-7, it is clear that our empirical model can explain about 20% to 30% of total inequality as measured by the Gini index.

6.6 Conclusion

This chapter employs regression-based decomposition technique to analyze income inequality in rural China by using individual-level data from 2003 to 2008. It is found that rural income inequality is extremely unequal with a rising trend. Gini coefficient in 2003 is 0.5383, while in 2008 it increases to 0.5878.

The estimation coefficients of income generation function show that the coefficients of gender, happiness and regional disparity of eastern provinces are significant positive in all selected years. Political status, marriage, health have significant positive effect on personal income except 2003. Religious belief, the education of father and the political status of father are insignificant. The coefficient of age is significant positive in all selected years except 2005. Other variables show the

inconsistent effect (with positive effect on income inequality if it is significant) in different years. Deleting insignificant variables, new income generation function can be derived to apply decomposition approach.

Decomposition results show that, age, gender, eastern dummy and happiness affect rural income inequality in all selected years. Leaving 2003 behind, education, political status, marriage and health also contribute a lot to rural income inequality. Education, age and eastern dummy are the most fundamental factors which impact on rural inequality. Relatively, the effect of education and age are impressive. Comprehensively, age, education, gender, eastern dummy, political status, marriage, health and happiness are determinants of rural income inequality.

It's interesting that age is the only equalizing factor of rural income inequality in all selected years. In 2006 and 2008, education is also the equalizing factor of inequality. Taking the square term into consideration, both age and education contribute to rural inequality is positive. It is suggested that education is very important to change the income structure of rural residents. Education input should be raised in order to reduce rural income inequality. Policy makers should promote the rural old-age insurance policies. Aging problem of rural residents should be paid more attention. The one-child policy should be relaxed earlier to allow couples to have two children if one parent is an only child[22], in order to solve the face of a rapidly aging population. Gender also contributes to rural inequality obviously, which offer empirical evidence for traditional male-preference in rural China. Thus, it's necessary to take measures to address the nation's growing gender ratio imbalance. Health has become a most important factor in affecting income inequality in rural China. It is suggested that China should make endeavor to accelerate the reform of medical treatment system to solve the issues of poor access and high fee. Regional disparity is a crucial contributor to inequality. Reducing regional disparity is good for decrease rural income inequality. The impact of ethnicity, political status and family factors on inequality is small, but can't be neglected. Political status offers the opportunity for rent-seeking, while ethnicity with income inequality will provoke inner contradiction so as to social problem.

The shortcoming of this study is that the sample size is short and discontinuous. It's hard to investigate the time effect of determinants on personal income. Besides, the explanation power is small. It can be claimed that the decomposition results are not too informative because the explanatory variables account for maximum 27% of income inequality as measured by the Gini index. The result illustrates that personal income determinants of rural residents are much more complicated. In further study, the shortcoming will be overcome for detailed survey and more factors will be explored to analyze income inequality of rural China.

[22] Currently, couples are restricted to one child unless both parents are only children and rural families are allowed to do so if their first child is a girl.

7. Discussion and Prospect

7.1 Summary Conclusions

This paper investigates the relationship between economic growth and rural income distribution in China. New methods of Iterative I and maximum likelihood proposed by Dagum (1977) is applied to measure rural income inequality. Household data in rural China over the time period of 1985 to 2010 are covered. Through calculation, I find out an increasing trend of rural income inequality since 1985. Maximum likelihood prefers to offer a higher Gini ratio since it avoids the approximate problem in Iterative I method. However, both of the methods provide an increasing trend of income inequality in rural China. It can be concluded that Dagum distribution fits household data well in the case of rural China.

Considering the effect of rural income inequality on economic growth, time series over period from 1998 to 2010 are employed. Unit root test and Granger causality test show that rural income inequality is an endogenous variable. To overcome endogenous problem, GMM estimation is applied to explore the relationship between growth and rural income inequality. Empirical study shows a significant negative effect of rural income inequality on economic growth in China. That is, rural income inequality will negatively affect economic growth. This finding is consistent with the viewpoint propounded by Persson and Tabellini (1994) and Alesina and Rodrik (1994), and also supports the evidence for a negative relationship between growth and income inequality in poor countries held by Barro (2000).

Subsequently, the impact of economic performance on rural income inequality is investigated by time series of 1978 to 2010. The effect of rural-to-urban labor mobility is also included for 1998 to 2010 due to data unavailability. It can be concluded that economic growth, primary industry, fiscal expenditure are significant negative impact on rural income inequality, while other variables including migration, and educational input show a significant positive relationship with rural income inequality. With distinguishing intra-provincial labor mobility and inter-provincial labor mobility, the effect of rural-to-urban labor mobility on rural income inequality is also taken into consideration, since there is significant disparity in occupation, income and social security between inter- and intra-provincial labor force mobility. Empirical study shows that both inter-provincial labor force mobility and intra-provincial labor force mobility increase income inequality of rural China. Comparatively, the effect of intra-provincial labor force mobility on rural income inequality is larger (6.258) than that of inter-provincial labor force mobility (0.891).

At last, I concentrate on addressing the fundamental determinants of rural income inequality by

applying regression-based decomposition using individual level data of 2003, 2005, 2006, and 2008. Rural income inequality calculated by individual data is extremely unequal with a rising trend. Gini coefficient in 2003 is 0.5383, while in 2008 it increases to 0.5878. The estimation coefficients of income generation function show that the coefficients of gender, happiness and regional disparity of eastern provinces are significant positive in all selected year. Political status, marriage, health have significant positive effect on personal income except 2003. Religious belief, the education of father and the political status of father are insignificant. The coefficient of age is significant positive in all selected year except 2005. Other variables show the inconsistent effect (with positive effect on income inequality if it is significant) in different years. Deleting insignificant variables, new income generation function can be derived to apply decomposition approach.

Decomposition results show that, age, gender, eastern dummy and happiness affect rural income inequality in all selected years. Leaving 2003 behind, education, political status, marriage and health also contribute a lot to rural income inequality. Education, age and eastern dummy are the most fundamental factors which impact on rural inequality. Comparatively, the effect of education and age are impressive. Comprehensively, age, education, gender, eastern dummy, political status, marriage, health and happiness are determinants of rural income inequality. Other variables, relatively, which contribute much smaller to income inequality in some year, are also important factors to affect personal income, such as ethnicity and family factors, the effect of which on income cannot be neglected. Conclusively, age, education, gender, eastern dummy, health, political status and happiness are determinants of rural income inequality.

7.2 Discussion

This paper has provided a brief introduction to the development of models for income distribution and applies Dagum (1977) distributions to household data. Two methods including Iterative I and maximum likelihood are easy to estimate the parameters of Dagum model. Gini coefficient is mainly decided by the method applied. Various models offer many kinds of results. It is necessary to choose the suitable model to fit different types of data.

Through studying the relationship between rural income inequality and economic growth, empirical evidence shows that there is negative relationship between economic growth and rural income inequality. That is, rural income inequality will negatively affect economic growth. The conclusion provides the evidence that the rising trend of rural income inequality is harmful to economic growth. Reduction of rural income inequality is one of the main concerns for policy makers in China.

Concerning the impact of economic growth on rural income inequality, empirical study shows a negative relationship. The results illustrate that economic growth is good for the reduction of rural

income inequality. Although China experienced high speed of growth, the engine is concentrated on urban sector. The rural areas have just been very limitedly developed. Central government should put more resources to develop rural areas, such as fiscal expenditure budget, educational resources, agricultural policies, and so on, in order to alleviate income inequality in rural China. Besides, the development of agriculture is good for alleviate rural income inequality since half of the population are living in rural China. Enhancing agricultural contributions need to continue to encourage the transfer of rural labor, raise the level of consumption of rural residents, encourage export and increase farmers' income in order to make the national economy develop rapidly and orderly.

Rural-to-urban labor force mobility is also an important factor which affects rural income inequality. It's necessary to improve the uneven development of regions. Decomposition also shows that eastern dummy have impressive effect on rural income inequality. The reduction of regional disparity is conducive to direct the mobility of labor force and capital, so as to have effect on rural inequality. Furthermore, the rural-to-urban labor market has remained a secondary labor market "of unskilled jobs, poor wages, and insecure employment". Rural-to-urban labor force has to take 3-D ("dangerous, dirty, and demeaning") jobs. This discrimination is from the special household registration system of China. Therefore, it's urgent to carry out reforms of the *hukou* system so as to allow greater mobility.

In chapter 6, the estimated coefficient of education is negative. The average education of the samples is about 5 and 6 years, which stress the awful situation of rural education. Education is supposed to have positive impact on personal income. However, the low level of rural education is not enough to affect rural income. Decomposition shows that age have impressive effect on rural income inequality. The result suggests that Chinese government should put more resources on rural education and improve educational quality.

Decomposition also shows that age and health have impressive effect on rural income inequality. Ageing problem is serious in current rural areas. China's relatively lack of social security coverage for rural elders exacerbates the already severe rural-urban economic disparity. Health care systems are also worrying. Although the government make endeavor to reform social security systems and health care systems, it will take long time to make rural resident enjoying national treatment. Policy makers should continue paying attention to the development of rural areas.

7.3 Prospect

The shortcoming of this study is that the data set of empirical study on the relationship between rural income inequality and economic growth is time series, while which is cross-sectional data on decomposition procedure, due to data unavailability. Time series is unable to stress the impact of regional disparity on rural income inequality and economic growth. Cross-sectional data is hard to

provide the time effect of determinants on personal income. Panel data typically refer to data containing time series observations of a number of individuals. Panel data, by blending the inter-individual differences and intra-individual dynamics, have two advantages over cross-sectional or time-series data: 1) more accurate inference of model parameters; 2) greater capacity for capturing the complexity of human behavior than a single cross-section or time series data. However, the collection of panel data is obviously much more costly than the collection of cross-sectional or time series data.

For the decomposition procedure, time period is short and discontinuous. It's hard to investigate the time effect of determinants on personal income. Besides, the explanation power is very small. The explanatory variables account for about 30% of income inequality as measured by the Gini indicator. The result illustrates that personal income determinants of rural residents are much more complicated.

In further study, the shortcoming will be overcome for detailed survey. The data set used to empirical studies will be addressed well and more factors will be explored to analyze income inequality of rural China.

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