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**NANYANG
TECHNOLOGICAL
UNIVERSITY**

**AGGREGATION IMPLICATIONS OF HETEROGENEOUS
CONSUMER BEHAVIOR IN URBAN CHINA**

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SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

2012

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CONSUMER BEHAVIOR IN URBAN CHINA**

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*To my parents,
To my husband and adorable son,
for their love and support.*

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List of Abbreviations

ABBREVIATIONS	FULL EXPRESSIONS
AIH	Absolute Income Hypothesis
HA	Heterogeneous Agent
HK	Hildenbrand and Kneip
LCH	Life Cycle Hypothesis
MPC	Marginal propensity to consume
MPS	Marginal propensity to save
PIH	Permanent Income Hypothesis
RA	Representative Agent

Summary

In spite of the booming economy, China's consumption as a share of its GDP has kept decreasing in the past few decades. The phenomenon has drawn attentions from many economists and two main-stream explanations are frequently seen in the literature. In particular, one opinion believes that it is the high saving ratio that causes a low consumption share (Modigliani and Cao (2004)); while the other, represented by Aziz and Li (2007), attributes the reason to the declining household income as a share of GDP. More recently, some researchers have achieved promising results by exploring other potential factors such as precautionary savings, the labor share of income, and the increasing gender imbalance.

This thesis reaches some interesting conclusions by studying the consumption issue in urban China from a novel empirical perspective. Most of the work mentioned above drew their conclusions from a macro view solely based on aggregate data, while ignored the heterogeneities and divergences among individuals. One of the representative methods to study the macroeconomic activities would be the Representative Agent (RA) approach, which is based on the assumption that the macroeconomic behavior is essentially the same as homogeneous individual behaviors. The RA approach and its alike, however, have become obsolete in studying micro-foundations of macro economy as they fail to capture the key microeconomic facts – heterogeneity and dynamics. This thesis intends to study the consumption problem in urban China by considering different individuals' consumption behaviors over years by employing the Heterogeneous Agent (HA) approach. Specifically, heterogeneous individual behaviors are incorporated into the aggregate consumption in a principled manner by conducting aggregation from micro to macro level. We aim to shed new lights on the stagnating consumption in China by answering the following questions: 1) what the main reason is for the declining aggregate consumption propensity; 2) how the distributional effect can be effectively captured and examined while studying macroeconomic activity.

The thesis is summarized as follows. First, the HA approach is used to study the decomposed heterogeneous individuals and obtain the national consumption propensity after aggregation. Second, the results of HA approach demonstrate a declining trend for the aggregate marginal propensity to consume (MPC). Third, the income distributional effect on consumption is examined and the empirical results show a significant negative impact of the enlarging urban income inequality on the urban consumption. More particularly, the impact of the intra-provincial inequality is much more significant than the inter-provincial counterpart. As a reflection of consumption habit, MPC decreases when income increases, i.e., people are used to spending smaller portion of their income when they earn more money, and vice versa. A key finding from our research is that the income of rich people grows much faster than that of low/middle-income people in China. Therefore, when the aggregated MPC is weighted by income share, the increasing share of high-income people contributes higher weights to low MPC, pulling down the overall aggregate MPC as a result. We believe that this is the main reason for the stagnant consumption growth.

Besides the income factor, this thesis also examines the impacts of other factors on urban consumption, including precautionary saving and dependency ratio. Precautionary savings for expenditures on medical care, education and housing negatively affect the aggregate MPC in most provinces. It is especially the case in east regions where social insurance policy is more mature and widely accepted. On the other hand, the declining urban dependency ratio is positively related to urban consumption, but not significant in some provinces. Comparing to income inequality, the impacts of the aforementioned two factors are relatively minor. As an extension of the thesis, consumption habits of Chinese consumers could be an interesting direction for further study. The Chinese usually tend to save as much as possible. Therefore, the individual MPC declines as one earns more and thus can save higher portion of his/her income. This might be one reason to explain why fast developing cities tend to have a significantly negative relationship between income inequality and consumption share -- because the proportion of high-income people increases fast in these cities. In future research,

we need to further study and explore both the measuring method and robust test for consumption habits.

In summary, via a macro-micro approach to examining consumption behaviors, our empirical study draws a major conclusion that the enlarging income inequality has the most significant influence on the reducing consumption propensity in urban China.

Chapter I. Introduction

1. Motivation and Objectives

During the past decade, the economic miracle of China has drawn a large amount of interests from economists over the world. Along with the high growth miracle, one particular phenomenon arousing wide discussions is the stagnation of aggregate consumption.

Figure I.1.1 Proportions of Urban Consumption and Income in China's GDP

The proportion of consumption in China's GDP has been declining in the past ten years (Figure I.1.1). The proportion of income has been fallen during the same period but in a much slower pace. With that said, less household consumption ratio is accompanied by higher household saving ratio in China, opposite to the worldwide reduction in the private saving ratio (Modigliani and Cao, 2004).

Figure I.1.2 Comparison of Household Consumption as a Share of Nominal GDP in Asian Countries

Household consumption ratio as a share of nominal GDP in China is not only below those of high-income Asian countries, but also below those of other developing Asian countries (Figure I.1.2). As consumption sector declines, the sectors of investment and net export become the main driving forces of the high growth of GDP. To maintain a sustainable and healthy growth of economy, however, consumption is supposed to play a more important role in the whole economy.

Although the absolute levels of urban income and consumption continuously increase, the gap between income and consumption is becoming larger in general (Figure I.1.3), indicating a decreasing consumption ratio and an increasing saving ratio in urban China. This is in accordance with the observation on the national level.

Figure I.1.3 Average Income and Consumption per Capita in China

Various consumption models have been employed in many previous studies, including Absolute Income Hypothesis (AIH), Life Cycle Hypothesis (LCH), and Permanent Income Hypothesis (PIH), to discuss factors that probably affect consumption behaviors in China (Yu and Li 2000, Yuan and Zhu 2002). Modigliani and Cao (2004) apply a LCH framework to examine the high saving ratio in China by extending its application from developed economies to low-income economies, and conclude with the significant effect of high saving on consumption. Similar statements are supported by other researchers (Blanchard and Giavazzi 2005, Kujis 2005, Prasad and Rajan 2005). Later, Aziz and Li (2007) find that instead of higher saving rate, the reason of consumption propensity drop is the decline of household income as a share of GDP, affected by wage, saving and government transfer aspects. In more recent work, Bai and Qian (2009) explain the decline of consumption in terms of the labor share of income, which is resulted from the changes of the composition of labor income. Wei and Zhang (2009) attribute the decline to the increasingly imbalanced sex ratio because the excessive number of male as compared to that of female requires the household with one male child to make more savings than before. The most recent research work of Chamon and Prasad (2010) bring back precautionary savings to our attention by concluding that the rising burden of expenditures on

health care, education and housing are the driving motives to higher saving rates, which negatively affect consumption. However, these studies only examine aggregate data on national level or at most on provincial level. Few studies pay enough attention to the heterogeneous individual household behaviors and the effect of income distribution on consumption. Therefore, I aim to shed some new lights on the consumption issue in China by answering the following questions: 1) how the aggregate consumption propensity will look like after considering heterogeneities; 2) how the change of income distribution, specifically income inequality, will affect the consumption propensity; and 3) how the other factors such as precautionary expenditures and dependency ratio will affect the consumption propensity.

To examine the distributional effect, one cannot ignore the heterogeneous properties among individual households. Therefore, in this thesis, I investigate the consumption behaviors in urban China from a different perspective by introducing heterogeneity, which hopefully can shed new lights on relevant issues. With the presence of heterogeneity, there arises the aggregate problem from individual level to aggregate level. The modelling of aggregation is the foundation of macroeconomic analysis. Aggregate problems with micro-foundations have been intensively studied in the past decades but there is still a lack of empirical study focusing on the consumption problem of China. Specifically in this thesis, empirical studies on aggregated consumption behaviors in China will be conducted using HA model.

Traditional macroeconomic models attempt to predict the fundamentals while microeconomic theories depict underlying mechanisms of economic behaviours on a more detailed ground. To approach the problem of aggregation, traditional economists often rely on the RA hypothesis wherein a single decision maker, or Representative Agent, is assumed to guide the aggregates of economic entities as if they behave in a way complying with the common optimal choice. It should be noted that, however, this framework is only effective under ideal conditions, i.e., all agents are behaving in a homogeneous way (Kirman 1992, Hartley 1997).

In the context of consumer behaviors in China, these conditions are usually hard to be satisfied. In China, the fast but uneven growth of economy makes the compositions of population and their income levels greatly vary from region to region and within the same region. The differences exist not only among different provinces but also within each individual province.

Figure I.1.4 (1)

Figure I.1.4 (2)

Figure I.1.4 (3)

Figure I.1.4 (4)

Figure I.1.4 (5)

Figure I.1.4 (6)

Figure I.1.4 (7)

Figure I.1.4 (8)

Figure I.1.4 (9)

Figure I.1.4 (10)

Figure I.1.4 (11)

Figure I.1.4 (12)

Figure I.1.4 (13)

Figure I.1.4 (14)

Figure I.1.4 (15)

Figure I.1.4 (16)

Figure I.1.4 (17)

Figure I.1.4 (18)

Figure I.1.4 (19)

Figure I.1.4 (20)

Figure I.1.4 (21)

Figure I.1.4 (22)

Figure I.1.4 (23)

Figure I.1.4 (24)

Figure I.1.4 (25)

Figure I.1.4 (26)

Figure I.1.4 (27)

Figure I.1.4 (28)

Figure I.1.4 (29)

Figure I.1.4 (30)

Figure I.1.4 Provincial Urban per Capita Income VS Consumption Subgroups Ordered by Income Level

Figure I.1.4 shows that there exist heterogeneous consumption behaviors among provinces and also within province for different income level groups. As heterogeneous individuals usually have different economic reactions and consumption patterns, the compositional effects on aggregate consumption could become substantial on a huge population base. In other words, one must

pay enough attention to the composition of income distribution on the population in order to comprehensively summarize the impacts of consumption propensity changes over time.

Figure I.1.5 (1)

Figure I.1.5 (2)

Figure I.1.5 (3)

Figure I.1.5 (4)

Figure I.1.5 (5)

Figure I.1.5 (6)

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Figure I.1.5 (9)

Figure I.1.5 (10)

Figure I.1.5 (11)

Figure I.1.5 (12)

Figure I.1.5 (13)

Figure I.1.5 Income Distribution in Urban China

The changes of income distribution is obvious in urban China, more specifically the gap of high income group and low and middle groups is getting bigger and bigger (Figure I.1.5). This diverse surely induce different consumption behaviors between different income level groups, which in turn affect the aggregate consumption propensity. The representative agent hypothesis and the general equilibrium models may not be suitable to cope with the aforementioned heterogeneous properties inherent in our problem. Instead, one should move his eyes to heterogeneous agent hypothesis

More studies nowadays have turned sights to tracking the change of economic activity with heterogeneous agents over time. This signals that researchers have begun to realize that each agent is different from another and that the differences among agents have to be captured when aggregate relationships are to be modelled (Blundell and Stoker 2002, Stoker 1993). However, involving heterogeneous individuals within a pure macro-level model is nontrivial due primarily to the variation of preferences and compositions of economic agents. Considering the compositional heterogeneity of data on groups, researchers have developed various alternatives to account for compositional heterogeneity in empirical modelling of aggregate data. Unfortunately, no one has implemented these methods to examine the consumption issue in China.

2. Major Contributions

The main contributions of this thesis are in two aspects - methodology and implication. Methodology is to apply a more popular and advanced method in recent years to study this China urban consumption topic; implication is by using this approach to find out the reason of declining consumption propensity.

This study implements Heterogeneous Agent approach to aggregate consumption behaviors over heterogeneous individual household. This method helps to examine aggregate activities more precisely by capturing the

decomposed heterogeneous behaviors. Methods accounting for such compositional heterogeneity are generally referred to as the micro-macro model or heterogeneous agent model, whereby aggregate problems are solved by starting from micro-level data and concluding at macro-level results. In line with this thought, the study will involve two stages. At the first stage, a heterogeneous agent model will be engaged to analyze data of heterogeneous individuals in China in the micro level; and at the second stage, the micro-level data will be aggregated to explore the implications of consumer behaviors in the macro level.

By using the aggregation method, this study points the major reason of declining urban consumption propensity to the enlarging urban income inequality, instead of other factors such as precautionary motives. This is more the case within the same region than among different regions (provinces). Other factors such as precautionary saving, income level and dependency ratio influence consumption propensity as well, but in a less significant degree, especially when they are considered in provincial or regional level.

3. Organization of the Thesis

Chapter II reviews the existing literature and introduces the relevant background knowledge. I firstly examine how the researchers solve the aggregate problems with different types of aggregate models. It shows from the literature why the HA approach outperforms the traditional RA approach when heterogeneity exists. In the second part of this chapter, the background knowledge of indices of income inequality is discussed because it is important to examine the impact of income inequality on consumption propensity. The last part of this chapter is to investigate the background of relation between precautionary saving and consumption behavior.

Chapter III is the empirical study to compare the aggregate results of HA approach and RA approach. The results show that HA aggregate result is more advanced because it can better capture the heterogeneous properties among

agencies. Recursive estimation is taken and shows that the aggregated MPC in urban area using HA approach is more sensitive to the change of income and consumer behavior than using RA approach. A robust test for deflation is conducted which shows that regardless the index used to deflating income, HA approach achieves more reasonable results. I also conduct a specification test to show that our sample data is more suitable for a linear form of consumption function instead of quadratic or cubic form.

Chapter IV investigates the impact of urban income inequality on the urban aggregated MPC by both national level and provincial level. The results indicate a negative relationship between urban MPC and income inequality, which can be captured only in HA method. Enlarging income inequality is an important reason to make China urban consumption propensity declining. To drill into more specific reasons, I examine the urban intra- and inter-provincial income inequality separately, and find that the impact of intra-provincial to consumption is more significant.

Chapter V explores the impacts of other factors such as precautionary expenditures, which include health and medical care, education and housing, and dependency ratio, on the urban consumption. Results show that although slightly, but increasing precautionary saving is another impediment to China urban domestic consumption which negatively affects consumption propensity, and so does the decreasing dependency ratio.

In the last chapter of this thesis, some limitations and future extensions are suggested before the conclusion drawn.

Chapter II. Literature Review and Background Knowledge

The practice of empirical macroeconomics rests on the idea that interrelationships between aggregate data are adequately described by some simple macroeconomic equations. These equations are regarded as exhibiting “typical” economic relationships, while differences at the level of individuals are regarded as somewhat idiosyncratic or of secondary importance. However, this “secondary importance” has drawn more and more attentions in recent years. When individual heterogeneity is important to economic decisions, how to reconcile this heterogeneity and the aggregate variables becomes a problem – aggregation problem (Stoker 1986). In other words, aggregation problem refers to the relation between estimates of the aggregate model parameters and individual behaviors. The fundamental features of aggregation problem apply to the basic structure of aggregate data models.

In this chapter, I will firstly review three main approaches to empirical modelling of aggregate data in the literature, namely representative agent approach, micro-simulation approach, and heterogeneous agent approach. While the first two approaches model aggregate data and individual economic behavior respectively, the heterogeneous agent approach models aggregation and individual data in a joint manner, and is thus dubbed micro-macro model. Then I will review the background knowledge of indices of income inequality, followed by the literature of relative work of precautionary saving.

1. Three Major Approaches to Solve Aggregation Problem

1.1 Representative Agent Approach

The representative agent approach, also known as per capita modeling approach, has been a popular paradigm for modeling aggregate data in the history of macroeconomics. It examines aggregate data solely and builds a standard model on aggregates. The aggregate data is treated as though it was consistent with the optimal behavior of a single agent and estimating equations are formulated for aggregate data by solving an individual optimization problem. Good examples are general equilibrium models on macroeconomic issues, wherein every individual is assumed to have identical properties and preferences, and a representative agent model is set up to examine aggregate economic activities. In this approach, one usually specifies and estimates the regressors representing the major economic influences on the macroeconomic variables. The motivation is to forecast or get rough insights on the interplay of macroeconomic variables when analyzing economic policies.

The representative agent approach has been successfully applied in several well-known settings, where aggregate data have the structure appropriate for a representative agent. For instance, in terms of demands for different goods, an aggregate preference relation exists if individuals have identical and homothetic preferences (Gorman 1953), or if the government is continuously redistributing income in an optimal way (Paul Samuelson 1956). This kind of models also contributes to the development of rational choice models over the past two decades, which coincide with the decision process for a single individual and obey the constraints of rational choices by a single decision maker (Calvert 1985, Trumbull 1989, Corman and Mocan 2000, Donohue III and Levitt 2000, Green 2002). As compositional issues are ignored in these settings, the representative agent approach could be the most efficient way to parsimoniously summarize interactions among aggregate variables.

In what follows, let us have a brief review on the developmental history of the RA models. The RA models start from Gorman's polar form, a linear demand function with homogeneous preferences (Gorman 1953). He is soon questioned by Theil (1954) because of the estimated bias. Later, Jorgenson et al. (1982) generalize an exact aggregation approach, which relaxes Gorman's stringent conditions to introduce the distributional information of agents across different sections. Unlike the Gorman's polar form, the cross-sectional estimation allows people to examine the change of agent behaviors. But it is still restrictive and stringent – homogeneous conditions must be held to use analogy principle and representative agent hypothesis. All of these approaches assume certain homogeneous properties in macroeconomic variables.

Although successful in general equilibrium and macroeconomic relation studies, RA approach has its limits on behavioral studies. Stoker (1986) summarizes two important attributes of the RA model in the context of consumption analysis. Firstly, it can accurately describe behavior in the presence of a rather extreme externality, which means that all individual agents make their economic decisions on the basis of total variables in the economy. Secondly, it can accurately describe behavior when all marginal reactions of individual agents coincide. In econometric terms, a linear model is assumed for each agent on the micro-level, and moreover the model is the same among aggregate variables. In fact, Stoker also points out that the view of behavior in the first attribute is implausible and irrational from the perspective of individual economic decisions, even from casual observations. And the equal marginal effect assumed in the second attribute is also unrealistic for most macroeconomic problems. In 2005, Blundell and Stoker further verify these assertions using some empirical evidences, such as demand analysis, consumption growth and wealth, and wages and labor participation.

In both situations mentioned above where the representative agent model is supposed to work, the model does not consider the heterogeneous and distributional effects of individual properties. This induces biased and invalid interpretation in terms of microeconomic behavior. Simple behaviors of

heterogeneous individuals can yield complex dynamics (Lippi 1988). Instead of using increasingly complicated dynamic model within RA framework, it is more desirable to find out patterns that directly stem from aggregation over heterogeneous individuals.

Besides consumption, RA models have been shown to be invalid in many economic areas. For instance, of the development of the theory of general equilibrium is invalid with a representative agent, e.g. Weak Axiom of Revealed Preferences and the Impossibility Theorem of Arrow (Kirman 1992). Many previous works have shown that the RA hypothesis is not consistent with the fact that heterogeneity is widely exist in the economic agents and the information is usually imperfect and asymmetric, such as (Leijonhufvud 1981) and the New Keynesian Economics (Stiglitz 1992) and the work of Forni and Lippi (1997). Based on the conclusion of aggregate failure, Marshall and Parekh (1999) incorporate some small consumption adjustment with heterogeneous agents and find that undetectable adjustment has important implications for the co-movements of aggregate consumption and asset returns. An, Chang and Kim (2008) prove the failure of aggregation method by showing the conflict between the equilibrium of RA model and the aggregate data (the conclusion made by Mankiw, Rotemberg and Summers 1985). In the fields of financial market and game theory research, heterogeneous behavior in the economy has been put more and more emphasis.

With the empirical examples, Alan Kirman (1992) does a comprehensive survey and theoretically proves the deficiency of the RA approach. His arguments are four fold. First, it cannot be justified that the aggregate of individuals would maximize utility like one individual does. Second, facing the macroeconomic changes such as policy change, the aggregate of individuals would not necessarily behave similar to one individual. Third, it is not legitimate to decide economic situations by using the heterogeneous choices of representative individuals. Fourth, interactions among heterogeneous individuals would yield very complicated dynamic behaviours that cannot be well modelled using the RA approach. He points out that testing a RA model is amount to testing a joint

hypothesis including specific behavioural hypothesis and the hypothesis that the aggregate of individuals acts as a single utility-maximizing agent. The fact that these tests being rejected shows the deficiency of the RA model.

So far, I have given a broad exposure of how a representative agent is not capable of reconciling individual differences and restrictions in aggregate data. RA models can describe the pattern of aggregate data in some degree although RA model itself attempts to optimize the behavior of each individual under certain restrictions. Many empirical works have demonstrated that the subtle macro-micro link exists in the assumptions for accurate aggregation and also in the restrictions to whether there exists a representative agent. Representative agent assumption has been shown to be both empirically invalid and analytically inconsistent (Stoker 1993, Kirman 1992). Without attention to aggregation over heterogeneity, one can only be skeptical about using empirical results from a model that solely assumes a representative agent.

1.2 Micro-simulation Approach

Micro-simulation approach, in opposition with the representative agent approach, deals with the problem of heterogeneity by carrying out all behavioral modeling at the level of individual agents. This approach begins with a full model of the behavior of each different type of individuals in the population and then simulates aggregate values by adding up across all individuals. Examples include the Joint Committee on Taxation's (1992) model for simulating tax policy impacts, and various models of appliance choice and energy demand (Thomas Cowing and Daniel McFadden 1984). Micro-simulation models have the potential for the most realistic representation of aggregate data movements because it includes the behavior of each kind of economic players and represents the full information of economic aggregates.

Micro-simulation is such a technique that models the behaviour of each single individual, including person, household or firm. In this model, each individual is

represented by a set of associated attributes and some changing dynamics such as transition probabilities. In this way, the state change of individuals can be effectively simulated so as the collection of the individuals.

The drawback of this approach is obvious – its foundation is sound, but the practical implementation is very difficult. To set up such a model, one needs to carry out a separate simulation for each individual's behavior and set exogenous and predetermined variables, as well as starting condition when the individual models are dynamic. One can envisage unlimited flexibility in the application of micro-simulation models and this simulation process becomes virtually intractable to carry out. Because the results for aggregated variables are dependent upon precisely how the individual simulations are specified, the unlimited possibilities preclude any meaningful understanding of the primary influences on aggregate data movements. There have been almost no conclusive comparisons of aggregate tracking performance between micro-simulation models and statistical models of aggregate data alone. For micro-simulation models, even the simplest form of aggregate validation is either difficult or impossible (Thomas Cowing and Daniel McFadden 1984). Thus, people turn to seek another solution named heterogeneous agent approach, which plays a reconciliation role between individuals and aggregate.

1.3 Heterogeneous Agent Approach

The heterogeneous agent approach, as compared with the previous two, permits individual and aggregate data to be modeled under one consistent framework. In particular, an individual model is specified together with assumptions that allow an aggregate model to be formulated in a way consistent with the individual model. The good comparability of individual behavioral patterns and aggregate data patterns removes any problem induced by the one-sided focus of studying aggregate data alone or individual data alone.

Heterogeneous agent models are advantageous from the following aspects. First of all, any restrictions on behavior applicable at the individual level model can be applied in a consistent fashion to the aggregate model. The parameters of individual level equations appear in the aggregate level model, and restrictions on those parameters are applicable at both levels. By this construction, simulations of individual level equations are consistent with simulations of the aggregate level equations. Second, simultaneous modeling of both individual and aggregate level data permits pooling of both kinds of data, which broadly allows heterogeneity to be characterized by observed individual differences in behavior. Finally, the models are applicable to a wide array of empirical problems, as the individual level model can be used to measure distributional effects, and the aggregate level model can be used to simulate and forecast patterns of future aggregate data.

One important virtue of HA approach is that the distributional effects in a heterogeneous agent economy can be included and assessed during the procedure of aggregating. This is useful in discussing heterogeneous behaviors and interpreting the interactions among macroeconomic activities. When differences among individuals are important to economic decisions, it is reasonable to expect that the distributional composition has an important influence on relationships among aggregate variables. As Kirman (1992) points out, in the presence of heterogeneous agents, a distributional description of the agents' states is usually preferred over a specific state in economic equilibrium. Note that it is a crucial issue to choose an appropriate degree of dispersion when taking advantage of the distributional effect. If one allows a large dispersion of characteristics, the conclusion to be achieved will have high degrees of freedom and thus become uninformative. If the characteristics are over concentrated, however, individuals will become almost identical and the approach will degrade to a representative agent model. It is necessary to find a reasonable trade-off between these two extreme conditions.

To solve the difficulties encountered in RA approach due to stringent assumptions, researchers firstly try to prove RA approach by allowing the

presence of idiosyncratic and dynamic factors. As a first try, Davidson et al. (1978) develop an approach to integrate long-term constraints on aggregate consumption with short-term dynamics generated by micro data. Kalejan (1980) and Stoker (1984) develop a stochastic aggregation approach allowing various forms of aggregate models to model the micro-relationships. However, this aggregate approach is prohibitively complex and highly rely on distributional data of individuals and therefore useless in practice. Krusell and Smith (1998) further try to examine the dynamic behavior of a model by introducing idiosyncratic risk and aggregate risk, which have been shown to make no significant difference to the aggregate magnitude. Carroll (2000) advises that the underlying reason could be that the distribution of wealth is in fact still in a representative agent framework.

To move “top-down” from aggregate relation to introducing heterogeneity is not realistic anymore, therefore people seek a “bottom-up” way. In the following, I will introduce several advanced and recent studies about the heterogeneous agent approach which starting from micro data and then aggregate to macro level.

To examine heterogeneity and aggregate over individual, one cannot ignore the distributional effect of certain properties among individuals (Joachim 1996). In the context of consumption model, the dynamics in aggregate consumption are not only related to the heterogeneous behaviors of consumers but also related to the time-variant income distribution. Carroll (2000) modifies Krusell and Smith’s approach with uninsurable idiosyncratic risk and studies the distributional effects of income with respect to the aggregate consumption level. His results show that capturing the microeconomic facts enables better understanding of ups and downs of the macro economy as well as the underlying policies than a simple aggregate economy with representative agent. However, his study on heterogeneous behaviors is not thorough because he only divides consumers into two groups - “patient” and “impatient”.

Hildenbrand (1998) and Hildenbrand and Kneip (2004) (henceforth HK) firstly propose an approach to modeling temporal variations within a population that is possibly large in size and heterogeneous in attribute using micro-data. HK start the aggregation analysis on consumption expenditure by specifying a set of micro-level explanatory variables. HK then decompose the aggregate change based on the joint distributions among population that is evolving over time. In a later research, Chakrabarty, Schmalenbach and Racine (2006) develop a statistical distributional approach toward consumption aggregation based on HK's approach.

Gisber (2003) suggested an alternative approach to examining distribution algebraically, which uses weighted samples on top of standard kernel density estimators. Extending this to some empirical work, Pittau and Zelli (2004) estimates the distribution of real income in Italy using an adaptive bandwidth in kernel density estimation. This method is more popular in simulations of consumption behavior.

In this thesis, my model is based on Keynesian consumption model and adjusted according to Carrol's and HK's approaches. The overall urban population will be decomposed first according to regions and income levels. Then the heterogeneous behaviors will be examined based on the income distributional effect which is changing over time.

2. Indices to Measure Income Inequality

In modeling aggregate consumption, the changing distribution of income should also be taken into consideration (Borooah and Sharpe 1986, Thomas 1992, Joachim 1996). Fair and Dominguez (1991) demonstrate the reaction of numerous aggregate functions to demographic changes. All these empirical work show that income distribution across population is important for aggregate problems.

Rising income inequality is the most important social and economic issue in China as it is one of the key factors that affect the stability of the society and well as the long-term growth of economy (Wan, Lu, & Chen, 2006). Hence in recent years, there are a lot of researchers investigate China's income disparity issue from various aspects, and try to find some implications. But most work (Tsui 1991, Rozelle 1994, Kanbur and Zhang 1999, Wan 2001) has been carried out on studying regional inequality and overlook that each province covers expansive areas and contains large populations. People should examine not only the income disparity among provinces, but also the income disparity within each province, because the latter is usually the reason that caused consumption imbalances in China.

Firstly, let us look at some discussion about the inter-provincial income inequality. In the early study of inter-provincial income inequality, Donnithorne (1976) and Lardy (1978) draw opposite conclusion for the pre-reform era due to data fragments and inconsistency. However, later work invariably finds the trend of inter-provincial inequality indeed to be oscillatory in the pre-reform era (Lyons 1991, Tsui 1991, Bhalla et al. 2003, Wang 2006). More recently, studies show a decreasing trend in the 1980s and an increasing trend since the 1990s (Benjamin et al. 2005).

Looking at the intra-provincial income inequality, more in-depth discussions label it as a major cause for China's income disparity (Bhalla et al. 2003, Sahoo 2004, Wu and Perloff 2005, Dai et al. 2006, Li and Xu 2008, Liu 2006, Qin 2006). Among them, Wu and Perloff (2005) decompose income distribution into urban and rural sectors, and find that inequality is rising within both urban and rural area which further widen the urban-rural income gap and thereafter cause overall inequality rising. Li and Xu (2008) implement Theil index to decompose income distribution into counties level and find that the weight of the intra-provincial income inequality is higher than that of the inter-provincial income inequality. Although using different methods of decomposing, both reach the

same conclusion that intra-provincial inequality is significant in China. Income composition is one of the contributors to income inequality as the sources of income are becoming increasingly diversified, both in urban and rural. The income level of the rich people increases much faster than that of their counterparts, and this trend accelerated after the late 1990s nationwide and within provinces.

To examine the distributional effects of income, I first compare some potential methods for measuring income inequality. These include Gini coefficient, the Theil index, the Hoover index, the Atkinson ratio, the Coefficient of Variation and the Generalized Entropy Class. Gini Coefficient and Theil index are the two most frequently used models. In this study, Theil index, which is a summary measure of the generalized family of inequality indices (Beblo and Knaus, 2001), is chosen to examine the income inequality in China considering the following merits. First, Theil index is scale invariant – the index doesn't change if everyone's expenditure increases or decreases by the same ratio. Second, it is invariant to population size – the index doesn't change with the change of absolute number of households at each expenditure level since it only depends on the relative population frequencies. The third merit is the Pigou-Dalton or transfer principle – if wealth is transferred from the rich to the poor so that the rank of income changes, the index should decrease. The last merit distinguishes Theil index from the other indices by the additive decomposability – an overall inequality measure can be additively decomposed into its sub-group distinct inequality measures (Shorrocks 1980 & 1984). The decomposable property is due to the instinctively additive property of logarithms for Theil index. This means that the overall inequality equals the sum of inter-provincial (between) and intra-provincial (within) income inequality. Although Gini coefficient is decomposable as well, it is non-additive, i.e. the overall Gini of a society cannot be obtained by summing up the Ginis of all sub-groups. There are some researchers who try to apply the same additive way in Theil index to the calculation of Gini coefficient, it is proved to be equivalent to using Theil index in the first place (Dikhanov 1996). The well-proved additive property of Theil index makes it more suitable to apply

in measuring generalized and decomposed population entropy, which is the reason why Theil index is coincident with the study purpose of this thesis.

3. Precautionary Saving

Quite a few researchers assert that high precautionary saving is a significant impediment to consumption propensity (Modigliani and Cao 2004, Blanchard and Giavazzi 2005, Kujis 2005, Prasad and Rajan 2005), though someone has different conclusion (Aziz and Li 2007). Put the debate aside for a moment, and allow me to introduce some background about precautionary saving.

In general, there are three types of motive for saving one's current income, namely inter-temporal motive, bequest motive, and precautionary motive. Inter-temporal saving prepares for future expenditure that may not be covered by future income. Pension is such an example. Leaving estates or properties to one's offspring after he/she died is the so-called bequest saving. Precautionary, however, is to save for future's uncertainties regarding to income or expenditure. Among these motives, precautionary saving has been studied less than the other two before 1990's.

The first formal treatment of precautionary saving is only exploited by Leland (1968). He also studies the attitude that drives the precautionary saving, which is now known as prudence. This is a terminology that was easily confused with risk aversion. But in the responses to uncertainty, precautionary behavior is one that cannot be explained by risk aversion alone. Leland shows unlike risk aversion in a concave utility function form, precaution requires convex marginal utility. At that time, this study does not draw so much attention. Precautionary saving has only been demonstrated important for macroeconomic policy in the last 20 years (Kimball, 1990). Kimball defines the preference parameter which motivates precautionary saving as prudence, which measures the magnitude of the precautionary motive.

Browning and Lusardi (1996) point out that precautionary motive should always be taken into account when modelling economic behaviours even when the uncertainty is not so significant. However, little empirical progress has been achieved in the following years on the intensity of prudence as well as the extent of precautionary saving. A whole bunch of simulations suggest that the level of precautionary saving could be large (Skinner 1988, Zeldes 1989, Caballero 1991, Deaton 1992, Carroll and Samwick 1998), but they fail to see any significant degree even getting close to the magnitudes (Skinner 1988, Kuehlwein 1991, Grossberg 1991, Starr-McCluer 1996, and Parker 1999).

Based on the household survey of Italy, Guiso et al. (1992) propose a consumption function to determine the degree of precautionary saving by optimizing household consumption as part of permanent income. Their approach innovates the way to estimate the uncertainty of future income from a subjective point of view. However, this measure has been demonstrated to be not so reliable in practice, and only plays a minor role in the research of precautionary saving.

In a similar empirical work, Dardanoni (1991) estimates the precautionary saving to be 60% of total saving of U.K. households. The risk aversion is assumed to be constant and absolute. Consumption is modelled as a function of permanent income. However, as the component of the permanent income and other saving motives are assumed to be constant, the effects of time-variance are not properly represented. As a result, the outcome of the model is prone to overstatement regarding the the significance of precautionary saving.

Another optimistic empirical work is done by Eisenhauer and Venture (2003), using samples of Italian households as micro-level data to rebuild the model of household saving which includes an explicit role for the prudence of precautionary saving. A less restricted utility form is used to estimate absolute and relative prudence. Moreover, the measurements are directly linked to precautionary saving by households. In their study, the precautionary saving is

statistically significant, summing up to about 20% of total saving. However, they fail to consider time preference component.

Overall, the empirical literature so far only link precautionary saving to the income component, but not the other side, the propensity to consume. In fact, the preference to save is a composition of driven of total saving – marginal propensity to save (MPS), which is a compliment to marginal propensity to consume (MPC) as $MPS = 1 - MPC$. In fact, studying propensity to consume is the other direction to study total savings. Among the three reasons to save (intertemporal, bequest and precautionary), precautionary saving is the most significant one containing the uncertainty and time variation regarding to the current income level, expectation and preference, but not so much with the future ones. Since our study is to investigate the time-variant heterogeneous consumer behaviors, precautionary saving is also relevant.

Chapter III. Aggregation Models on Heterogeneous Agents

1. Introduction

After we have reviewed the existing literatures on heterogeneous agent model, this chapter explains the theoretical model being used and its empirical results to the aggregate implication of consumption behavior. Keynesian consumption model is applied as the baseline framework, and the aggregation process is adjusted according to Carroll's and HK's heterogeneous agent approach. The statistics and data will be first explained in Section 2, and then the model and empirical results in Section 3, followed by several robust tests in Section 4.

2. Data

For empirical work, data are the basis of subsequent analysis and the completeness and correctness of data are crucial for drawing meaningful conclusions. Hence, it is necessary to clarify certain issues existing in data collection and preparation before proceeding to the methodology section. The data used in this study include national and provincial non-agricultural population, per capita urban consumption expenditure, per capita urban disposable income, urban CPI, and GDP deflator. They mainly come from three sources: China Statistical Yearbooks, Provincial Statistical Yearbooks and China Population Statistics Yearbooks. The panel data I collected span 13 years, ranging from 1997 to 2009, and cover 30 provinces of China¹, each of which including 7 subgroups² ordered by income level. Discrepancy will inevitably exist for the same data in multiple sources, and the latest one will be used in this case.

¹ Due to insufficient data, Gansu fails to meet the minimum criterion of consistent data and has to be excluded. Please refer to section 3.3 for details.

² For the 7 subgroups in each province, the percentiles are lowest-income level 10%, lower-income level 10%, lower-middle income level 20%, middle income level 20%, higher-middle income level 20%, higher-income level 10%, and highest income level 10% of the total provincial non-agriculture population

Most provincial statistical data only archive living expenditure instead of consumption expenditure before 1997, which employs a different gauging method and is not comparable. For consistency, I only make use of the data after and including 1997.

2.1 Population

To classify the population into urban and rural, there are in fact two criteria being used in China. One is by literally urban and rural, and the other is by non-agriculture and agriculture. These two criteria use different gauging standards. Urban residents usually refer to those living in cities and towns for more than a year or a half, and employed in non-agricultural sectors, while rural residents refer to those living in rural and mainly engaged in agricultural sectors. Non-agricultural residents, however, refer to those registered as permanent city members no matter where they live; while agricultural residents refer to those registered as permanent rural members. Although the criterion of urban and rural represents a new and more reasonable system consistent with international standard, population data classified by it are insufficient, for example urban/rural population is only available in about 10 provinces for no more than 3 years, whereas non-agriculture and agriculture population data are available for all the provinces. Failing to notice this change underestimates the number of urban population (Lu and Want 2002). For these reasons, I decide to choose non-agriculture population as a substitution of urban population in our work.

Now come to the problem how to decompose the non-agriculture population in this study. In many distributional problems, the impacts of the composition of the population are considered in terms of different groups of agents. The data required to study such compositional issues are observations over time on the percentages of agents in classified group categories, or cell proportion data. In this work, I follow this method and classify the population of each province based on the level of income. In particular, based on percentiles of urban

population, the data on consumption variables are divided into 7 subgroups for each province and ordered from the lowest income level to the highest. Preferences of consumers are assumed to vary across subgroups, i.e. heterogeneous agents, but be homogeneous³ within each group. Therefore, the preference of each subgroup will be described by its own MPC. The way of cell proportion data divided is not a thorough decomposition anyway. It will be ideal if individual household data is available.

2.2 Income and Consumption

To aggregate heterogeneous urban consumer behaviors in China, I use the data of disposable income and consumption expenditure for different percentiles of provincial urban households, grouped by different income levels. In the survey to collect urban data for income and expenditure, sample cities are selected by using stratified random sampling strategy, wherein the cities are ranked based on average annual income, and then the accumulative population. Samples are systematically drawn according to the size of the samples. One issue to be noted is that the survey only focused on non-agricultural households until 2001. From 2002 onwards, the survey began to cover the households of all cities that are defined as urban area. So there is a gauging adjustment for income and consumption since 2002 from non-agricultural sample to urban sample, which in turn could cause abnormality in the empirical results.

After collecting urban disposable income and consumption expenditure, I need to consider the inflation issue before using the sample. There are two ways to the deflation, by using urban CPI and GDP deflator. It sounds reasonable to deflate consumption with CPI and income with GDP deflator. To be consistent with provincial urban income and consumption data, the deflator should be provincial and urban. Unfortunately, there is no such data for provincial urban GDP deflators, only in a national overall manner. It seems there is no perfect way to do so far. But I do the robust test using the two ways to deflate. To deflate

³ Decomposition into individuals is neither practical nor allowed by the availability of data.

provincial urban consumption expenditure, I use provincial urban CPI in both methods. To deflate provincial urban disposable consumption, one is also using provincial urban CPI, and another is using national overall GDP deflator for all provinces so that we can see whether the model is robust when changing deflators. In both ways, 1995 is set to be the base year for the deflation.

2.3 Missing Data

Incomplete data in China is an impediment to my empirical analysis in the first place. The income and expenditure data of certain years are missing for a number of provinces. To circumvent this problem, I resort to various imputation methods like interpolation, extrapolation and regression estimation, etc. Specifically, to achieve the smoothest path and smallest errors, I apply cubic-spline interpolation and extrapolation to estimate Shanxi's consumption in 1997, Hebei's income from 2002 to 2004 and consumption in 2004. Regression estimation is used to fill out the missing data for Shanghai's income in 1997 and 1998, Hunan's income and consumption from 2006 to 2009, Hainan's income and consumption in 2009, and Guizhou's income in 2005 and 2009. It should be noted that, however, if the missing data are comparable to or even more than data available, taking Gansu for example which lacks 6-year's data out of 13, it is not appropriate to apply any of these methods. To avoid possible bias, I have excluded Gansu from further consideration.

3. Aggregation of Heterogeneous Consumer Behaviors

3.1 Methodology and Econometric Considerations

Before I go to empirical models, firstly let me introduce the HA approach in a more general form as derived from Carrol's and HK's models. Modelling of aggregation over heterogeneous individuals usually begin with a specification of

individual behaviors, which needs an econometric model to apply to micro level data. The first step is to model individual consumption demand functions for each individual agent.

$$d_{it} = f_i(y_{it}) \quad (\text{III.3.1.1})$$

Consumption demand d_{it} is the dependent variable of expenditure budget – income y_{it} .

Due to heterogeneity, individual attributes affect individual demands, including observable differences and stochastic differences. I use A_{it} to represent the time-variant individual differences and rewrite (I.4.1.1) as

$$d_{it} = f_i(A_{it}, y_{it}) \quad (\text{III.3.1.2})$$

The framework here is laid out on basic issues and applicable generally to static and dynamic empirical models, not just to consumption models. The essential feature of this general model is to elaborate aspects that vary over individuals and that are common across individuals, further to discuss the feasibility of econometric application.

Next step, the model of aggregate consumption demand $\bar{d}_t$ appears as

$$\bar{d}_t = \frac{1}{N_t} \sum f_i(A_{it}, y_{it}) \quad (\text{III.3.1.3})$$

where N_t is the total population at time t . When the population size is large enough to appeal to a statistical law of large numbers, one can get the mean $E_t(d)$ of $\bar{d}_t$ as

$$E_t(d) = \int f(A_t, y) d\xi_t(y) \quad (\text{III.3.1.4})$$

where ξ_t is the distribution of income y at time t .

The important feature of this theory is that the distributional statistics ξ_{jt} are functions of averages, so the permissible distributional statistics are sample moments

$$\xi_{jt} = N^{-1} \sum \phi_j(A_{it}, y_{it}), \quad j = 1, \dots, J \quad (\text{III.3.1.5})$$

where $\phi_j(A_{it}, y_{it})$ is a function of the individual income and attribute value. The effects of individual attributes are impossible to measure with aggregate data when aspects of the heterogeneity distribution are strictly constant. This is the major reason this study to examine aggregate consumption over heterogeneous individuals, which is not evenly distributed.

Since the distribution effect is not measurable with aggregate data alone, the straightforward solution is to model individual data in a way consistent with aggregate level model, and then combine individual data in estimation if possible. Unfortunately, the information richness of individual is very difficult to collect and numerate. Therefore a better solution is to consider distributional effects of income and population, and consider agents of grouped population instead of each individual. To capture distributional effects when I aggregate consumption over groups as targeted agents, the dynamics of the underlying income distribution among populations should also be considered.

3.2 Empirical Models

As I have talked about the theoretical background, now let me explain the specific empirical model used in the study, which is based on the traditional Keynesian consumption model.

It is generally believed that the Keynesian consumption theory is more suitable to low-income nations. The consumption expenditure of China urban households is sensitive to current disposable income, which is consistent with liquidity constraint. In China, household consumption is unlikely be supported by borrowing, and it is well approved that there exists myopia pattern of consumer behaviors caused by low and constraint income level. My study of aggregate implication of urban China consumption starts from a linear Keynesian consumption model which related to current period household disposable income.

$$C_t = a_t + b_t \cdot Y_t \quad (\text{III.3.2.1})$$

where C_t denotes the total consumption expenditure in year t , a_t denotes the autonomous consumption in year t ($a_t > 0$), b_t denotes the marginal propensity to consume in year t ($0 < b_t < 1$), and Y_t denotes the disposable income in year t (income after taxes and transfer payments). The second term $b \cdot Y_t$ is the induced consumption in year t .

Suppose all households have identical homothetic preferences, the above equation is exactly a RA model, where national average consumption is used.

$$\bar{C}_t = a_t + b_t \cdot \bar{Y}_t \quad (\text{III.3.2.2})$$

In a RA approach, the aggregate consumption usually implements a formulation of such “per capita” terms $\bar{C}$ and $\bar{Y}$. Using national average consumption expenditure of urban households as dependent variable and national average disposable income of urban households as independent variable, and after adjusting inflations, the OLS regression over 13 years can be obtained by

$$c_t = \alpha + \beta \cdot y_t + \varepsilon_t \quad (\text{III.3.2.3})$$

As Table III.3.1 below shows, given 13 years observations since 1997 to 2009, the estimate of coefficient of income approximately equals to 0.81 and is significant at 1% level. The high adjusted R^2 means the national average disposable income of urban households explains majority of the variable of national average consumption expenditure. The MPC of urban consumers in China is approximately 0.81, which means that every 1 CNY earned, people will spend 0.81 CNY and save the rest 0.19 CNY in this 1 CNY. This is a constant MPC estimated over 13 years’ observation, and only when new observation is added in, it changes.

Table III.3.1 Time-series Regression of a RA Model

Variable	Coefficient	Std. Error	t-Statistic
Income***	0.81	0.04	18.21
Constant	-254.28	395.17	-0.64
Adjusted R-squared	0.97	S.E. of regression	448.96
Prob(F-statistic)	0.00	Observations	13

Noted: * significant at 10%; ** significant at 5%; *** significant at 1%

Using traditional RA consumption model as above can give us only a point estimate of MPC over the 13 years observations. This has no advantage comparing to the time-variant MPC using the HA method. To further make it comparable and get time-variant MPC, I take the cross-sectional regression over the observations of 30 provinces j in each year as the following

$$c_{ij} = \alpha_t + \beta_t \cdot y_{ij} + \varepsilon_{ij} \quad (\text{III.3.2.4})$$

This cross-sectional RA approach assumes individuals with different income and consumption levels have the same preference and homogeneous consumer behavior. In this sense, all individuals have the same MPC in each year. Thus compensates the fact that the aggregation result based on a period of time-series data is unable to capture the dynamics of aggregate consumption. The reason I choose provincial average data is to make sure that the behaviors among these 30 agents are consistent in an aggregate level, instead of further division by income into more agents with risk of inducing heterogeneities and biased results in the cross-sectional RA approach.

The regression results are shown in Table III.3.2. Coefficients of income are all significant at 1% level, but relatively lower than the time-series estimation. In each year, all agents share the same MPC although they have different income levels and preferences. Although the MPC varies over time, it is essential to satisfy the same rational and optimal consumption choice for every individual. Based on time-series macro data alone, I can obtain a constant MPC which represent the consistency of the consumption behavior. Based on cross-sectional data alone, we can get time-variant MPC but without considering the habits and

time-consistent preferences of consumers. The next and reasonable try is to use panel data allowing heterogeneities.

Table III.3.2 Cross-sectional Regression of a RA Model

Year	Coefficients		Adjusted R-squared	Std. Error of regression
	Income	Constant		
1997	0.78 (35.88)***	125.07 (1.21)	0.97	155.27
1998	0.89 (42.00)***	66.84 (0.63)	0.97	175.93
1999	0.75 (18.80)***	156.17 (0.79)	0.92	312.82
2000	0.75 (21.71)***	244.07 (1.26)	0.96	229.18
2001	0.71 (30.43)***	412.89 (2.67)**	0.97	219.17
2002	0.78 (26.56)***	-82.52 (-0.38)	0.94	327.22
2003	0.73 (29.30)***	292.08 (1.46)	0.93	382.97
2004	0.74 (33.31)***	136.75 (0.68)	0.94	419.67
2005	0.74 (29.11)***	122.21 (0.51)	0.94	439.55
2006	0.71 (21.96)***	144.75 (0.45)	0.93	498.48
2007	0.73 (17.39)***	-253.50 (-0.53)	0.90	655.98
2008	0.85 (12.74)***	-290.89 (-0.40)	0.91	834.31
2009	0.84 (13.48)***	-57.80 (-0.08)	0.90	933.82

Noted: t-statistics is in brackets, based on robust standard errors due to heterogeneity in the cross-section data

* significant at 10%; ** significant at 5%; *** significant at 1%

Since heterogeneity is the most important feature I hope to exploit, the regression of household consumption can be expressed as:

$$c_{it} = \alpha_i + \beta_i \cdot y_{it} + \varepsilon_{it} \quad (\text{III.3.2.5})$$

where $i = 1, \dots, m$, $m=210$ is the total number of heterogeneous agents, and t is from 1997 to 2009. The estimated function is

$$c_{it} = a_i + b_i \cdot y_{it} \quad (\text{III.3.2.6})$$

where a is the estimate of coefficient α and b is the estimate of coefficient β .

For each agent i , autonomous consumption a_i and MPC b_i are different due to different preferences and heterogeneous consumption behaviors. In this work, the heterogeneous individuals are the subgroups divided by provinces first and then by income level in each province, to represent different agents according to different income levels. Our sample includes 30 provinces and each province is divided into 7 groups, so that in total there are 210 agents. For each agent i , there is a common MPC _{i} . Aggregate consumption is now given by

$$\sum_{i=1}^m N_{it} \cdot c_{it} = \sum_{i=1}^m N_{it} \cdot a_i + \sum_{i=1}^m b_i \cdot N_{it} \cdot y_{it} \quad (\text{III.3.2.7})$$

$$\sum_{i=1}^m \frac{N_{it}}{N_t} \cdot c_{it} = \sum_{i=1}^m \frac{N_{it}}{N_t} \cdot a_i + \sum_{i=1}^m b_i \cdot \frac{N_{it}}{N_t} \cdot y_{it} \quad (\text{III.3.2.8})$$

Where N_{it} is the urban population in each province i in the year t , N_t is the total urban population in China in the year t .

Comparing (III.3.2.8) with (III.3.2.2), I have

$$a_t = \sum_{i=1}^m \frac{N_{it}}{N_t} \cdot a_i, \quad (\text{III.3.2.9})$$

$$b_t \cdot \bar{Y}_t = \sum_{i=1}^m b_i \cdot \frac{N_{it}}{N_t} \cdot y_{it} \quad (\text{III.3.2.10})$$

and because

$$\bar{Y}_t = \sum_{i=1}^m \frac{N_{it}}{N_t} \cdot y_{it} \quad (\text{III.3.2.11})$$

I have

$$b_t = \sum_{i=1}^m b_i \cdot \frac{\frac{N_{it}}{N_t} \cdot y_{it}}{\sum_{i=1}^m \frac{N_{it}}{N_t} \cdot y_{it}} \quad (\text{III.3.2.12})$$

$$MPC_t = b_t = \sum_{i=1}^m b_i \cdot \frac{N_{it} \cdot y_{it}}{\sum_{i=1}^m N_{it} \cdot y_{it}} \quad (\text{III.3.2.13})$$

where b_t is the national urban MPC _{t} and b_i is urban MPC _{i} for each agent.

3.3 Empirical Results and Implications

The first step to aggregate is to estimate individual MPCs for the 210 heterogeneous agents based on the regression function (III.3.2.5).

Use pooled LS to estimate the 210 individual MPC, and results are given in Table III.3.3. Majority of the coefficients MPC_i are significant at 1% level. One is significant at 5% level (the lowest subgroup in Hunan), one is significant at 10% level (the highest subgroup in Xizang), and the rest two are not significant (the lowest subgroups in Guizhou and Qinghai).

It is normal to find such exceptions in the lowest income groups because the following reason. One reason is that the income reported by lowest income households varies over years as their income is not guaranteed to be smooth, e.g. Qinghai. Another reason is missing data for a few years as for Hunan and Guizhou. As the case in Xizang, due to its unique policy and economic characteristics, it shares the same reason as the first one, the inconsistency in reporting data. However, the overall estimation explains very well with a high R^2 equal to 0.99.

Table III.3.3 Estimated MPC for 210 Heterogeneous Agents

Agent (Subgroup)	MPC	t-Stat	Robust Std. Error	Agent (Subgroup)	MPC	t-Stat	Robust Std. Error
Beijing 1	0.79	13.59***	0.06	Henan 1	0.80	11.95***	0.07
Beijing 2	1.21	6.22***	0.20	Henan 2	0.95	9.42***	0.10
Beijing 3	0.89	16.34***	0.05	Henan 3	0.81	10.23***	0.08
Beijing 4	0.81	13.25***	0.06	Henan 4	0.81	11.81***	0.07
Beijing 5	0.87	8.10***	0.11	Henan 5	0.74	11.53***	0.06
Beijing 6	0.47	23.11***	0.02	Henan 6	0.53	28.51***	0.02
Beijing 7	0.48	23.34***	0.02	Henan 7	0.50	26.37***	0.02
Tianjin 1	1.01	11.42***	0.09	Hubei 1	0.69	6.93***	0.10
Tianjin 2	1.08	21.55***	0.05	Hubei 2	1.01	9.98***	0.10
Tianjin 3	0.97	23.70***	0.04	Hubei 3	1.00	12.39***	0.08
Tianjin 4	0.93	17.49***	0.05	Hubei 4	0.96	13.74***	0.07
Tianjin 5	0.89	10.69***	0.08	Hubei 5	0.86	9.19***	0.09
Tianjin 6	0.66	20.22***	0.03	Hubei 6	0.59	25.75***	0.02
Tianjin 7	0.48	13.51***	0.04	Hubei 7	0.55	48.89***	0.01
Hebei 1	0.81	8.61***	0.09	Hunan 1	0.46	2.49**	0.18

Agent (Subgroup)	MPC	t-Stat	Robust Std. Error	Agent (Subgroup)	MPC	t-Stat	Robust Std. Error
Hebei 2	0.99	8.71***	0.11	Hunan 2	0.92	3.69***	0.25
Hebei 3	0.73	5.34***	0.14	Hunan 3	1.06	6.06***	0.18
Hebei 4	0.75	5.47***	0.14	Hunan 4	0.98	5.96***	0.16
Hebei 5	0.72	4.95***	0.15	Hunan 5	0.93	7.08***	0.13
Hebei 6	0.53	8.35***	0.06	Hunan 6	0.72	32.09***	0.02
Hebei 7	0.53	8.93***	0.06	Hunan 7	0.63	27.10***	0.02
Shanxi 1	0.68	12.71***	0.05	Guangdong 1	0.50	5.53***	0.09
Shanxi 2	0.89	9.47***	0.09	Guangdong 2	1.52	6.34***	0.24
Shanxi 3	0.90	12.05***	0.07	Guangdong 3	1.65	7.73***	0.21
Shanxi 4	0.76	10.81***	0.07	Guangdong 4	1.34	9.24***	0.14
Shanxi 5	0.75	13.29***	0.06	Guangdong 5	1.23	8.90***	0.14
Shanxi 6	0.55	27.66***	0.02	Guangdong 6	0.78	28.48***	0.03
Shanxi 7	0.53	15.41***	0.03	Guangdong 7	0.68	22.21***	0.03
Neimenggu 1	0.85	8.55***	0.10	Guangxi 1	0.68	5.93***	0.12
Neimenggu 2	1.04	10.53***	0.10	Guangxi 2	0.98	10.68***	0.09
Neimenggu 3	0.94	9.53***	0.10	Guangxi 3	0.92	9.84***	0.09
Neimenggu 4	1.00	9.25***	0.11	Guangxi 4	0.77	8.58***	0.09
Neimenggu 5	0.96	10.06***	0.10	Guangxi 5	0.79	7.40***	0.11
Neimenggu 6	0.74	46.74***	0.02	Guangxi 6	0.54	21.08***	0.03
Neimenggu 7	0.77	12.89***	0.06	Guangxi 7	0.48	14.32***	0.03
Liaoning 1	1.02	15.32***	0.07	Hainan 1	0.74	7.23***	0.10
Liaoning 2	1.22	12.15***	0.10	Hainan 2	1.10	12.84***	0.09
Liaoning 3	1.19	10.81***	0.11	Hainan 3	1.10	10.00***	0.11
Liaoning 4	1.07	11.24***	0.10	Hainan 4	1.08	6.88***	0.16
Liaoning 5	1.00	11.25***	0.09	Hainan 5	1.06	7.13***	0.15
Liaoning 6	0.69	54.73***	0.01	Hainan 6	0.78	13.82***	0.06
Liaoning 7	0.65	23.73***	0.03	Hainan 7	0.72	20.50***	0.04
Jilin 1	0.88	8.59***	0.10	Chongqing 1	0.73	8.90***	0.08
Jilin 2	1.13	7.17***	0.16	Chongqing 2	1.02	15.07***	0.07
Jilin 3	1.12	9.21***	0.12	Chongqing 3	0.99	22.99***	0.04
Jilin 4	1.04	9.97***	0.10	Chongqing 4	0.89	22.06***	0.04
Jilin 5	1.04	8.36***	0.12	Chongqing 5	0.89	9.25***	0.10
Jilin 6	0.77	15.49***	0.05	Chongqing 6	0.68	20.83***	0.03
Jilin 7	0.60	44.47***	0.01	Chongqing 7	0.64	38.54***	0.02
Heilongjiang 1	1.36	27.69***	0.05	Sichuang 1	0.87	16.80***	0.05
Heilongjiang 2	1.48	6.71***	0.22	Sichuang 2	1.05	3.41***	0.31
Heilongjiang 3	1.22	9.78***	0.12	Sichuang 3	1.01	5.79***	0.18
Heilongjiang 4	1.10	10.59***	0.10	Sichuang 4	0.91	5.22***	0.17
Heilongjiang 5	0.93	9.27***	0.10	Sichuang 5	0.87	3.62***	0.24
Heilongjiang 6	0.67	45.41***	0.01	Sichuang 6	0.65	43.06***	0.02
Heilongjiang 7	0.50	17.35***	0.03	Sichuang 7	0.62	20.31***	0.03
Shanghai 1	0.73	30.67***	0.02	Guizhou 1	-0.03	-0.85	0.04
Shanghai 2	1.30	6.05***	0.22	Guizhou 2	1.19	5.90***	0.20
Shanghai 3	0.98	16.30***	0.06	Guizhou 3	1.03	10.77***	0.10
Shanghai 4	0.99	9.18***	0.11	Guizhou 4	0.98	7.79***	0.13
Shanghai 5	1.14	5.34***	0.21	Guizhou 5	0.90	12.66***	0.07

Agent (Subgroup)	MPC	t-Stat	Robust Std. Error	Agent (Subgroup)	MPC	t-Stat	Robust Std. Error
Shanghai 6	0.62	40.96***	0.02	Guizhou 6	0.59	25.11***	0.02
Shanghai 7	0.73	29.08***	0.02	Guizhou 7	0.42	27.75***	0.02
Jiangsu 1	0.62	10.78***	0.06	Yunnan 1	0.98	4.45***	0.22
Jiangsu 2	1.01	8.25***	0.12	Yunnan 2	1.26	7.05***	0.18
Jiangsu 3	0.90	9.72***	0.09	Yunnan 3	1.15	7.35***	0.16
Jiangsu 4	0.82	9.19***	0.09	Yunnan 4	0.84	10.39***	0.08
Jiangsu 5	0.79	7.21***	0.11	Yunnan 5	0.74	9.56***	0.08
Jiangsu 6	0.57	44.31***	0.01	Yunnan 6	0.50	13.17***	0.04
Jiangsu 7	0.46	42.42***	0.01	Yunnan 7	0.51	6.86***	0.07
Zhejiang 1	1.01	18.29***	0.06	Xizhang 1	1.07	8.11***	0.13
Zhejiang 2	1.02	10.71***	0.10	Xizhang 2	1.39	8.01***	0.17
Zhejiang 3	0.89	9.95***	0.09	Xizhang 3	1.26	10.36***	0.12
Zhejiang 4	0.89	8.46***	0.11	Xizhang 4	1.09	6.87***	0.16
Zhejiang 5	0.79	12.40***	0.06	Xizhang 5	0.64	5.15***	0.12
Zhejiang 6	0.57	21.45***	0.03	Xizhang 6	0.32	3.81***	0.08
Zhejiang 7	0.55	22.04***	0.03	Xizhang 7	0.23	1.69***	0.13
Anhui 1	0.76	13.91***	0.05	Shaanxi 1	0.90	28.61***	0.03
Anhui 2	1.09	12.89***	0.08	Shaanxi 2	1.64	6.33***	0.26
Anhui 3	0.98	10.69***	0.09	Shaanxi 3	1.15	13.30***	0.09
Anhui 4	0.97	9.42***	0.10	Shaanxi 4	1.07	17.40***	0.06
Anhui 5	0.85	11.07***	0.08	Shaanxi 5	1.12	9.47***	0.12
Anhui 6	0.60	29.97***	0.02	Shaanxi 6	0.60	37.89***	0.02
Anhui 7	0.56	18.67***	0.03	Shaanxi 7	0.59	29.48***	0.02
Fujian 1	0.95	10.22***	0.09	Qinghai 1	0.24	0.77	0.31
Fujian 2	1.06	13.41***	0.08	Qinghai 2	1.69	6.14***	0.28
Fujian 3	1.00	10.32***	0.10	Qinghai 3	1.21	4.91***	0.25
Fujian 4	0.91	9.98***	0.09	Qinghai 4	0.88	7.61***	0.12
Fujian 5	0.85	11.20***	0.08	Qinghai 5	0.75	12.40***	0.06
Fujian 6	0.60	36.37***	0.02	Qinghai 6	0.48	19.07***	0.03
Fujian 7	0.53	17.59***	0.03	Qinghai 7	0.48	22.47***	0.02
Jiangxi 1	0.79	11.58***	0.07	Ningxia 1	1.30	15.63***	0.08
Jiangxi 2	0.99	19.56***	0.05	Ningxia 2	1.36	10.29***	0.13
Jiangxi 3	0.89	18.51***	0.05	Ningxia 3	1.08	11.13***	0.10
Jiangxi 4	0.85	12.82***	0.07	Ningxia 4	0.97	13.96***	0.07
Jiangxi 5	0.83	9.91***	0.08	Ningxia 5	0.87	10.38***	0.08
Jiangxi 6	0.62	27.14***	0.02	Ningxia 6	0.60	17.82***	0.03
Jiangxi 7	0.55	14.93***	0.04	Ningxia 7	0.52	21.20***	0.02
Shandong 1	0.68	7.66***	0.09	Xinjiang 1	0.94	4.41***	0.21
Shandong 2	1.04	10.32***	0.10	Xinjiang 2	1.24	5.23***	0.24
Shandong 3	0.96	11.20***	0.09	Xinjiang 3	1.14	7.00***	0.16
Shandong 4	0.85	11.87***	0.07	Xinjiang 4	1.03	8.22***	0.12
Shandong 5	0.80	11.38***	0.07	Xinjiang 5	0.93	7.74***	0.12
Shandong 6	0.57	29.43***	0.02	Xinjiang 6	0.68	16.56***	0.04
Shandong 7	0.56	33.18***	0.02	Xinjiang 7	0.59	21.45***	0.03

Noted: t-statistics is based on robust standard errors due to heterogeneity in the cross-section data

* significant at 10%; ** significant at 5%; *** significant at 1%

Theoretically, the value of MPC should be normally confined within 0 and 1. But some values of coefficients MPC_i are greater than 1 especially for those subgroups with low income. This might be true due to the fact for low income households, because the disposable income is insufficient to support their daily consumption expenditure and they have to borrow or pursue other income, such as family transferred income and government subsidies, or other unreported income.

This phenomenon could be more often observed in countries with fast enlarging gap between rich and poor, such as current China. Poor agents have to spend most of their income on daily consumption expenditure and save little, which makes their marginal propensities to consume much larger compared to their marginal propensities to save. As income increase, people tend to spend less share of their income so that higher income agents have lower MPC. That is to say, MPC is negatively related to income.

Thus, when facing the same variation in total resources available for consumption, poor agents would make a larger adjustment in consumption than wealthy agents. This implies that when the total resources at hand are subject to uncertainty, the growth rate of consumption for poor agents is more volatile than that for wealthy agents.

So far the estimations on micro level finished, the next step is to estimate the aggregate provincial time-variant MPC_t using the estimated individual MPC_i above. This can be accomplished by introducing income weights that change over time. The aggregated provincial and national MPC are shown in Table III.3.4. Provincial MPC is aggregated from 7 subgroups in each province, so that it contains relatively less heterogeneous information as the split is too coarse. What I want to examine here is the national MPC, which exhibits a declining trend over year. As results shows, from 1997 to 2009, the urban China MPC declines 0.03. Comparing to 13 years ago, which means consumers in urban China spend 0.03CNY less for each 1CNY earned.

Table III.3.4 MPCt for Provinces and Nation

Year	Beijing	Tianjing	Hebei	Shanxi	Neimenggu	Liaoning	Jilin	Heilongjiang
1997	0.752	0.809	0.684	0.697	0.895	0.944	0.926	0.926
1998	0.746	0.806	0.683	0.702	0.895	0.939	0.927	0.927
1999	0.748	0.803	0.683	0.704	0.895	0.939	0.925	0.925
2000	0.743	0.803	0.682	0.699	0.894	0.934	0.927	0.913
2001	0.738	0.790	0.681	0.698	0.897	0.934	0.921	0.906
2002	0.729	0.789	0.670	0.683	0.884	0.914	0.897	0.878
2003	0.741	0.792	0.669	0.698	0.885	0.923	0.896	0.893
2004	0.728	0.786	0.672	0.697	0.891	0.922	0.908	0.888
2005	0.730	0.783	0.675	0.697	0.891	0.917	0.910	0.874
2006	0.732	0.791	0.675	0.698	0.893	0.918	0.910	0.875
2007	0.730	0.787	0.676	0.695	0.894	0.917	0.911	0.878
2008	0.724	0.788	0.672	0.695	0.886	0.905	0.905	0.869
2009	0.724	0.795	0.673	0.694	0.888	0.911	0.907	0.877

Year	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Jiangxi	Shandong	Henan
1997	0.929	0.721	0.771	0.816	0.804	0.778	0.767	0.705
1998	0.930	0.719	0.769	0.816	0.802	0.769	0.765	0.708
1999	0.918	0.712	0.767	0.812	0.802	0.769	0.760	0.702
2000	0.924	0.712	0.763	0.803	0.800	0.763	0.766	0.694
2001	0.916	0.705	0.760	0.805	0.795	0.762	0.762	0.695
2002	0.914	0.685	0.755	0.786	0.786	0.744	0.743	0.679
2003	0.908	0.690	0.748	0.795	0.784	0.737	0.750	0.691
2004	0.897	0.686	0.746	0.797	0.784	0.756	0.749	0.689
2005	0.898	0.688	0.745	0.799	0.783	0.757	0.745	0.689
2006	0.894	0.688	0.743	0.803	0.783	0.757	0.748	0.692
2007	0.900	0.687	0.742	0.801	0.782	0.759	0.747	0.693
2008	0.899	0.692	0.740	0.790	0.776	0.761	0.748	0.690
2009	0.899	0.689	0.741	0.792	0.778	0.758	0.749	0.690

Year	Hubei	Hunan	Guangdong	Guangxi	Hainan	Chongqing	Sichuan	Guizhou
1997	0.805	0.852	1.119	0.716	0.951	0.834	0.830	0.765
1998	0.808	0.848	1.116	0.719	0.954	0.832	0.830	0.772
1999	0.803	0.848	1.119	0.714	0.943	0.826	0.827	0.769
2000	0.797	0.850	1.118	0.710	0.934	0.827	0.820	0.778
2001	0.795	0.843	1.106	0.683	0.941	0.820	0.816	0.772
2002	0.780	0.830	1.043	0.705	0.915	0.808	0.799	0.745
2003	0.783	0.845	1.057	0.682	0.931	0.826	0.806	0.746
2004	0.796	0.845	1.061	0.703	0.934	0.822	0.806	0.760
2005	0.794	0.834	1.061	0.695	0.929	0.820	0.808	0.757
2006	0.790	0.837	1.064	0.695	0.931	0.822	0.808	0.757
2007	0.790	0.836	1.068	0.694	0.930	0.821	0.834	0.752
2008	0.781	0.835	1.070	0.701	0.932	0.822	0.812	0.756
2009	0.778	0.835	1.073	0.701	0.933	0.825	0.812	0.758

Year	Yunnan	Xizang	Shannxi	Qinghai	Ningxia	Xinjiang	Nation
1997	0.728	0.750	0.965	0.786	0.831	0.879	0.851
1998	0.724	0.728	0.956	0.784	0.835	0.880	0.848
1999	0.718	0.741	0.958	0.782	0.827	0.890	0.843
2000	0.721	0.741	0.940	0.784	0.833	0.883	0.841
2001	0.724	0.732	0.939	0.777	0.820	0.888	0.834
2002	0.709	0.732	0.901	0.754	0.811	0.875	0.816

Year	Yunnan	Xizang	Shannxi	Qinghai	Ningxia	Xinjiang	Nation
2003	0.717	0.716	0.930	0.755	0.814	0.882	0.829
2004	0.710	0.725	0.931	0.766	0.813	0.881	0.827
2005	0.701	0.745	0.928	0.754	0.804	0.878	0.825
2006	0.702	0.675	0.929	0.750	0.810	0.879	0.822
2007	0.699	0.670	0.927	0.740	0.800	0.887	0.822
2008	0.694	0.688	0.924	0.725	0.801	0.879	0.819
2009	0.700	0.697	0.927	0.733	0.803	0.887	0.821

Figure III.3.1 Comparison of Aggregate MPC in Urban China Using Three Methods

The results are displayed in Figure III.3.1, together with previous results using RA approach. Let us examine the HA results first. There is an obvious dip for aggregated MPC in 2002 by using HA approach and cross-sectional RA approach. The reason is the change of statistical gauging standard - the survey sample population changed in 2002 from non-agriculture population to the residents living in cities and towns, which named as urban population. Urban population is usually larger than the population registered as non-agriculture, because the former includes migrants from rural or other urban areas, whereas there are very few people willing to migrate from rural to urban. Migrants in urban include rural migrants coming from rural and urban migrants coming from other urban areas. Migrants from other urban areas are relatively in their young ages with no dependents, requiring less consumption expenditure and more savings for their future. Migrants from rural usually have no dependents accompanied them and

live in dormitories, and sometimes are subsidized for their meals. But they do have dependents in their home towns so that they need to save their income and remit to their families. Both of two types of migrants have less personal consumption and more saving preference. The inclusion of this portion of population makes the MPC suddenly drop in 2002.

Compare to the estimated results using RA approach in section 3.3, aggregated MPC using HA approach has a slightly declining trend, which is not as constant as the ones using RA approach based on time-series regression, and not as dynamic as the ones using RA approach based on cross-section regression. Using typical aggregate effect as an approximation is either unable to capture the changes in behaviors or unable to present a consistent habit of consumption propensity. However, HA approach gives us a new perspective to examine the time-variant aggregate consumption behavior, at the same time considering the heterogeneities and distributional effects. I will talk about the details of distributional effect in HA results in chapter IV.

Overall, the above empirical studies corroborate the statement that when aggregating over individuals, heterogeneous agent approach outperforms representative agent approach. This is because the heterogeneous agent approach aggregates the micro-data to macro level and better captures the heterogeneities and dynamic effects. Individual consumer acting rationally does not engender the same rational choice made in aggregate consumption due to heterogeneity of reality behaviors. Furthermore, the reaction of the individuals to some macro changes, policy change for example, is not necessarily consistent with the population reaction. Interaction and heterogeneity among individuals must be a considerate. Therefore, further decomposing population into more heterogeneous subgroups helps improve the results.

4. Tests

In this section, I will do several tests. Firstly, the robustness of the model is examined by using GDP deflator to deflate income instead of using urban CPI. Secondly I will test linear functional form with quadratic and cubic functional forms, and compare the results. Lastly, I perform recursive estimates to test the stability of the consumption model and compare the results of RA approach and HA approach.

4.1 Sensitivity Test

In the previous empirical study, both disposable income and consumption expenditure in urban China and provinces are deflated by urban national and provincial CPI. However, it makes more sense to deflate income by GDP deflator.

There are two differences between CPI and GDP deflator. GDP is only concerned about the prices of goods and services made in the country, but CPI reflects the prices of a selected basket of goods without considering where they are produced. It can be seen that CPI is more appropriate for deflating consumption expenditure. From accounting measurement, national income is usually related to GDP, so private income as part of national income should be more appropriately deflated by GDP deflator.

To be statistically consistent, one should use urban provincial GDP deflators to deflate disposable income. Unfortunately, such data cannot be obtained publicly, and there is only overall national GDP deflator is accessible. In the test, I use national GDP deflator to deflate all provincial urban income, and compare to previous empirical results which are deflated by the urban provincial CPI. The purpose of this test is to see the sensitivity of the HA model to the change of the underlying parameters.

Figure III.4.1 Comparison of HA Aggregate MPC by Using Urban CPI and GDP Deflator to Deflate Income

Comparing two results of urban MPC aggregated by HA approach, Figure III.4.1 shows that two methods of deflation obtain similar trend of movement of urban MPC, only with the one deflated by GDP deflator is higher than the one deflated by urban CPI. This is because CPI underestimates inflation for income sector comparing to GDP deflator. So after deflated by GDP deflator, the adjusted urban disposable income is lower than the one deflated by urban CPI. Therefore, higher MPC is obtained. However, the two MPC trends are almost parallel, which means that there are no significant impacts on the dynamics and changing in consumer behaviors.

4.2 Recursive Estimates

By using traditional RA approach based on aggregate time-series data, one can get a constant marginal consumption to propensity from the regression of 13 observations from 1997 to 2009. However, an augmented Dickey-Fuller F test can show that the parameters of the aggregate consumption relation are time varying (Chakrabarty et al. 2006). Therefore, a constant MPC is not so meaningful in the study of heterogeneous consumer behaviors, and is not

comparable to the time-variant national aggregate MPC_t either. Instead of using cross-sectional regression to achieve time-variant MPC, recursive estimates are performed to make the results of aggregate MPC in RA and HA models comparable.

Recursive estimation is a method to investigate time variations in models and signal properties by examining how the parameters will change if the next observation is added in. The estimator could be in a stochastic approximation or with some distribution property. By each new observation added in, the estimator will be updated.

There are many forms of the estimators in recursive estimations. This study takes one of those forms corresponding to this empirical work – Recursive Series Estimate. In the empirical regression model, there is an initial estimate of β together with a corresponding variance-covariance matrix of the estimator $\sigma^2 P_0^{-1}$. The recursive series estimator of coefficient of β is defined as

$$b_t = b_{t-1} + (P_{t-1}^{-1} + y_t y_t')^{-1} y_t (c_t - y_t' b_{t-1}) \quad (\text{III.4.3.1})$$

where b_t is the estimated coefficient, y_t is disposable income and c_t is consumption expenditure. Parameter b is updated based on its previous value when new observations, such as next year income and consumption, are added in the regression model.

Figure III.4.2 Trends of Recursive Aggregate MPC by HA and RA Approaches

The results of recursive estimates comparing HA approach and traditional RA approach are shown in Figure III.4.3. The one based on HA approach is to do individual recursive estimates first and then to aggregate, while the other based on RA approach is to get aggregate level data first and then to do the recursive estimate. The resulting MPCs of two methods show similar trends but HA recursive MPC is higher than the RA one. This indicates that using RA approach might underestimate the consumption propensity. Both results show that their estimates are time-variant and sensitive to new observations, and also shows that the recursive MPCs are more sensitive to the information contained in the new observations rather observations in previous periods. Comparing to Figure I.1.1, as consumption share declines from 2002 to 2007 and increases since 2008, the recursive MPCs of both approaches follow the same trend. However, the same trend makes it harder to make HA approach to stand out. The reason might be that the division of 210 agents comparing to 1 representative agent is still too coarse to bring enough heterogeneous information and properties to incorporate into the aggregate MPC. However, we can still get some implications from such results.

Sample data is from 1997 to 2009 and recursive results are from 1999 to 2009. The first 2 years have no recursive estimates due to little information and could only play a role as observations. The more periods the recursive process includes, the more accurate information about consumption can be obtained. So I only show the recursive estimates from 2002 to 2009. The aggregated MPC using HA approach is above the one using RA approach, and both rise drastically since 2008, which implicates either a statistical reason or the change of consumption behaviors in these two years. What comes to my mind immediately is that the influence might come from the financial crisis starting from US in mid-2008, but to my knowledge, the crisis didn't affect China's households directly and significantly although it did dampen the export sector. Another possible reason is the high inflation and relatively little growth in the households' real income in recent few years. This might be a reasonable explanation to such phenomenon.

Among the individual recursive estimates for the total 210 agents, only 34 out of 210 agents show a small decline or flat trend from 2008 to 2009, and the rest all drop and induce the overall drop of MPC after aggregation. The interesting thing is that 24 out of the 34 declining agents belong to the higher and the highest income households, and the other 10 are from the lowest income households. Inflation might not influence the consumption behaviors of high income group because the increase of the cost for household living is only a small portion of their income to change their habits. For the 10 lowest income agents, the explanation will be a little tricky by saying that their living standard is too low to be influenced, but they are indeed either no change with flat trend or with abnormal values such as a MPC greater than 1 and slightly declines. These 34 agents are only a small portion of the whole sample, so the aggregate MPC is driven by the majority and shows a sharp increase in 2008 and 2009.

5. Conclusion

Based on rigorous investigation on theoretical and empirical work in relevant field, I have examined several approaches such as RA and HA models to calculate

the aggregate MPC in urban China in this chapter. I also performed several tests to verify why HA model is suitable to use when one examines urban household's consumption propensity in China.

Seeing nowadays developing and diversifying in societies across the world, one could not satisfy to use a uniform representative agent behaviour to describe a macro or aggregate economic component. If still using traditional RA approaches during examining macro-level behaviors, people cannot tell from both perspectives of dynamics and aggregated diverse individuals at the same time. Fortunately, widely spreading method of HA approach in recent years help to solve such problem. Though some economists also seek mid ways or linkages between RA and HA approaches, I found HA approach is more useful when I examine the declining consumption propensity to consume in urban China.

The empirical MPC aggregated by pooling 210 individual agents with different income levels and consumption behaviours give more reasonable conclusions than aggregated by only one or a few representative agents. The aggregated MPC in urban China is generally higher than the RA result, which indicates traditional MPC are usually undervalued due to exclusion of heterogeneities among individuals. The reason is that among the heterogeneous individuals in urban China, most population fall into low- and middle-income levels across the total distribution. Such distribution attributes to pull up the aggregate MPC because lower income people tend to have high propensity to consume. However, a RA approach only use the means of all income and expenditure levels which are obvious higher than the modes - because minority of rich people gather majority of nationwide wealth, and give lower MPC than HA's.

From statistical perspective, HA approach gives us a new angle to examine the time-variant aggregate consumption behavior, at the same time considering the heterogeneities and distributional effects. Aggregated MPC using HA approach is not as constant as time-series RA results, and not as dynamic as cross-section RA results. Using typical uniform approximation is either unable to capture the changes or unable to present the consistent habit of behaviors.

Furthermore, by conducting sensitivity test, functional form test and recursive estimation test, I feel confident about the robustness of the approach used in this study. In the sensitivity test, the two MPC trends with and without inflation adjusted are almost parallel, showing no significant impacts on the aggregated results. In the functional form test, results of quadratic and cubic functional forms are not satisfied, with the coefficients for second- and third-degree terms close to zero. The recursive estimates also support that HA approach give a more reasonable result of aggregated MPC than the RA results. The empirical studies corroborate the statement that when aggregating over individuals, heterogeneous agent approach outperforms representative agent approach by better capturing the heterogeneities and dynamic effects. Therefore, interaction and heterogeneity among individuals are crucial considerations.

Now one might already observe that income dispersion induces different behaviors in consumption. In the next chapter, I will discuss in details about how the income distribution could affect the consumption propensity.

Chapter IV. Impacts of Income Inequality on Consumer Behaviors

1. Introduction

Aggregated MPC by decomposing population into heterogeneous agents can better capture the difference properties and preferences among individuals by the mechanism of distribution effect. In recent years, the income distribution in urban China is heavily left skewed as majority of the population are in lower and middle income categories, only a few portion of population obtain the majority of income (Figure I.1.5). Some parametric and non-parametric estimation methods have shown that the average and variance of the distribution of income can have severe impact on aggregate consumption expenditure (Chakrabarty et al., 2002 & 2006).

China's income disparity has been on the rise over the years since it opened up and reformed its economy (Gustafsson and Li 1999, Khan and Riskin 1998, Yang 1999, Meng 2004), and the gap widen especially since 1990s. According to some reports, the Gini coefficient of China has reached 0.5 in 2010 (2010 Blue Book of China's Society published by CASS). This is close to the alarming level of 0.6, beyond which a country's economic security and social stability is believed in danger. What role does the enlarging income inequality play in the examination of aggregate consumption?

So far, I have measured the consumer behaviors using MPC estimated by aggregating over heterogeneous individual agents. In this chapter, I will investigate the impacts of income inequality on consumption behaviors by using quantitative measure of the dispersion in income distribution.

2. Model of Theil Index

Theil index is derived by Henri Theil in 1967 from Claude Shannon's (1948) information theory. There are two different ways to measure Theil index, the Theil-T and the Theil-L index. Theil-T index weights by income shares while Theil-L index weights by population shares. Theil-T is more susceptible to variations in more advanced provinces, whereas Theil-L index is more susceptible to variations in the developing provinces (Akita 2003). My study uses Theil-L index because majority of the population in China fall into the poorer side of the distribution.

The Theil-L index is calculated as follows:

$$T_L = \sum_{i=1}^I p_i \ln \frac{p_i}{y_i} + \sum_{i=1}^I p_i \sum_{j=1}^{n_i} p_{ij} \ln \frac{p_{ij}}{y_{ij}} \quad (\text{II.4.1})$$

where p_i is the urban population share of province i in the entire nation, y_i is the income share, p_{ij} is the population share of subgroup j in province i , y_{ij} is the income share of subgroup j , and n_i is the total urban population in province i . Particularly, to get p_i , the urban population of province i (P_i) is divided by the nation's total urban population (P_N). Income share y_i is to use the total urban disposable income of province i (Y_i) divided by the total national income in the urban area (Y_N). Total income Y_i is obtained by multiplying the average income of provinces i ($\bar{Y}_i$) by its total urban population, where $\bar{Y}_i$ is the weighted (with population share) average of urban disposable income.

Theil-L index can be decomposed into two terms, the inter-province index and the intra-province index. The first term on the right hand side of equation (II.4.1) is the Theil-L index measuring inequality among provinces, which can be expressed as

$$L_B = \sum_{i=1}^I p_i \ln \frac{p_i}{y_i} \quad (\text{II.4.2})$$

The second term, Theil-L index within province, can be expressed as

$$L_W = \sum_{i=1}^I p_i \sum_{j=1}^{n_i} p_{ij} \ln \frac{p_{ij}}{y_{ij}} \quad (\text{II.4.3})$$

Given $p_{ij} = P_{ij} / P_i$ and $y_{ij} = Y_{ij} / Y_i$, I have $p_{ij} / y_{ij} = (P_{ij} / P_i) / (Y_{ij} / Y_i) = (Y_i / P_i) / (Y_{ij} / P_{ij}) = \bar{Y}_i / \bar{Y}_{ij}$, so that (II.4.3) can be rewritten as

$$L_W = \sum_{i=1}^I p_i \sum_{j=1}^{n_i} p_{ij} \ln \frac{\bar{Y}_i}{\bar{Y}_{ij}} \quad (\text{II.4.4})$$

After computing the inter- and intra- provincial urban Theil-L indices, L_B and L_W respectively, for each province, the national overall urban Theil-L index T_L can be obtained by summing L_B and L_W up.

Zero Theil_L index indicates perfect income equality, otherwise there exists income inequality. Particularly, a negative index indicates there are more rich people and a positive index indicates there are more poor people.

3. Data

The examination of income inequality is based on the distribution of income among population. My initial is to examine the income distribution of urban population; however, due to insufficient data and the change in statistical gauge, non-agriculture population is used instead. The two terms are partly overlapped but not exactly the same groups of population. Urban population includes those live in cities and towns where are namely urban areas, and usually engaged in non-agriculture activities; rural population is the rest in rural and mainly evolved in agriculture activities. Non-agriculture population refers people who are officially registered as “non-agriculture” no matter where they stay and what their jobs are, while agriculture population officially registered as “agriculture”. Normally agriculture population should be ones only working in agriculture sector, but as the emerging of rural to urban migration after China’s economic reform, many agriculture people move to urban area and become urban residents although they are still officially “agriculture”. Thus induces a fact that non-agriculture population is underestimated comparing to urban population.

Unfortunately, the urban population data is insufficient and inconsistent. Furthermore, in measuring household income and expenditure, the survey sample is based on non-agriculture population from 1997 to 2001 and changed to urban population from 2002 to 2009. To get sufficient population data, it is more appropriate to use non-agriculture as a proxy of urban population throughout the whole empirical time period.

In this chapter, disposable income per capita and non-agriculture population are used to examine the urban income distribution. The data sets of disposable income per capita, inflation (urban CPI) and non-agriculture population consist of 30 provinces' data in urban China, sourced from 30 provincial Statistical Yearbook 1998-2010, China Statistical Yearbook 1998-2010, China Population Statistical Yearbook 1998-2010. Inflation is eliminated by deflating by urban CPI, and the disposable income per capita is measured in constant price level in 1995. 30 provinces are included without Gansu province due to 6 out of 13 years missing income data, which is a big lack that cannot be filled in by any method of simulation, extrapolation, or estimation.

The statistical data in this study come directly from household surveys collected by the survey teams of the provincial and National Bureaus of Statistics. Besides lack of data, there are some concerns about the poor quality and the consistency in the statistics as well. These flaws in data place some difficulties in my study, which could directly affect the empirical results and the implication interpretations.

4. Empirical Results and Implications

The calculation results for the indices of inter-provincial, intra-provincial and overall urban China's income inequality are listed in Table IV.4.1. The trend of inter-provincial income inequality is shown in Figure IV.4.1.

Table IV.4.1 Inter- and Intra-provincial and Overall Theil_L Index for Urban China

Year	Inter-provincial	Intra-provincial	Overall
1997	0.0504	0.0388	0.0892
1998	0.0496	0.0409	0.0905
1999	0.0473	0.0446	0.0919
2000	0.0507	0.0511	0.1019
2001	0.0480	0.0562	0.1042
2002	0.0500	0.0860	0.1360
2003	0.0568	0.0762	0.1330
2004	0.0644	0.0719	0.1364
2005	0.0691	0.0750	0.1441
2006	0.0689	0.0729	0.1418
2007	0.0658	0.0724	0.1383
2008	0.0781	0.0764	0.1545
2009	0.0811	0.0749	0.1561

Figure IV.4.1 Trend of Inter-provincial Theil_L index in urban China

Before 2002, the income inequality among provinces and regions are relatively stable with small fluctuation. Since 2002, accompanied China's economy continuously shooting, the inequality among regions of the west, the middle and the east accelerates. High income and more advanced provinces are usually in the east and the coast regions. The middle and especially the west are less advanced and poorer. The inequality among these regions is mainly rising from the increasing migration from the middle and the west regions to the east where there are a lot of export-oriented companies thirsty for labors. Those migrants play a heavy weight on the lower-income part of population in the east region,

which means the advanced area takes advantage of the cheaper labors from the poorer region. Another reason for the increasing inequality is the local-central tax sharing system implemented in 1994, in which after the revenue share is taken by central government, the rest revenue would be returned to local government as compensation. This rule benefits the rich provinces more because the rich provinces can keep more revenue in local government, which exaggerate the inequality among provinces. In the upward trend of inequality, there is one turning point needs to be noted, a significant drop in inter-provincial inequality in 2007. The possible reasons for such a dip are the “back-home” trend of migrated labors and 10 increases of reserve ratio by the Central Bank.

Figure IV.4.2 Trend of Intra-provincial Theil_L index in urban China

Figure IV.4.2 illustrates the inequality within provinces. Because this study examines urban population, the intra-provincial income inequality is in fact an issue of intra-urban inequality. The general trend of inequality in urban within provinces is also upward. This is partially due to the migrants from rural to urban playing heavier weights on lower income side, and partially due to the fast accumulating speed of income on the minority of higher end. The fast growing of high-end income level maybe rely on several reasons. Firstly, before 2008 there is tax difference between domestic and foreign enterprises. Tax credit benefits

foreign invested corporates, who pay less tax than domestic corporates, and encourages more and more foreign companies coming to China's the east and coasted urban area. Thus makes the rich richer. Secondly, quite a large portion of income has been gathered illegally by corruption or bribing, and it eventually exacerbates the inequality. During the trend of increasing inequality, there is a notable bump in 2002 when there is a peak of migration from rural to urban.

Figure IV.4.3 Trend of overall Theil_L index in China

The national Theil_L index is obtained by summing up the Theil_L index of all the provinces in each year. Results in Table IV.4.1 above show there exists income inequality and majority of the urban population are still relatively poor. Income inequality in China's urban area has a generally upward trend over the past 13 years as shown in Figure IV.4.3. This is a natural and instinctive result since MR. Deng Xiaoping introduced the policy allowing someone getting rich first in the early 1980s. As globalization and fast growing Chinese economy bring up international trade and foreign direct investment, one should not be surprised to see serious income inequality. On the other hand, reduced restrictions on migration caused by the residential registration and the opening up of the markets for rural-urban migrant labour play significant roles as well. The bump in 2002 shows dramatic increase in income inequality mainly attributing to the

large inequality within urban provinces as the same reason in Figure IV.4.2 - the surge of less-cost rural labours into urban making intra-provincial inequality aggravated. The through in 2007 might be caused by the drop of regional inequality among provinces as regional migration surge cooling down.

Comparing to aggregate MPC_t , I find that income inequality and MPC move in opposite directions. The correlation coefficient r between Theil_L index and MPC is a good description of their relationship. By examining the correlation coefficient between the national overall Theil_L index and aggregate MPC_t , a correlation of -0.95 is obtained, which shows that income inequality has an almost perfectly negative influence on consumption propensity. Since the income gap in China is becoming larger, consumers are expected to keep reducing the shares of their income on consumption.

The negative correlation between Theil_L index and MPC can be understood in the following way. With the increase of Theil_L index, the rich become richer while the poor become poorer in real terms. Although the low-income population is the majority, their income only occupies a very small portion of that of the entire national population. The weights of their MPC are therefore small. It is the other way for rich people, i.e. small population but large income shares and thus large MPC weights. As rich people have smaller MPC, the aggregate MPC will decrease due to the influence from low MPC of the richer.

Besides examining the correlation alone, I also perform a fixed-effect pooled estimation about the coefficients of provincial income inequality to the provincial aggregate MPC in China urban areas. The regression is based on the panel data of provincial Theil_L index and MPC

$$MPC_{jt} = c_j + b_j \cdot Theil_L_{jt} \quad (IV.4.1)$$

where j is the j th province, $j = 1, \dots, 30$.

In the pooled estimation of the panel data, fixed effect is preformed due to possible unobservable heterogeneities among provinces, and by doing so the accuracy of the regression could be improved (Yi and Wang 2008). I use a linear

form here to relate Theil_L index and MPC because they have a strong perfectly negative correlation, and even in lognormal form as I examined as well, the differences are only the values but not the signs and significances.

For the panel of 30 provinces and 13 years, majority of provinces have negative coefficients although vary in absolute values (Table IV.4.2). In some provinces, the negative impacts of urban income inequality are bigger, where the interesting thing is that they are mainly advanced eastern provinces such as Beijing, Tianjin, Shanghai, Jilin, Hainan, and developing western provinces such as Xizang, Ningxia, Ningxia. There are also several provinces with small positive impact of inequality on consumption, but not significant.

Table IV.4.2 Correlation Coefficients of Urban Provincial Theil_L Index for Aggregate MPC

Provincial Theil_L	Coefficient	t-Stat
Beijing	-27.83	-9.78***
Tianjing	-12.25	-5.62***
Hebei	0.76	0.75
Shanxi	-8.59	-1.86*
Neimenggu	-1.19	-0.36
Liaoning	-6.59	-8.72***
Jilin	-12.65	-6.14***
Heilongjiang	-9.79	-7.86***
Shanghai	-21.19	-5.62***
Jiangsu	-3.18	2.99***
Zhejiang	6.53	1.16
Anhui	-3.70	-7.07***
Fujian	-4.87	1.89*
Jiangxi	-5.10	-1.14
Shandong	-0.37	-0.51
Henan	-0.50	-0.31
Hubei	-4.56	-3.01***
Hunan	-0.81	-5.61***
Guangdong	1.76	0.47
Guangxi	-1.69	-2.05**
Hainan	-11.13	-1.02
Chongqing	-5.92	-1.38
Sichuan	-2.96	-8.77***
Guizhou	-2.86	-4.12***
Yunnan	-2.90	-12.31***
Xizang	-96.75	-6.85***
Shannxi	-8.52	-2.90***
Qinghai	-43.12	-16.01***
Ningxia	-133.43	-6.19***
Xinjiang	-0.18	-0.22

Noted: t-statistics is based on robust standard errors

* significant at 10%; ** significant at 5%; *** significant at 1%

To investigate the reason behind this, I further examine the impact of the inter- and intra- urban provincial income inequality on the consumption propensity as

$$MPC_{jt} = c_j + b_j \cdot Theil_LB_{jt} + d_j \cdot Theil_LW_{jt} \quad (IV.4.2)$$

It clearly shows that the urban Theil_LB has mixed effects among the provinces but urban Theil_LW negatively affects all provinces (Table IV.4.3).

Table IV.4.3 Correlation Coefficients of Inter- and Intra- Urban Provincial Theil_L Index for Urban Provincial Aggregate MPC

Provincial Theil_L	Theil_LB (Inter-)		Theil_LW (Intra-)	
	Coefficient	t-Stat	Coefficient	t-Stat
Beijing	13.15	2.29**	-107.46	-9.87***
Tianjing	0.10	0.07	-111.79	-12.71***
Hebei	0.20	2.73 ***	-7.84	-34.21***
Shanxi	0.11	0.80	-7.07	-17.57***
Neimenggu	-0.67	-0.75	-21.97	-8.77***
Liaoning	-2.66	-3.70 ***	-28.07	-24.09***
Jilin	0.01	0.04	-38.27	-44.68***
Heilongjiang	-0.75	-0.16	-74.83	-8.10***
Shanghai	0.42	2.42 **	-8.21	-27.46***
Jiangsu	-0.30	-1.16	-17.99	-36.74***
Zhejiang	-0.36	-1.03	-28.83	-18.19***
Anhui	0.46	0.61	-14.30	-11.78***
Fujian	0.95	1.53	-13.10	-12.02***
Jiangxi	0.29	2.55 **	-7.41	-9.29***
Shandong	-0.61	-3.09 ***	-11.87	-25.67***
Henan	-0.87	-2.47 **	-15.06	-29.86***
Hubei	2.19	3.05 ***	-19.62	-31.59***
Hunan	-1.68	-2.89 ***	-6.41	-10.77***
Guangdong	1.33	1.79 *	-18.86	-7.21***
Guangxi	-0.06	-0.15	-16.38	-9.52***
Hainan	0.17	2.95 ***	-13.46	-68.52***
Chongqing	-3.26	-4.96 ***	-44.56	-16.76***
Sichuan	-4.08	-0.53	-169.86	-28.68***
Guizhou	0.58	0.98	-14.16	-26.33***
Yunnan	0.31	1.84 *	-6.62	-13.65***
Xizang	1.64	1.29	-12.56	-6.82***
Shannxi	-18.78	-1.28	-666.55	-8.15***
Qinghai	-2.47	-1.37	-158.27	-30.17***
Ningxia	1.44	2.12 **	-31.97	-6.25***
Xinjiang	-7.30	-2.15 **	-67.82	-8.89***

Noted: t-statistics is based on robust standard errors

* significant at 10%; ** significant at 5%; *** significant at 1%

For half of the provinces (16 out of 30 provinces), inter- urban provincial income inequality has positive influence on consumption, while the rest half have

negative impacts. And most of the absolute values of these coefficients are small which means the impacts are relatively little. However, one can see significantly negative impact of intra-urban inequality on consumption for all the provinces where the absolute values of coefficients are much bigger than the inter-ones. That is to say, instead of regional income inequality, the enlarging inequality within the same region is the major reason for the decline of consumption propensity. Facing same economic development and similar living cost, the larger the gap between high income subgroups and low income subgroups, the lower the aggregate MPC is. With high income growth of the minority high-income population, their weights in the process of aggregation become bigger and bigger. And since high-income people tend to have lower and lower MPC, it is natural that the aggregate urban MPC is pulled down. Therefore, the aggregate MPC is more reflecting high-income consumer's behaviors than the low-income ones.

5. Conclusion

Generally, MPC declines accompanied the increase of income level for overall population, which is true because the value of income per capita indeed increases (Figure I.1.3). People with higher income have tendency to save more and spend less share of their total disposable income. However, the share of income in national GDP declines over years (Figure I.1.2) and saving ratio increases at the same time. Figure I.1.1 gives us a more interesting story in urban China. The difference between urban income and expenditure as shares of GDP is bigger when urban income share increases. However, this difference is not narrower when urban income share decreases.

The reason of low consumption is already been discussed by many researchers. Some argue that it is due to high saving ratio (Modigliani and Cao 2004, Prasad and Rajan 2005). Some argue against them saying that the major reason of low consumption is the decline of household income as a share of national income (Aziz and Li 2007). Both stand firm but basically talk about the same thing from

the opposite sides, high saving ratio and low income share. The problem seems changing to which one is the momentum.

My study shows that the expanding income inequality, especially within the same region, is an important factor causing consumption propensity to decrease. Although the population share for each subgroup is fixed, the income distribution are different according to income level, therefore, the high-income people have heavier weights and cast heavier influences during the aggregation. As a result, the rich contribute more to the aggregate consumer behavior and the aggregate MPC has a tendency to decrease. In next chapter, I will also compare the impacts of income gap to other factors such as precautionary savings and income.

Enlarging income inequality is also an important indication to distinguish the heterogeneous agent approach from representative agent approach. Grandmont (1992) found in his empirical work that the variations of income distribution causes the differences of parameters when gauged in microeconomic and macroeconomic scenarios. Based on this observation, results obtained from non-uniform income growth rates are expected to demonstrate typical time series pattern, and that is consistent with our findings. Furthermore, the underlying reasons of income inequality can be attributed to the surge of migration from rural to urban areas and unbalanced development among provinces, which eventually causes heterogeneity of consumer behaviors in turn.

Chapter V. Impacts of Precautionary Savings and Dependency Ratio on Consumption

1. Introduction

In this chapter I will further discuss the implications of precautionary savings such as medical care, educational and housing expenditure, and other factors on China urban aggregate consumption propensity. People usually save a portion of their income for the uncertain future. Therefore intuitively, precautionary saving should negatively contribute to MPC. Other factors to be examined include dependency ratios in urban provinces and absolute provincial average income level. The study in this chapter tries to examine the relation between consumption and the factors mentioned above, and compare to the impact of income inequality. In the last chapter, I concluded that the income inequality especially the inequality within urban provinces has significant negative impact on aggregate MPC. The hypothesis in this chapter is that among all these factors I mentioned above, income inequality is the main reason to cause the drop of consumption propensity.

2. Impact of Precautionary Saving

2.1 Data and Model

In this study, panel data for urban household precautionary saving is needed. Total saving data of urban household can be easily found, but not easy for precautionary saving. To proxy precautionary saving, I use precautionary expenditure data including expenditures on medical care, education, and housing, because current expenditures on such sectors can squeeze out expected precautionary saving. From China and various provincial Year Book 1997-2009,

yearly urban provincial data on these expenses is collected and deflated using urban provincial CPI to 1995's base year constant price.

Among many previous studies on precautionary saving, Parker and Preston (2005) examine the impact of precautionary saving on consumption fluctuations. They decompose consumption expenditure of the Euler equation into four proximate causes and factors – real interest rate, new information, precautionary saving and preference. Their findings show precautionary saving together with other factors play a significant role in consumption fluctuations. The study in this chapter is to investigate the impact of precautionary saving over heterogeneous consumer behaviors. Therefore, based on Parker and Preston's (2005) model, I modify the model in this study using some transformation and pooling data by regions of eastern, middle and western areas.

Starting from preference of saving, namely prudence, the relation between MPS and precautionary saving, such as medical care, education, housing, is supposed to be

$$mps_{jt} = b_0 + b_1 \cdot \log(MED_{jt}) + b_2 \cdot \log(EDU_{jt}) + b_3 \cdot \log(HOU_{jt}) + \varepsilon_{jt} \quad (V.2.1)$$

where $j=1,...,30$ donates province j , MED_{jt} is the portion of expenditure spending on medical care, EDU_{jt} is the portion of expenditure on education, and HOU_{jt} is the portion of expenditure on housing, ε_{jt} is the error term.

And because $mps_{jt} = 1 - mpc_{jt}$, I have a relation between MPC and precautionary saving as

$$mpc_{jt} = b'_0 + b'_1 \cdot \log(MED_{jt}) + b'_2 \cdot \log(EDU_{jt}) + b'_3 \cdot \log(HOU_{jt}) + \varepsilon'_{jt} \quad (V.2.2)$$

Regression equation can be written as

$$mpc_{jt} = \beta_0 + \beta_1 \cdot \log(MED_{jt}) + \beta_2 \cdot \log(EDU_{jt}) + \beta_3 \cdot \log(HOU_{jt}) \quad (V.2.3)$$

2.2 Empirical Results

The estimations are made by pooling provincial data from the east, the middle and the west, using urban medical care, education and housing expenditures as explanatory variables and urban aggregate MPC as dependent variable.

The fitness of the model looks good for the three regions because empirical results show high R^2 , adjusted R^2 and low F-statistics (Table V.2.1). However, the results for individual provinces on medical care, education and housing are not all significant. In fact, majority of the coefficients are not significant even at 10% level. I try to find some implications by telling from the signs of coefficients.

Table V.2.1 Regional Examination of Impact of Precautionary Savings on Urban Aggregate MPC

Table V.2.1 (a) Provinces in Eastern Region

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
Med_Beijing	-0.021 (-2.083)**	Edu_Beijing	-0.008 (0.555)*	Hou_Beijing	-0.006 (-0.670)*
Med_Tianjin	-0.007 (-1.352)	Edu_Tianjin	-0.010 (-0.442)	Hou_Tianjin	-0.025 (-1.797)*
Med_Hebei	-0.006 (-1.283)	Edu_Hebei	-0.006 (-0.558)	Hou_Hebei	-0.012 (-2.304)**
Med_Liaoning	-0.007 (-0.907)	Edu_Liaoning	-0.015 (-1.142)	Hou_Liaoning	-0.008 (-1.788)*
Med_Shanghai	-0.023 (-3.077)***	Edu_Shanghai	-0.045 (-5.331)***	Hou_Shanghai	-0.005 (-2.316)**
Med_Jiangsu	-0.028 (-0.806)	Edu_Jiangsu	0.007 (0.140)	Hou_Jiangsu	-0.008 (-1.149)
Med_Zhejiang	-0.011 (-1.266)	Edu_Zhejiang	-0.020 (-3.459)***	Hou_Zhejiang	-0.006 (-1.197)
Med_Fujian	-0.001 (-0.208)	Edu_Fujian	-0.034 (-3.658)***	Hou_Fujian	0.002 (0.395)
Med_Shandong	-0.015 (-0.926)	Edu_Shandong	-0.014 (-0.735)	Hou_Shandong	0.008 (0.638)
Med_Guangdong	-0.012 (-0.453)	Edu_Guangdong	-0.065 (-1.528)	Hou_Guangdong	-0.030 (-2.343)**
Med_Guangxi	-0.006 (-0.621)	Edu_Guangxi	-0.083 (-2.562)**	Hou_Guangxi	-0.036 (-2.735)***
Med_Hainan	-0.002 (-0.233)	Edu_Hainan	-0.064 (-2.982)***	Hou_Hainan	-0.013 (-3.313)***
C	0.024 (1.238)	R ²	0.999	S.E. of regression	0.007
		Adjusted R ²	0.998	Prob(F-stat)	0.000

Table V.2.1 (b) Provinces in Middle Region

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
Med_Shanxi	0.026 (1.109)	Edu_Shanxi	0.001 (0.112)	Hou_Shanxi	-0.028 (-1.250)
Med_Neimenggu	0.002 (0.259)	Edu_Neimenggu	-0.001 (-0.111)	Hou_Neimenggu	-0.008 (-1.266)
Med_Jilin	-0.030 (-2.767)***	Edu_Jilin	-0.042 (-2.446)**	Hou_Jilin	-0.032 (-4.308)***
Med_Heilongjiang	-0.009 (-0.456)	Edu_Heilongjiang	-0.015 (-0.855)	Hou_Heilongjiang	-0.032 (-1.910)*
Med_Anhui	-0.017 (-2.904)***	Edu_Anhui	0.028 (2.920)***	Hou_Anhui	-0.010 (-1.182)
Med_Jiangxi	0.007 (0.961)	Edu_Jiangxi	-0.046 (-2.227)**	Hou_Jiangxi	-0.001 (-0.064)
Med_Henan	-0.035 (-1.127)	Edu_Henan	0.031 (0.686)	Hou_Henan	0.012 (0.826)
Med_Hubei	-0.022 (-2.743)***	Edu_Hubei	0.010 (0.478)	Hou_Hubei	-0.015 (-2.131)**
Med_Hunan	-0.018 (-4.441)***	Edu_Hunan	-0.027 (-1.675)*	Hou_Hunan	-0.009 (-1.176)
C	-0.121 (0.027)	R ²	0.997	S.E. of regression	0.007
		Adjusted R ²	0.996	Prob(F-stat)	0.000

Table V.2.1 (c) Provinces in Western Region

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
Med_Chongqing	0.000 (0.030)	Edu_Chongqing	-0.021 (-2.036)**	Hou_Chongqing	0.002 (0.152)
Med_Sichuan	0.007 (0.354)	Edu_Sichuan	-0.032 (-0.917)	Hou_Sichuan	-0.028 (-1.970)*
Med_Guizhou	0.014 (0.747)	Edu_Guizhou	-0.038 (-1.664)*	Hou_Guizhou	-0.003 (-0.211)
Med_Yunnan	-0.033 (-5.120)***	Edu_Yunnan	0.017 (0.865)	Hou_Yunnan	-0.001 (-0.099)
Med_Xizang	0.001 (0.126)	Edu_Xizang	-0.006 (-0.135)	Hou_Xizang	0.015 (0.420)
Med_Shaanxi	0.008 (0.405)	Edu_Shaanxi	-0.037 (-1.705)*	Hou_Shaanxi	-0.027 (-1.364)
Med_Ningxia	-0.013 (-0.996)	Edu_Ningxia	-0.010 (-0.910)	Hou_Ningxia	-0.007 (-1.348)
Med_Qinghai	-0.092 (-5.239)***	Edu_Qinghai	0.046 (1.793)*	Hou_Qinghai	-0.002 (-0.192)
Med_Xinjiang	-0.003 (-0.500)	Edu_Xinjiang	-0.005 (-0.600)	Hou_Xinjiang	0.008 (1.581)
C	-0.063 (-1.675)*	R ²	0.991	S.E. of regression	0.017
		Adjusted R ²	0.988	Prob(F-stat)	0.000

Noted: t-statistics is based on robust standard errors

* significant at 10%; ** significant at 5%; *** significant at 1%

Expenditures on medical care and education sectors have negative impact on MPC, which is more obvious in the eastern than in the middle and the western

areas. This is because the eastern region has more advanced health care system and education level and therefore has high cost on these sectors. Expenditure on housing seems equally negatively related to MPC in all the regions.

In medical care sector, the negative impact on consumption propensity is significant in the following provinces: Beijing, Shanghai, Jilin, Anhui, Hubei, Hunan, Yunnan and Qinghai. In the east region, all the coefficients are negative. In the middle region, majority is negative (6 out of 9 provinces), while in the west minority is negative (4 out of 9). A lot of research studies state that households in the middle and the west regions have more precautionary motives for saving than the eastern households. In my study, I further find that the eastern households' consumption is squeezed out by medical care expenditures, which is more obvious than the middle and the west.

Education sector is similar to medical care sector. Almost all the provinces in the east have negative effect of education expenditure on MPC, except Jiangsu province. In the middle region, 5 out of 9 provinces have negative coefficients, while in the west 7 out of 9 negative. The squeeze-out effect of education on consumption is most obvious in the east, followed by the west and then the middle. The significant impacts can be found in Beijing, Shanghai, Zhejiang, Fujian, Guangxi, Hainan, Jilin, Anhui, Jiangxi, Hunan, Chongqing, Guangzhou, Shaanxi and Qinghai.

The impact of housing expenditure seems no big difference in the three regions. In the east, 10 out of 12 provinces are negatively affected, in the middle region 8 out of 9 and in the west 6 out of 9. That is to say, comparing imbalanced development of medical care and education among regions, the consumer behaviors with regard to housing expenditure are quite similar. Furthermore, housing expenditure is a high burden generally across all the provinces and could squeeze out a large portion of other household consumption.

In conclusion, as a proxy to precautionary saving, the increasing expenditures on medical care, education and housing dampen the propensity to consume in

urban China. Before the reform of health insurance scheme, medical care was used to be paid by the government. After reform, which is my study period, the burden has been gradually transferred from government to individuals. Furthermore, the education fees and housing prices have been increased a lot in this period, which were mostly paid by the government before. Therefore, after reform people have more burdens and are more willing to make precautionary savings for future expenditure in order to cope with potential risks and any uncertainty about future income and expenditure. The long historical tradition in China determines that the risk-aversion Chinese people prefer saving for the future, not to mention the uncertainty during the economic reform and other social transformation. People could feel safer when they have more savings. With increase of household savings, medical care, education and housing expenditures are expected to have negative impacts on consumption expenditure growth and propensity. The national precautionary saving aggregated over provincial agents is also consistent with the above conclusion that medical care, education and housing all negatively affect consumption.

3. Impact of Inclusion of Dependency Ratio

As discussed in previous chapters, disposable income is the main direct factor to affect consumer behavior, but there are other reasons such as income inequality and precautionary saving. Besides these factors, there is another discussion that the decline of dependency ratio is also an important reason for the increase share of household saving and the decrease share of household consumption expenditure. Generally, the smaller the dependency ratio in an economy is, the higher the productivity and the higher the saving rates (Leff 1969, Bloom 1998, and Higgins 1998).

Furthermore, dependency ratio could be further divided into two parts, the children dependency ratio (0 to 14 years old) and the old dependency ratio (above 65 years old). In China, the former has been decreasing and the latter has been increasing in recent 10 years. But since the former declines much faster

than the latter grows, the overall dependency ratio exhibits a decline (Zhong and Li, 2009). The one-child policy causes lower dependency ratios over the past decades, because the children born during the baby boom have been turning to be working-age adults. While this generation and their next generation are turning older and older, aging population and fewer newborns according to one-child policy will induce the dependency ratio increase in the near future. It is expected that since 2015 the dependency ratio in China will change from decreasing to increasing because children dependency ratio will become flatter and old dependency ratio will speed up increasing (Zhong and Li, 2009).

Figure V.3.1 Trend of Urban Dependency Ratio

The Urban dependency ratio shown in Figure V.3.1 has a similar decrease trend as calculated aggregate MPC_t in Chapter III shown in Figure V.3.2. Since the decreasing dependency ratio reduces the propensity to consume and increases saving, the inclusion of dependency ratio should have some positive impacts on consumption propensity.

Figure V.3.2 Trend of aggregated Urban China MPC by HA approach

Based on (V.2.3), I include urban dependency ratio as an explanatory variable

$$mpc_{jt} = \beta_0 + \beta_1 \cdot \log(MED_{jt}) + \beta_2 \cdot \log(EDU_{jt}) + \beta_3 \cdot \log(HOU_{jt}) + \beta_4 \cdot \log(DR_{jt}) \quad (V.3.1)$$

Table V.3.1 Estimation of Precautionary Savings and Dependency ratio on Urban Aggregate MPC

Variable	Coefficient MED	Coefficient Edu	Coefficient Hou	Coefficient DR
Beijing	-0.016 (-1.866)*	-0.013 (-0.883)	-0.010 (-1.324)	0.033 (1.338)
Tianjing	-0.010 (-1.286)	-0.011 (-0.459)	-0.026 (-1.837)*	0.010 (0.575)
Hebei	-0.007 (-1.321)	-0.004 (-0.330)	-0.010 (-1.219)	0.011 (0.376)
Shanxi	0.028 (1.188)	0.001 (0.073)	-0.028 (-1.162)	0.010 (0.263)
Neimenggu	0.000 (0.011)	-0.001 (-0.087)	-0.007 (-0.875)	-0.012 (-0.261)
Liaoning	-0.004 (-0.451)	-0.013 (-0.885)	-0.006 (-0.969)	0.054 (1.010)
Jilin	0.031 (2.763)***	-0.045 (-2.211)**	-0.033 (-4.999)***	-0.016 (-0.333)
Heilongjiang	-0.011 (-0.573)	-0.015 (-0.767)	-0.035 (-1.902)*	-0.037 (-0.469)
Shanghai	-0.023 (-3.220)***	-0.045 (-4.772)***	-0.005 (-1.883)*	0.001 (0.059)
Jiangsu	-0.039 (-1.059)	-0.007 (-0.138)	-0.008 (-1.423)	0.072 (1.683)*
Zhejiang	-0.009 (-0.998)	-0.021 (-3.378)***	-0.005 (-1.133)	0.008 (0.596)
Anhui	-0.018 (-3.137)***	-0.027 (-4.120)***	-0.011 (-1.811)*	0.032 (1.724)*

Variable	Coefficient MED	Coefficient Edu	Coefficient Hou	Coefficient DR
Fujian	-0.000 (-0.043)	-0.034 (-3.275)***	0.001 (0.260)	0.002 (0.096)
Jiangxi	-0.007 (-0.899)	-0.046 (-2.090)**	0.000 (-0.047)	0.007 (0.211)
Shandong	-0.027 (-1.705)*	-0.020 (-1.184)	0.015 (1.355)	0.080 (1.562)
Henan	-0.021 (-1.005)	-0.002 (-0.100)	0.009 (0.882)	0.139 (1.916)*
Hubei	-0.022 (-2.035)**	0.010 (0.411)	-0.015 (-1.926)*	0.004 (0.119)
Hunan	-0.020 (-4.076)***	0.020 (1.177)	-0.008 (-1.204)	0.038 (1.571)
Guangdong	-0.029 (-1.120)	-0.065 (-1.469)	0.033 (2.621)***	0.056 (4.840)***
Guangxi	-0.004 (-0.464)	-0.076 (-2.359)**	-0.038 (-2.584)***	0.026 (0.978)
Hainan	-0.011 (-0.751)	-0.061 (-2.911)***	-0.015 (-2.289)**	0.058 (0.899)
Chongqing	-0.002 (-0.199)	-0.018 (-1.275)	-0.004 (-0.210)	0.019 (0.567)
Sichuan	-0.006 (-0.268)	-0.032 (-0.784)	-0.028 (-1.263)	0.003 (0.075)
Guizhou	-0.009 (-0.653)	-0.030 (-1.702)*	-0.005 (-0.383)	0.032 (0.393)
Yunnan	-0.033 (-5.903)***	-0.017 (-0.979)	-0.000 (-0.058)	0.010 (0.250)
Xizang	0.001 (0.398)	-0.003 (-0.117)	0.022 (1.000)	0.102 (2.641)***
Shannxi	0.007 (0.372)	-0.037 (-1.811)*	-0.027 (-0.210)	-0.005 (-0.079)
Qinghai	-0.090 (-7.097)***	-0.043 (-2.318)**	-0.001 (-2.480)**	-0.109 (-1.377)
Ningxia	-0.012 (-1.212)	-0.008 (-0.665)	-0.007 (-2.480)**	-0.026 (-0.609)
Xinjiang	-0.002 (-0.279)	-0.006 (-0.653)	0.007 (1.406)	-0.008 (-0.519)
C	0.024 (-1.238)**		R ² Adjusted R ²	0.999 0.998
S.E. of regression	0.007		Prob(F-stat)	0.000

Noted: t-statistics is based on robust standard errors

* significant at 10%; ** significant at 5%; *** significant at 1%

Regression results in Table V.3.1 show that urban dependency ratio has positive impact on urban MPC in most provinces, except for 7 north and west provinces including Neimenggu, Jilin, Heilongjiang, Shaanxi, Qinghai, Ningxia and Xinjiang. Most of the individual estimations for the coefficients are not significant with regard to the confidential level, but the functional regression result as a whole is enhanced as higher adjusted R². It is clearly shown in the panel regression that

consumption is negatively correlated with medical care, education and housing expenditures, and positively correlated with dependency ratio. Decreasing urban dependency ratio, mainly driven by children dependency ratio, indicates an enlarging working population facing a smaller dependent group. Less current period burden makes people consume less in the current period and save for future's uncertainty and better life. A general nature of traditional Chinese people is to work hard young and enjoy life old or leave heritage to their children. Therefore, declining dependency ratio is another possible reason for the drop of consumption expenditure weights in GDP.

4. The Combination of Multiple Factors

Now the empirical study has shown negative impact of income inequality, negative impact of precautionary expenditures and positive impact of dependency ratio on urban China's aggregate consumption propensity. Are the magnitudes of these factors affecting consumption same? If not, then which factor makes consumption drop most significantly?

Based on equation (V.3.1), the estimation is made by the following regression

$$\begin{aligned} mpc_{jt} = & \beta_0 + \beta_1 \cdot \log(MED_{jt}) + \beta_2 \cdot \log(EDU_{jt}) + \beta_3 \cdot \log(HOU_{jt}) \\ & + \beta_4 \cdot \log(DR_{jt}) + \beta_5 \cdot \log(|Theil_LW|_{jt}) \end{aligned} \quad (V.4.1)$$

where $|Theil_LW|$ measures the absolute values of income inequality within province. To get logarithm form, I use absolute values of Theil_LW index because the values in some provinces are negative due to more rich population within the province. I do not choose overall Theil_L index because the inequality within province (Theil_LW) is proved to be more significantly related to consumption than the overall inequality and the inequality between provinces (Theil_LB).

Table V.4.1 Estimation of Multiple Factors on Urban Aggregate MPC

Variable	Coefficient MED	Coefficient Edu	Coefficient Hou	Coefficient DR	Coefficient Theil_LW
Beijing	-0.005 (-1.050)	-0.005 (-0.683)	-0.004 (-1.028)	0.002 (0.270)	-0.06 (-5.250)***
Tianjing	-0.001 (-0.262)	-0.001 (-0.057)	-0.001 (-0.196)	0.001 (0.200)	-0.065 (-9.029)***
Hebei	0.001 (0.821)	0.001 (0.678)	-0.001 (-0.588)	0.004 (1.145)	-0.035 (-19.897)***
Shanxi	-0.003 (-0.807)	-0.001 (-0.385)	-0.001 (-0.810)	0.018 (2.878)***	-0.040 (-17.546)***
Neimenggu	-0.001 (-0.150)	-0.001 (-0.154)	-0.005 (-1.978)**	0.011 (0.447)	-0.044 (-5.667)***
Liaoning	-0.009 (-5.725)***	-0.014 (-5.053)***	-0.007 (-3.512)***	0.016 (1.489)	-0.037 (-35.993)***
Jilin	-0.008 (-2.821)***	0.005 (3.874)***	0.001 (0.554)	0.033 (2.906)***	-0.092 (-34.275)***
Heilongjiang	0.013 (0.930)	-0.021 (-0.873)	-0.002 (-0.596)	0.017 (0.861)	-0.023 (-1.546)*
Shanghai	-0.003 (-0.316)	-0.005 (-0.424)	-0.004 (-2.703)***	0.002 (0.166)	-0.049 (-19.281)***
Jiangsu	-0.005 (-0.637)	-0.008 (-1.344)	-0.005 (-1.709)*	0.002 (0.444)	-0.039 (-5.134)***
Zhejiang	-0.002 (-0.387)	-0.018 (-1.901)*	-0.003 (-0.866)	0.017 (1.123)	-0.040 (-5.357)***
Anhui	-0.003 (-0.151)	-0.006 (-0.686)	-0.016 (-2.305)**	0.031 (1.664)*	-0.061 (-4.117)***
Fujian	-0.012 (-2.079)**	-0.027 (-2.422)**	-0.009 (-2.409)**	0.005 (0.812)	-0.042 (-16.009)***
Jiangxi	-0.005 (-2.248)**	-0.009 (-1.938)*	-0.001 (-0.301)	0.009 (1.206)	-0.038 (-22.777)***
Shandong	-0.001 (-0.248)	-0.006 (-1.842)*	-0.006 (-2.851)***	0.008 (1.535)	-0.035 (-9.179)***
Henan	0.000 (0.073)	0.010 (1.369)	0.004 (1.674)*	0.006 (0.524)	-0.040 (-7.945)***
Hubei	-0.001 (-0.692)	-0.004 (-2.664)***	-0.003 (-1.139)	0.004 (0.287)	-0.035 (-13.535)***
Hunan	-0.012 (-1.802)*	-0.050 (-3.848)***	-0.015 (-2.903)***	0.017 (1.067)	-0.065 (-10.948)***
Guangdong	-0.019 (-2.780)***	-0.003 (-0.343)	-0.003 (-0.543)	0.011 (0.428)	-0.060 (-7.390)***
Guangxi	-0.009 (-2.701)***	-0.007 (-1.889)*	-0.004 (-1.792)*	0.019 (3.075)***	-0.056 (-11.741)***
Hainan	-0.005 (-2.590)***	-0.009 (-0.744)	-0.001 (-0.160)	0.002 (0.203)	-0.053 (-5.997)***
Chongqing	-0.005 (-1.146)	-0.010 (-3.195)***	-0.002 (-0.245)	0.000 (0.029)	-0.074 (-7.779)***
Sichuan	-0.001 (-0.168)	-0.005 (-1.443)	-0.001 (-0.985)	0.006 (0.641)	-0.076 (-9.650)***
Guizhou	-0.003 (-0.922)	-0.008 (-3.374)***	-0.005 (-1.529)	0.005 (0.801)	-0.045 (-22.080)***
Yunnan	-0.005 (-1.790)*	-0.017 (-3.346)***	-0.004 (-3.049)***	0.026 (1.851)*	-0.052 (-22.400)***
Xizang	0.015 (2.102)**	-0.000 (-0.112)	-0.014 (-3.233)***	0.020 (0.858)	-0.026 (-5.812)***
Shannxi	0.001 (1.431)	0.004 (0.551)	0.011 (1.312)	0.012 (0.611)	-0.183 (-9.009)***

Variable	Coefficient MED	Coefficient Edu	Coefficient Hou	Coefficient DR	Coefficient Theil_LW
Qinghai	-0.006 (-0.342)	0.011 (1.086)	-0.009 (-2.484)**	0.008 (0.220)	-0.071 (-4.706)***
Ningxia	0.004 (1.516)	0.006 (1.256)	0.002 (1.244)	0.004 (0.300)	-0.045 (-16.120)***
Xinjiang	0.010 (1.475)	-0.020 (-1.883)*	0.002 (0.684)	-0.019 (-0.683)	-0.034 (-5.639)***
C	-0.610 (-47.756)**		R ² Adjusted R ²	0.9999 0.9998	
S.E. of regression	0.003		Prob(F-stat)	0.000	

Noted: t-statistics is based on robust standard errors

* significant at 10%; ** significant at 5%; *** significant at 1%

The empirical results in Table V.4.1 show that comparing to expenditures on medical care, education and housing, and dependency ratio, income inequality has the biggest and the most significant impact on consumption. This conclusion suggests that among all the factors, the enlarging income inequality, especially within urban province, is the main reason causing aggregate consumption propensity to drop.

5. Conclusion

The marginal propensity to consume in China declines over years along with the drop of consumption expenditure as a share of GDP. This can be explained in several aspects.

The biggest contribution is the enlarging income inequality. The income distribution in China is that majority of population fall into lower and middle income side, and a few portion of population fall into high-income tail. The weights in the aggregating process are the multiplying products of average income and population share of the subgroups. Population shares are equally distributed into 7 groups, so the income level is critical to determine the aggregation weights in each subgroup. It is already known that the higher the income level becomes, the lower the MPC is. The highest income holding by a

small portion of population makes the overall MPC exhibit a property closer to these people, which means the national overall MPC declines over years.

Secondly, the increase of precautionary saving also causes consumption propensity to drop. This is empirically and also intuitively true because saving and consumption are complemented sourced from disposable income. After economic reform, government guaranteed health care, education and housing are replaced by the private market. The uncertainty about future income and expenditure and the high risk-averse nature make people save more so that the portion of precautionary saving in GDP increases. This portion of expenditure for precautionary motive squeezes out the portion of income used to consume.

Thirdly, decreasing dependency ratio is coincident with decreasing consumption propensity. Decreasing dependency ratio, mainly driven by children dependency ratio, indicates an enlarging working population facing a smaller dependent group. Few children and old people to raise means less burden to working population, so that they have more money to save for future and spend less on current consumption.

However, among all the factors, the enlarging income inequality within urban province is the most significant reason causing stagnant of consumption than the other two. This is one of the major contributions in this thesis.

Chapter VI. Conclusion

1. Limitation

As mentioned in previous chapters, statistical data problems in China are still a major trouble according to availability and reliability. Firstly, missing data usually causes bias in the study. For example, urban population should be used when I aim to examine urban consumption in China. However, due to data availability, I use non-agriculture population instead, which is a sub-optimal solution but the empirical results have no substantial difference. Provincial disposable income and consumption expenditure are not sufficient in some provinces as well. Although such missing data can be filled up by various approaches like interpolation and extrapolation, the estimation is still prone to imputation errors. The time-series data is from 1997 to 2009, containing only 13 observations. The number of data series is not ideal to do econometric regression, a minimum of 30 observations for statistical conferencing should be considered. But the measurement of disposable income in China only started since 1997, and so does the de-aggregate data for different income groups.

Secondly, the change of gauging standards makes the estimation inconsistent and implausible. For example, in 2002 the household survey is changed from non-agriculture population to urban population, which induces a dip in the estimated aggregate MPC. Furthermore, data in various statistical year books comes from manual surveys, which are often associated with bias and errors.

Thirdly, the issue of unreported income makes the disposable income data underestimated. In China, there might be numerous missing part of the grey income which is not included in the statistical system. This is also a reason why in some provinces the disposable income is less than consumption expenditure in the lower and lowest income subgroups. The data issues are not only found in urban statistical and survey work in China, but also in rural China which

situation is even worse. Fourthly, it is better to use urban provincial GDP deflator to deflate urban disposable income, but such data is also not available.

It would be better to get more data or extend series to longer time span. 13 years data in this study is still too short to fully understand the income distributional characteristics and many valuable policy implications. Even if data are sufficient and accurate, it is still an open question that how the balance between the micro and macro levels would be. The number of heterogeneous agents (subgroups) should be a good trade-off that gives the best simulation while still computable. The way to distribute urban household income is also limited due to data availability. Subgroups in each province is weighted as 10%, 10%, 20%, 20%, 20%, 10%, 10% sorted by income levels, which is essentially a equal distribution of the population, but not in income. Using percentile groups is equivalent to presuming that all individuals in the same quintile group have the same income. This could take the risk to underestimate the inequality and eliminates heterogeneity, which could distort the empirical results or induce bias. All of these concerns require more efforts to resolve in the future.

2. Extension

After data problems, future work could be carried on investigating other implications of the consumer behaviors in China. Besides income inequality, precautionary savings and dependency ratio, one could further consider the impact of pension participation ratio, level of financial development, changes in real interest rate and real exchange rate, the share of employment and unemployment in the service industry. These factors should influence the household consumption directly or indirectly. The examination of dependency ratio could be further divided to children and old dependency ratios.

The individual and aggregate functions can try different forms or include more variables such as consumption and income in the previous period. One can

examine the lag effect and the differential consumption between two periods with regard to the change of disposable income as well.

Another extension of current work might be to include the rural areas so as to examine the entire nation of China. Rural households in China have much lower income than urban households. Even though the rural population is large, they still have relatively low weights of income share. This will make them behave like the lowest-income subgroups in urban areas.

In addition to the above discussions, the consumer behaviors in China have more special features worth studying: 1) there exists high risk in people's income during the recent transition period in China, 2) the problem of liquidation constraints in China is serious. Due to these reasons, myopia consumers in China might partition their life span into several periods to make short-term and long-term consumption plans. The partition could be based on certain key points in one's entire life such as marriage, carrying babies, retirement, etc.

3. Conclusion

In this thesis, I have addressed the aggregate problem of urban households' consumption in China. There are two major contributions of this study. The first one is that by using a Heterogeneous Agent approach, I find the aggregate MPC has a more serious declined trend over years, which is the reason why the consumption as a share of GDP declines at the same time. Another important finding is that behind the decline of consumption propensity is the enlarging income inequality which makes the most significant contribution, because the high-income minority population play a heavy weight on lowering the aggregate MPC.

Building a solid microeconomic foundation for macroeconomic models has been an important research topic for years. Recently, substantial progress has been made in dealing with aggregation problems, especially in empirical work

(Blundell and Stoker 2005). The consumption behaviors of individuals play an important role in China's macroeconomics.

This study has done an extensive review of the most commonly used models in aggregation problem, especially the RA model and the HA model. HA model is found to be superior to RA model as it creates a nice bridge between the consumption behaving individuals and the economic aggregates. The empirical work in this thesis shows the appropriate approach to building micro-level foundations is to study the aggregate activities of heterogeneous individuals with direct interactions. In the HA model, provincial panel data is used. The advantage of panel data has been discussed that it is superior to the time-series regression giving only constant estimation and the cross-sectional regression giving volatile coefficients without considering consistent preferences and habits.

By using HA model, the aggregate urban MPC shows a consistent declining trend, which is coincident with the fact that urban consumption share in GDP drops over years. Amid the sustained fast growth of the whole economy, the contribution from consumption sector is reducing comparing to investment and net export, mainly due to declined propensity of household consumption. The reasons should be, 1) the increased income inequality pulls down consumption propensity as the rich get richer with faster growing speed than the poorer; 2) there is less money to spend because households' income is squeezed by factors like precautionary savings as medical care, education, housing, and pension; 3) lower dependency ratio due to the one-child policy increases the household saving.

Before I go to the examination of the above hypothesis, I make several the robustness and consistency tests for my model. Firstly I test the sensitiveness of the model with respect to the change of deflator of income. The results show difference in the values of aggregate MPC but not much difference in the trend. Secondly, I test the functional form of the model by using non-linear functional forms, in particularly in quadratic and cubic forms, comparing to linear one. The result shows that linear form is more suitable in this study as the data for

subgroups in provinces is semi-decomposed and still possess some aggregate linear property. Thirdly, I use recursive test to compare aggregate MPC by HA and RA approach, which tells us both methods show similar trend but RA approach undervalues MPC and is more sensitive to the newly added observation.

Based on the above mentioned hypothesis, I examine the impacts of income inequality on consumption first. In addition to income level, income distribution has a significant effect on aggregation consumption as empirical results show. In recent years, consumption demand in China has been in a state of insufficiency and doldrums. One important reason is the growing population with a huge base and the increasing income inequality. As a primary component of aggregate demand in macroeconomy, this will seriously impede the sustainable and healthy development of China economy. It is therefore necessary to investigate the impacts of income distribution and income discrepancy on household consumption as well as aggregate over heterogeneity. It is possible that HA model can conveniently check the distributional effects of relevant heterogeneous characteristics. My results show that a negative correlation exists between income inequality and MPC – the gap of income in urban China is increasing meanwhile the consumption propensity of urban population is decreasing.

My study also finds that expenditures on medical care, education and housing have squeezed out the portion of household income used to consume. From such perspective, precautionary saving has negative effect on consumption. I also find that dependency ratio is positively correlated with consumption propensity. As urban dependency ratio is lower, the current burden for working population is less so that current consumption is reduced. However, this situation is expected to reverse because of the problem of aging population in China in the near future. Although precautionary saving and dependency ratio can influence consumption behaviors, my conclusion is that urban income inequality, especially within province, has bigger and more significant impact on consumption.

The findings in this study are helpful to enlighten some policy implications to researchers and policy makers when concerning about the phenomenon of declining consumption both in a marginal propensity matter and as a share of national production.

Understanding the nature of China's rising inequality is also vital to solve consumption problem and make effective policies. In recent years, China's aggregate demand structure seems heavily weight on export and investment. It is time to orient to domestic consumption-driven economy from which a country show a real improvement of economic well-being backed up by strong and solid domestic purchasing ability. The improvement of consumption and income distribution should focus on structural changes to adjust from secondary to tertiary industry like service and high-end goods to encourage consumption and enhance living quality. Central and local governments cooperate to lessen income inequality, support low income labor to develop, ensure minimum wage levels according to different living cost across areas, and improve social security system.

To achieve sustainable development, efforts and new technologies should be put to industries like low pollution, energy saving, and low carbon emission. This is a painful and long way to go, because no real structural changes can be made without affecting vested interests. All the reforms require key political changes to enable and coordinate the corresponding sectors and principals.

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