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A GENERAL DEMAND FRAMEWORK OF GOODS AND MONEY: THE THEORETICAL MODEL AND EMPIRICAL EVIDENCE IN CHINA

BY

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ABSTRACT

A GENERAL DEMAND FOR GOODS AND MONEY: THE THEORY AND EMPIRICAL EVIDENCE IN CHINA

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Since 1978 China has embarked on a complex and historically unprecedented process of economic restructuring. One of the difficult challenges facing the Chinese government is to achieve the equilibrium in money market so as to tackle the fundamental sources of inflation. Therefore, the monetary authority has to understand fully the demand side of money.

The basic purpose of this thesis is to explain the comprehensive demand structure of rural households in China, especially the money demand behavior. The main hypothesis is that money demand in LDC countries is not only determined by the income level, general prices and interest rates explored by the prevailing neoclassical theory, but it also is a function of governmental pricing policies on specific goods and socio-economic variables, such as the level of economic development, demographic variables and fixed investment.

The neoclassical demand theory fails to explain the interaction of goods demand and money demand. Also, it does not explore the methodology for incorporating institutional variables into the demand system. Further, as double

functional agents of both consumer and producer in a semi-commercialized economy, rural households will retain a portion of agri-products for consumption, while purchasing both industrial consumer and producer goods in markets. The conventional theory is difficult to describe these features.

Based upon the new home economics, this thesis constructs a general demand framework for goods and money. It is so general that in LDC countries, rural households' demand for home-produced agricultural output, industrial consumer and producer goods, as well as money assets can be simultaneously analyzed within the framework. In addition, socio-economic variables are explicitly incorporated into the general demand system. The socio-economic variables defined are household demographic factors, the indices characterizing rural economic developmental level, and the indicator of fixed investment.

The major findings indicate that along with the process of rural economic development, two contradictory effects exist in the demand for M1 (cash and demand deposits): as the income level of rural households rises, on the one hand, the demand for M1 will increase; as the income becomes more monetized, the level of rural production activities is more diversified and the fixed investment is achieved, on the other hand, the M1 demand tends to decline. Besides, governmental relative pricing policies on specific goods may exert positive impacts upon the demand for M1.

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CHAPTER I

INTRODUCTION

In most developing countries, rural residents still make up the major part of the population. In 1987, about 70 percent of the total population in low-income developing countries resided in rural areas; while in lower-middle income and upper-middle income developing countries, the percentages of rural residents in the total population were roughly 54 percent and 37 percent, respectively.[1] Therefore, rural households in developing countries are significant in the total demand for both goods and monetary assets. For example, in 1985, Chinese rural households' demand for goods and money accounts for 58.5 percent and 60 percent of the whole country's demand for goods and money, respectively.[2]

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[1] World Bank, "World Development Reports 1989", Oxford University Press, 1989, Table 31, pp224.

[2] The report of the Institute of Development under the State Council of China, "Peasants, market and the institutional innovation __ the reform in the depths facing the rural development after eight years of fixing household production quotas", Economic Research, Jan. 1987, Beijing, pp7.

Table 1: Percentage of Rural Population in 1987, Selected Developing Countries.

Low-income economies	Percent	Lower-middle income economies	Percent	Upper-middle income economies	Percent
China	62	Philippines	59	Brazil	25
Chad	70	Egypt	52	Hungary	41
Bangladesh	87	Thailand	79	Argentina	15
India	73	Turkey	53	Algeria	56
Sierra Leone	74	Peru	31	Venezuela	17
Pakistan	69	Malaysia	60	Panama	46
Haiti	71	Costa Rica	55	Gabon	57
Ghana	68	Morocco	53	Libya	33
Indonesia	73	Mexico	29	Iran	47
Zambia	77	Zimbabwe	74	Trinidad & Tobago	33
Unweighted Average	72.4		54.5		37.0

Sources: "World Development Report, 1989", World Bank, Oxford University Press 1989, Table 31.

Note: Low income economies: a GNP per capita of U.S.$480 or less in 1987; lower-middle income economies: a GNP per capita between $480 and $1,940 in 1987; upper-middle income economies: a GNP per capita between $1,941 and $6,000 in 1987.

As a major part of total money demand in the economy, rural households' money demand is extremely important for the central bank's monetary policy in the money market, such as money supply decisions and interest rate policy. In addition, the general demand structure of rural households also deeply reflects the government intervention such as pricing policies, demographic policies, rural development planning, and even direct investment in infrastructure and projects; and it again impacts the non-rural economy through demand linkages.

Consequently, it is important to understand and account for rural households' general demand behavior for goods and

Table 2: Percentage of Total Sales and Demand Deposits in China's Rural Area.

Years	Percent of total goods sales in rural areas	Percent of total demand deposits in rural areas
1984	59.2	36.1
1985	58.5	34.8
1986	57.7	34.2
1987	57.6	32.8

Sources: "Abstract of Chinese Statistics, 1988", the National Bureau of Statistics, the Press of Statistics, 1988, Beijing.

money assets. One of the main problems specifying and predicting general demand systems of rural households in developing countries, however, is that the demand framework is often confounded by the complex characteristic of rural households in LDC countries as a double functional agent in semi-commercialized rural economies. Most rural households, on the one hand, will purchase industrial consumer goods and retain some agri-output for their own consumption; and on the other hand, they will also buy industrial producer goods (like fertilizer, pesticides and etc.) for the production of agricultural output. Besides demand for both market and non-market goods, rural households highly desire to obtain monetary assets, especially cash-holdings and demand deposits. Hence a general demand system must include households' demand for money. Furthermore, households' demand functions are not only determined by the income level, market prices and interest rates, but also affected by some socio-economic or institutional factors such as demographic variables or rural income structures, which may reflect some features of the development process.

In Chapter II, we will discuss the data. First of all, we will describe the general economic and social conditions of the areas from which the rural households data come. Then we will explain the categories of the data set which will be applied to our theoretical formulation for estimation. The micro-economic data are Chinese rural households in the province of Sichuan, surveyed annually by the Sichuan Provincial Statistical Bureau. Two hundred and forty households during the period of 1985 to 1987 are available. They include many detailed variables: quantities of goods items obtained by households, and expenditure upon those goods, money assets required by households, demographic information, and the sources of income. Besides those micro-household data we will use exogenous macro-aggregate data published by the People's Bank of China (the central bank of China), the National Statistical Bureau and the Provincial Statistical Bureau; for example, annual interest rates, inflation rates, and others.

Obviously, the traditional theory is insufficient to describe the general demand behavior of rural households in developing countries. Again, it rarely considers the methodology of combining socio-economic variables into the demand system; and it also implicitly excludes the money market while specifying demand framework for goods.

Hence, in Chapter III we will construct a model which is capable of amending the conventional theory. First, we will discuss the new approach proposed by Becker, G. (1965), Lancaster, K. (1966), and adjusted by Pollak and Wachter (1975). Following this approach, we will specify rural households' optimizing problem. The new theory of home economics which is characterized by the internal household technology can be extended to depict rural households' demand behavior. Essentially, in this model, households will maximize the so-called "consumptive characteristics" which cannot be directly purchased. Instead, households will obtain economic goods to generate the consumptive characteristics via their internal production function. Thus the purchased goods are not arguments in household preference orderings, they just act as inputs of producing characteristics.

The extension of the new approach will show that, both rural households' purchased industrial producer goods and retained agricultural output will perform the role as inputs to produce the consumptive characteristics via households' internal technology, in which rural households' production function is implicitly incorporated.

Under budget and technological constraints, households' optimizing decision for consumptive characteristics is then equivalent to maximize the "inputs of characteristics", or the economic goods bundle. Therefore, an original household utility function of characteristics is translated into a modified utility function of goods, which obeys properties of the conventional theory. The optimal space of so-called "characteristics" is replaced by tangible goods space. This transformation then distinguishes the difference of household tastes and technology, which is often confounded by traditional theory. Consequently, the socio-economic variables can be explicitly expressed as parameters affecting households' internal technology in the modified utility function.

Since this theoretical treatment is compatible with many analytical searches incorporating socio-economic factors such as demographic variables into the demand equations, we will briefly review some concise methods which specify socio-economic factors as exogenous impacts on the demand system of households. Barten (1964) proposed a scaling method to incorporate exogenous variables into the demand system. The method consists of a commodity specific equivalent scales based upon the direct utility function. After Barten, Pollak and Wales (1978, 1980, 1981) contributed a translating procedure of combining demographic effects into the demand system with basis of duality theory. Also, Gorman (1976) introduced a technique which was employed by Pollak and Wales (1980, 1981), Barnes and Gillingham (1983) to conduct the empirical studies. Methodologically, Gorman's technique combines both translating and scaling specifications, but essentially it is more general than linear techniques due to its built-in joint demographic effects across demand functions. Finally, Lewbel (1985) proved that there exists the compatibility of the new home economics with these procedures by unifying them through a concise theoretical modeling.

Then we will discuss a general demand framework with money assets included. Some neoclassical economists like

Hicks, Samuelson (1947), Morishima (1952), Patinkin (1965), and Friedman (1969) have made attempts to incorporate money assets into the general utility function, in order to deal with demand for money. Recently many researchers have revisited the utility approach to combine money demand, among them were Chetty (1969), Bisgnano (1974), Diewert (1974), Clements (1976), Barnett (1981), Ewis and Fisher (1984). Also, the perfect foresight modeling with money in utility functions has been formulated by Brock (1974), Clavo (1979), Obstefeld (1983) and others. On the contrary, some economists, such as Clower (1967), Nichans (1980), Kareken and Wallace (1980) have questioned the attempts of treating money as an argument in the general utility function. Their arguments claim that the characteristics of money assets were not revealed; instead they proposed the method of including money into the budget constraint. Finally, these two approaches have been synthesized and proved to be functionally equivalent by Fischer (1974) and Feenstra (1986).

However, the criticism from Clower, Nichans, or Kareken and others has revealed the difference of "monetary characteristics" and money assets itself. We will extend the new approach of home economics to be a general framework in which households will optimize their utility function through both "consumptive and monetary characteristics" arguments. This original utility function is equivalent to maximize a modified utility function with goods and money assets as arguments, where goods and money assets are inputs to generate "characteristics" through household internal technology. In other words, an intangible bundle of "consumptive and monetary characteristics" derived from the original utility function is transformed into a tangible bundle of goods and money from a well modified utility function. Therefore, with the extended unitary household modeling, a general demand system for both goods and money assets under the influence of socio-economic factors is then obtainable.

In Chapter IV, based upon the modified utility maximization structure which satisfies all properties of traditional theory, we will investigate the specifications of demand functions which we will employ to conduct our empirical studies. Contemporary economic literature has specified demand systems through two procedures: by deriving demand systems from a process of utility maximization or by expressing them directly with certain restrictions. All demand systems obtained from these two procedures, however, will correspond to an explicit or implicit utility maximization problem.

The procedure of specifying a utility function or an expenditure function has been explored by many authors. Klein and Rubin (1947-48) suggested linear expenditure system (LES) derived from a direct utility function, with

Stone (1954) making a more detailed discussion about this model. Then Lluch (1973) generalized the extended linear expenditure system (ELES) based on an intertemporal maximization of the Klein-Rubin utility function. With a rapid development of duality theory, Houthakker (1960) derived a set of demand equations termed as the indirect addilog demand system (IADS) based upon an indirect function. Christenson, Jogenson and Lau (1975) explored a flexible functional form of demand system which is obtained from the quadratic approximation of the indirect translog utility function. This specification can be useful to test assumptions such as additivity of preferences. But the major limitation for it is the number of structural parameters required; thus, annual data series of usual length and more refined commodity groups involve serious problems of estimation.[3] Deaton and Muellbauer (1980) proposed an Almost Ideal Demand System (AIDS). They derived AIDS model from a specific class of preferences represented by a cost or expenditure function. This model is such a flexible functional form that the demand functions derived are first-order approximation to any set of demand functions from utility-maximizing behavior.

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[3] Berndt, E. R., Darrough, M. N., and Diewert, W. E., "Flexible functional forms and expenditure distributions: an application to Canadian consumer demand functions", Discussion paper pp77-100, Department of Economics, University of British Columbia.

Alternative procedure, on the other hand, directly expresses specifications of demand systems. Powell (1966) introduced a demand system of additive preferences. Barten (1964, 68, 69) and Theil (1967, 1971, 1975, 1976, 1980) proposed the Rotterdam demand system, which is formulated from first order differential forms. The Rotterdam model under appropriate restrictions can be rationalized as following from a utility maximization problem; for example, the Rotterdam demand system can be derived from the Klein and Rubin utility function.[4] This system of demand functions implies that all income elasticities are one, all own price elasticities are negative one, and all cross price elasticities are zero.

In particular, Deatan and Muellbauer's AIDS model in the first procedure and Rotterdam model in the alternative procedure are interesting ones. Since our data are cross-sectional, we will further explore adaption of Rotterdam and AIDS models as the linear Slutsky model (LS), the linear preference independence model (LPI), and the DM model; and the quadratic versions as the quadratic Slutsky model (QPI), quadratic independence model and quadratic AIDS model (QDM), which are originated by Theil, Chung and Seals (1989). With a modified utility maximization framework with goods and

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[4] Yoshihara, K.,"Demand functions: an application to the Japanese expenditure pattern", Econometrica, vol.37, April 1969, pp257-74.

money assets as arguments, we will then extend all of the six specifications to explicitly obtain a general demand systems for goods and money; and also functionally incorporating socio-economic factors as demographic variables or income structural parameters into the demand equations. Then we will discuss methods of aggregating our detailed data, among which the Greary (1958)-Khamis (1967, 70, 72) procedure is required as part of the modeling.

In chapter V we will employ the specified demand modeling to estimate rural households data in China. Based upon the results of the estimations, we will test the availability of demand specifications of the framework. Then we will discuss the effects of economic variables such as price, interest rate and income vectors on household simultaneous demand equations for goods and money, and the interactions among market goods and non-market goods, consumer goods and agri-input goods, as well as goods and money, for which we may tell whether the good and money are correlated. Also, we will demonstrate the impacts of socio-economic factors on demands for goods and money, which may reveal some profound aspects for rural households in the process of development.

With our empirical studies of general demand framework for China's rural households, we can then investigate government's interventions in the rural development. We can discuss the central bank's equalibrium money supply decision and interest rate policy; the effects of the government's pricing policies toward agri-output and agri-input; and its demographic policies. Also we can observe the impact of structural change and rural growth upon demand pattern. For example, the changes in household income structure may help us to capture the effects of growth of small scale industries in rural areas as well as the level of rural households commercialization. Furthermore, this study can indicate some indirect demand linkages to other sectors due to change in rural households' expenditure pattern.

In the last Chapter, we will briefly review the procedure of modeling, summarize our empirical results, and then present some economic explanations for the results.

CHAPTER II

DATA DESCRIPTION

2.1 Introduction

The basic data employed in the empirical study are a set of Chinese rural household data in the period of 1985-1987, which we will describe in this chapter.

The rural household data include basic information such as demographic formation, land, house condition, production equipment and others; household income and the sources; their expenditures and quantities of specific goods, and financial assets held. In addition, we will employ some macro-data such as interest rates, inflation rates, and others. The household data were surveyed by the National Statistical Bureau of China, and the macro-data were published by the People's Bank of China (the Central Bank) and the National Statistical Bureau of China. We will briefly introduce the regions where our rural household data were collected; describe in detail the raw data; and finally define the commodity categories and socio-economic variables which are used in our model.

2.2 Data Background

Our household data are from rural households in Sichuan province of the People's Republic of China for the years of 1985-1987. Sichuan province is located at 26 01'-34 21'North Latitude and 97 60'-110 12'East Longitude on the upper reaches of the Yangtze River in the southwest China. It covers an area of 567,000 square kilometers. With its population of more than one hundred million people, Sichuan is the most populous province among the thirty in the country. There are fifteen nationalities inhabited in Sichuan such as Han, Yi, Tibetan, and others. The capital is Chengdu.

The topography of Sichuan is highly diverse. In the eastern part of the province is the Sichuan Basin, the most fertile one of the four big basins in China. It is hemmed in by high mountains with rolling hilly land sprawling across the Chengdu Plain. The rainfall in this region is plentiful, and the frostfree period is long. The Yangtze River and its tributaries crisscross the basin, providing favorable conditions for irrigation, navigation and hydropower generation. The western part of the province abuts on the eastern edge of the Qinghai-Tibet Plateau and covers with 7.37 million hectare with virgin forests and 10.7 million hectare with grassland, making Sichuan to be one of the country's three forest centers and one of the

China's five major livestock breeding bases. The total area of the mountainous regions comprises 49.8 percent of the province, the plateaus 29.02 percent, the hilly land and plain 21.18 percent.

There is much variation in the climate of the province. The east Sichuan Basin has a sub-tropical climate with wet southeast monsoons and characterized by warm winters, early springs, hot and prolonged summers. Its average frost-free period lasting more than three hundred days a year. The plateau in the northwest has an intensely cold continental climate with wintery cold all year around. The highland in the southwest also has a sub-tropical climate with southwest monsoon alternates of rainy and dry seasons, but no severe summer and winter. The average annual precipitation of the province is about 1,000 mm.

Traditionally, Sichuan province has been one of China's most important agricultural regions. Rice, wheat, corn and sweet potato are its main staple-food products. Among the thirty provinces in China, Sichuan ranks first in the productions of grain, silk, tung oil, oranges, tangerines, and pigs; it also leads the country in the productions of rapeseeds, tea, ramie, sugarcane, tobacco, honey and medicinal herbs.

As one of two pioneering provinces, Sichuan led the rural economic reform started in 1978: the People's Commune system was disbanded and agricultural collective productions were abandoned. All of the farming land, and the majority of grassland and collective-owned woods and water areas were contracted to rural households for a period of more than fifteen years; big animals and production equipments were sold to households; and properties of non-agricultural production activities were partly distributed to households. Because these practices highly stimulated peasants' production incentive, agricultural products have greatly increased and the rural economy has thrived since then. Statistical data listed in Table 3-5 indicate the economic role of Sichuan province in China.

Table 3: Population, Area, Cities and Counties (1987) of China and Sichuan Province, Respectively.

Items	China	Sichuan	Percent
Population (1,000) (end of 1985)	1,045,320	101,880	9.75
Area (1,000 km)	9,600	570	5.94
Cities	378	19	5.03
Counties	1,986	174	8.76

Sources: (1) "A statistical Survey of China, 1988", the National Bureau of Statistics, Statistical Press, Beijing, 1988.

(2) "the Year Book of China, 1985", the National Bureau of Statistics, Beijing, 1985.

Table 4: Quantities and Values of Agricultural Products (1987) of China and Sichuan Province, Respectively.

Items	China	Sichuan	Percent
Grain (10,000 ton)	40,473.30	3,921.30	9.69
Cotton	424.50	10.20	0.24
Oil-bearing crops	1,527.80	161.50	10.60
Sugar-bearing crops	5,550.40	241.50	4.40
Red meats(pork, beef, and mutton)	1,986.00	336.00	16.90
Dairy Products	330.10	24.30	7.36
Value of Agricultural products(billion RMB)	467.57	38.894	8.32

Sources: "A Statistical Survey of China, 1988", the National Bureau of Statistics, Statistical Press, Beijing, 1988.

Table 5: Quantities and Value of Industrial Products (1987) of China and Sichuan Province, Respectively.

Items	China	Sichuan	Percent
Steel(10,000ton)	5,601.70	428.30	7.65
Iron	5,432.40	373.80	6.88
Coal	92,808.30	6,132.50	6.60
Petroleum	13,404.10	11.70	0.09
Electricity (billion kw/hr)	497.27	26.29	5.29
Concrete	18,128.30	1,243.90	6.86
Chemical fertilizers	1,703.30	154.40	9.06
Chemical pesticides	26.00	0.80	3.08
Cotton clothes (billion meter)	16.71	0.81	4.85
Chemical fabrics	115.70	2.40	2.07
Papers	1,008.20	70.20	6.96
Sugar	510.80	16.10	3.15
Industrial Products' Value (billion RMB)	13,806.40	725.00	5.25

Sources: "A Statistical Survey of China, 1988" National Bureau of Statistics, Statistical Press, Beijing, 1988.

Our rural household data came from three agriculture-dominated counties: Beichuan, Mianzhu and Wulon in the Sichuan Province during the period of 1985-87. They are geographically different areas, representing different levels of economic development. The survey was conducted by the Statistical Bureau of China. In each county eighty sampled rural households were surveyed quarterly by the Statistics Bueau. These sampled households have book-kept their all kinds of income sources and expenditure items. In total there are two hundred and forty rural households' information available over three consecutive years.

1) Beichuan County:

This county covers 2,952 square kilometers. It is divided into thirty-four townships with the population of 144,000.

Located on northwest edge of Sichuan Basin, Beichuan county is dominated by rugged area. There are four major rivers providing the region's irrigation and hydropower resources. The climate is quite various: generally it is warmer along the riverside than in the mountain region. Annual precipitation is 1377.2mm.

Beichuan is rich in forest resources and is the habitat of many rare animals including giant pandas. The main agricultural products include corn, wheat, potatoes, rice, beans and rapeseeds; and animal husbandry is also important in this area.

Mineral deposits consist of coal, iron and titanium. There are some small scale industries like mineral exploitation, hydro-power generation, concrete, food processing, tea processing, and timber mill. The high way system in the county facilitates transportation by connecting externally Beichuan to major cities and internally townships to one another. As far as per capita income is concerned, Beichuan is ranked the intermediate level in the province.

2) Mianzhu County:

The area is 1,233 square kilometers, and the population is 462,600. Mianzhu is divided into twenty-five townships. It lays in the Sichuan Basin. The plain dominates its southeast part; and the hilly area is in the northwest part. Two rivers flow through the county and provide reliable irrigation networks. The climate is mild, and annual rainfall is 1103mm.

The main agricultural products are rice, wheat, corn, sweet potatoes, rapeseeds, peanuts, tobacco and sugarcane. This county also supplies large quantity of pigs.

Many state-owned and province-owned large and medium size factories are located in the county, among which are machinery, fertilizer, and mineral exploitations. Small scale industries are also booming, such as food processing, paper-making, concrete, and printing. Since the Baoji-Chengdu railway passes through Mianzhu and the highway system is well developed, a convenient transportation is the county's big advantage. The per capita income is one of the highest in the province.

3) Wulon county:

It is located in the southeast side of the province, and the population is 350,000 with an area of 3,008 square kilometers. There are fifty-one townships. Wulon county lays on the fringe of Sichuan Basin, which is dominated by rugged region. There are some small size plains and hilly areas scattered within mountains. The Wu River, one of major contributories of Yangtze River, runs through the county. Along with about fifty small rivers, it provides the convenience of navigation, irrigation and electric generation.

The climate in this area is also quite various: in the mountain regions, there is a long period of snow covered winter and a very short summer. While the riverside areas are characterized by warm winters and prolonged summers. Annual raindrop is about 900-1,200mm.

The county is rich in natural resources like wood, coal, iron and aluminum. There are a few big state-owned and province-owned factories engaging in coal and iron exploitations, hydro-power generation, and others. The small scale industries in coal exploitation, concrete, and machinery repairs have taken shape.

The major agricultural products are corn, sweet potatoes, potatoes, rice, wheat, paulownia oil, tea, tangerines and oranges. Livestock breeding also constitutes an important part of rural production activities. This county's per capita income is placed in the low level in the province.

2.3 Expenditures, Money Assets and Prices

This portion of data contains rural households' annual expenditures on goods and money assets held, two major components of households annual income. Expenditures can be divided into four categories:

I) Staple Food

II) Non-staple Food

III) Clothing & Footwares

IV) Non-fixed Industrial Agri-input

These four categories are based upon the fact that rural households will retain part of their home-produced agricultural products and buy marketable consumer goods for the consumption, while also purchase industrial producer goods for agricultural production. "Staple food" is the aggregate of retained home-made goods; "non-staple food" and "clothing & footware" are aggregates of major industrial consumption goods; and "non-fixed industrial agri-input" is the aggregate of purchased industrial producer goods. Since the expenditure and quantity vectors of quite detailed consumption items are available for each household, we can then derive the price vectors of corresponding detailed commodities. With the expenditure, quantity and price vectors on all detailed commodities, we can aggregate price vectors for these four categories through the weighted average method. The detailed commodity items aggregated in the categories are listed below:

I) Staple Food

1. Rice
2. Wheat
3. Corn
4. Others

II) Non-staple Food

1. Vegetables
2. Bean products
3. Meats
4. Sugar
5. Cookies & Candies
6. Cigarettes
7. Wine & Liquors
8. Tea

9. Fruits

III) Clothing & Footwares

1. Cotton clothes
2. Composed clothes
3. Woolen clothes
4. Silk
5. Leather shoes
6. Rubber shoes & Sport shoes
7. Blankets
8. Others

IV) Non-fixed Agricultural Input

1. Chemical fertilizer
2. Pesticides
3. Gas & Coal
4. Others

In category III, only commodity items (1), (2), and (6) are included, because these items consist of more than 85 percent of the households' consumption on this category. For the same reason only items (1) and (2) are included into category IV: they make up more than 95 percent purchases on "non-fixed industrial agri-input". Table 6 shows mean percentages of included items in category III and IV for each county in 1985-1987.

Besides expenditures on both market and non-market goods, rural households hold "money assets" at the end of the year that mainly consists of cash holdings and net demand deposits. Because of relatively low income level, most rural households do not have time deposits. Precisely, cash holdings plus net demand deposits is the narrowly defined money or M1. This category is equivalent to rural

Table 6: Percentages of the Included Items in "Clothes" and "Agri-input".

County/Year	Percent of included items in "clothes"	Percent of included items in "agri-input"
Beichuan 1985	85.49	98.00
Beichuan 1986	81.03	97.50
Beichuan 1987	81.04	95.61
Mianzhu 1985	90.92	97.72
Mianzhu 1986	87.00	97.88
Mianzhu 1987	86.74	98.36
Wulon 1985	85.92	99.10
Wulon 1986	89.01	98.31
Wulon 1987	88.44	94.77

Note: Caculated from the "Rural Household Survey" 1985-1987, unpublished, Sichuan Provincial Bureau of tatistics.

households demand for money. It is the stock of money and serves as the means of wealth transaction from one time period to the next; it is also the principal financial assets held by the rural households.[1]

The "price" or cost of cash holdings consists of both opportunity cost and inflation cost, or internal and external costs. It can be expressed as $rc = (1 + R/(1+R)) + \pi$. Where rc stands the "price" of cash holdings, R is the interest rate paid to the alternative financial assets, and $R/(1+R)$ states the so-called user's cost suggested by Barnett;[2] π is the annual inflation rates. The first part of rc is the opportunity cost of cash holdings, and second part is the inflation cost. Thus, rc reflects the actual cost of holding money balances. By the same token, the "price" of net demand deposits also consists of both opportunity cost and inflation cost. It can be stated as: $rd = (1 + (R-\tau)/(1+R)) + \pi$, where τ is the interest rate paid to demand deposits, and $(R-\tau)/(1+R)$ states the user's cost for demand deposit, and rd is the total costs of having net demand deposit.

Other than above five goods and money categories, rural households also invest in consumer durable goods, production

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[1] Niehans, J. "The theory of money", the Johns Hopkins University Press, 1980, pp16-17.

[2] Barnett, W. "Consumer demand and labor supply", North-Holland Publishing Co. 1981, pp196-197.

equipment and construction of new houses. The detailed items of those investments which are available in our original data are listed as follows:

1) Durable goods
    1. Bicycles
    2. Sewing machines
    3. Watches & Clock sets
    4. Washing machines
    5. Furniture
    6. Television sets
    7. Radios & Cassette recorders
2) Capital Production Equipments
    1. Tractors
    2. Water pumps
    3. Draft & Big animals
    4. Wood & Steel
    5. Carts
    6. Others
3) New Houses

All the above investment items are characterized by the durability and not determined by current income level alone. Hence we will not consider them as current consumptions. Instead, we will regard the investment in durables and houses as exogenous factor that may influence rural

Table 7.1: Number of Households with New-built Houses, and Equipments Purchased In the period of 1985-1987.

Beichuan County:

Items	1985	1986	1987	Total	Percent
Bicycles	2	2	3	7	2.9
Sewing machines	3	1	1	5	2.1
Watches/clocks	11	5	7	23	9.6
Washing machines	0	2	1	3	1.3
Furniture	2	1	0	3	1.3
Televisions	2	2	12	14	6.7
Radio/cassettes	2	4	5	11	4.6
Tractors	0	0	0	0	0.0
Carts	0	0	0	0	0.0
Water pumps	0	0	0	0	0.0
Draft animals	0	1	4	5	2.1
Steel/wood	3	3	3	3	3.8
New houses	7	3	3	13	5.4

Note: Caculated from the "Rural Household Survey" 1985-1987, unpublished, Sichuan Provincial Bureau of Statistics.

Table 7.2: Number of Households with New-built Houses, and Equipments Purchased In the period of 1985-1987.

Mianzhu County:

Items	1985	1986	1987	Total	Percent
Bicycles	13	12	6	31	12.9
Sewing machines	0	0	1	1	0.4
Watches/clocks	10	12	7	29	12.1
Washing machines	1	1	0	2	0.8
Furniture	5	5	7	17	7.1
Televisions	6	3	6	15	6.3
Radios/cassettes	0	2	2	4	1.7
Tractors	2	0	0	2	0.8
Carts	0	1	1	2	0.8
Water pumps	0	0	1	1	0.4
Draft animals	2	8	5	13	6.3
Steel/wood	11	14	5	30	12.5
New houses	15	14	8	37	15.4

Note: Caculated from the "Rural Household Survey" 1985-1987, unpublished, Sichuan Provincial Bureau of Statistics.

Table 7.3: Number of Households with New-built Houses, and Equipments Purchased In the period of 1985-1987.

Wulon:

Items	1985	1986	1987	Total	percent
Bicycles	0	0	0	0	0.0
Sewing machines	1	2	3	6	2.5
Watches/clocks	14	13	9	36	15.0
Washing machines	0	0	0	0	0.0
Furniture	0	0	5	5	2.1
Televisions	0	1	2	3	1.3
Radio/cassettes	2	1	6	9	3.8
Tractors	0	0	0	0	0.0
Carts	0	0	0	0	0.0
Water pumps	0	0	0	0	0.0
Draft animals	8	5	8	21	8.8
Steel/wood	8	5	10	23	9.6
New houses	2	5	3	10	4.2

Note: Caculated from the "Rural household Survey" 1985-1987, unpublished, Sichuan Provincial Bureau of Statistics.

households' current expenditure pattern.

Tables 7.1-7.3 indicate the number of households with new-built houses, purchased durable and capital equipments, and the percentage in the 240 sample households in each county during the period of 1985-1987.

Since the investment on house construction and durable goods does not occur in every households nor in every year, it could be represented by a dummy variable and included in our estimation model. If household investment on new house construction or durables of either consumer or producer goods occur, the dummy variable is 1, otherwise it is 0. We will label this varible as "investment indicator". Through this practice we could observe how the fixed investment in houses and durables may affect the current expenditure pattern of rural households.

2.4 Socio-Economic Variables

There were many profound changes in China's rural economy over the last ten years. The biggest changes were to disband collective production system and to withdraw strict state planning on agricultural production activities. Therefore, rural households again became both productive and consumptive units. Since then they have experienced a change from the state of self-sufficiency to commercialized economy, and the total sales and purchases on market have significantly increased.

Of all agricultural and non-agricultural products the percentage of agricultural products sold commercially increased from 42.5 percent in 1978 to 58.0 percent in 1986; and that of non-agricultural products sold commercially rose from 53.7 percent to 68.1 percent. Both percentages increased by 15.5 percent and 14.4 percent within ten years, respectively. Table 8 below reveals these changes.

Such a change has great impacts upon the expenditure pattern of rural households. Along with the increase in the sales of rural products in the markets, the consumer goods purchased on market or, in another words, the commercial consumption of goods has also risen. Of the whole country's purchased commodities, the peasants' purchases of goods increased from 47.9 percent in 1978 to 65.0 percent in 1985; that is, the percentage had a rise by 17.1 percent within seven years. Table 9 states this fact.

The level of market involvement or commercialization of rural households can be described in many ways. Along with increases in rural households' sales and purchases, their incomestructure has also changed. In 1985 the ratio of rural households' net money income to total net income reached 63.1 percent, rising by 12 percent since 1980;[3] the ratio of cash holdings plus deposits to total net income per

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[3] Lu, Mai and Dai, Xiaojing, "An analysis of the rural households' economic behavior", the Journal of Economic Research, July, 1987, Beijing, pp12.

Table 8: 1978-86 Commercial Ratios of Agricultural Products and Non-agricultural Products in China.

Years	Percent of Commercial Agri-output in Total Agri-output	Percent of Commercial Nonagri-output in Total Nonagri-output
1978	45.2	53.7
1980	49.6	56.9
1981	49.9	57.1
1982	49.8	57.0
1983	52.0	59.2
1984	52.7	61.0
1985	53.9	63.9
1986	58.0	68.1

Sources: "The Statistical Year Book Of Chinese Rural Economy", 1985 and 1987; The National Bureau of Statistics, The Statistical Press, Beijing.

Table 9: Percentage of Peasants' Commercial Consumption of the All Consumption in China during 1978-85.

Year	Percent of Peasants' Commercial Consumption in the Total Amount
1978	47.9
1979	50.5
1980	55.8
1981	55.9
1982	56.4
1983	57.3
1984	60.3
1985	65.0

Sources: "the Collection of National Income Statistics: 1949-1985", the National Bureau of Statistics, Statistical Press, Beijing, 1986.

Table 10: Ratio of Cash and Deposits to Net Income Per Household in China during 1978-1986.

Years	Percent
1978	13.7
1980	13.9
1981	16.0
1982	18.4
1983	19.4
1984	26.0
1985	28.3
1986	35.2

Sources: "the Statistical Year Book of Chinese Rural Economy", 1985 and 1987, Statistical Press, Beijing.

household rose from 13.7 percent in 1978 to 35.2 percent in 1986, increasing by 21.5 percent; and the ratio of non-agricultural income to total income rose from 31.4 percent to 46.9 percent, increasing by 15.5 percent. Table 10 and Table 11 show those ratios.

The ratios of households' commercialization and income diversification reflect the level of rural development which may affect the households' expenditure pattern. Thus we will choose two indices to describe change in rural

Table 11: 1978-1986 Ratio of Non-agricultural Income to Total Income in China.

Year	Percent
1978	31.4
1980	31.1
1983	33.3
1984	36.8
1986	46.9

Sources: "the Statistical Year Book of Chinese Rural Economy", 1985 and 1987, Statistical Press, Beijing.

households' income structure and the development level of rural households.

(1) Monetized Index:

This is the ratio of a rural household's money income to its total income, also called commercialized index, which is based upon these facts: it is available in our data sets, and it reveals the level of household's market involvement or eonomic commercialization. Total income refers to the value of products and services provided by a rural household annually, while money income are the inflow of cash balances through selling agricultural and non-agricultural products or services in markets, the money borrowed, and interest payment earned by lending and deposits.

Generally, this ratio lies between zero and one. The higher the index, the higher the commercialized degree of a rural household. In some cases, however, a household's annual money income may surpass its total income so that the index is bigger that one. This abnormal ratio may be due to a mass money borrowing for new house construction. Fortunately, this situation just occurs once in a while.

(2) Diversified Index:

This is the ratio of non-agricultural income to total income indicating how a rural household diversifies its sources of income, or in another words, its production activities. The sources of households' total income can be divided into two parts: agricultural income and non-agricultural income. The sources of both parts are listed below:

1) Sources of Agricultural Income:
   1. Farming
   2. Animal husbandry
   3. Forestry
   4. Fishery
   5. Collecting & hunting
2) Sources of Non-agricultural Income:
   1. Handcrafts
   2. Rural industries
   3. Construction
   4. Transportation
   5. Exploitation of natural resources
   6. Vending & catering services
   7. Other services
   8. Employment in small scale industries

Since rural households have more or less engaged in some agricultural activities, this ratio also lies between zero and one, just like the commercialized index. The agricultural activities are not the only way to absorb rural laborers nor the sole source to provide household income;

and there is a tendency of the growth of rural household's non-agricultural activities.

Many less-developed countries' experiences have revealed this fact.[4] In China, about 45,772,000 rural laborers have switched from agricultural production activities to non-agricultural production activities during the period of 1979-1985; among which 6,000,000 rural laborers have gone to cities to look for works; and one fifth rural laborers left off agricultural activities. In 1985 there exist twelve principal kinds of rural non-agricultural production activities, and non-season workers in these productions accounts for 19 percent of total rural employment.[5] The switch of agricultural to non-agricultural production activities can be directly reflected in the rural household's income structure. Hence the diversified index may help us to explain structural changes and also the rural household expenditure pattern.

(3) Demographic Variables

The demographic variables are one of very important

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[4] Liedholm, C. and Mead, D., "Small scale industries in developing countries: empirical evidence and policy implications", MSU International Development Paper No.9, 1987; pp14-15, 18-20, 41-42.

[5] The report of the Institute of Development, "Peasants, market and the institutional innovation __ the reform in the depth facing the rural development after eight years of fixing household output quatos", the Journal of Economic Research, Jan. 1987, Beijing.

factors to affect rural household expenditure pattern. The size and age composition of a household, the combination of its laborers, and even educational level may have some impacts on the household's expenditure. For simplicity we will choose two groups of demographic variables for our model:

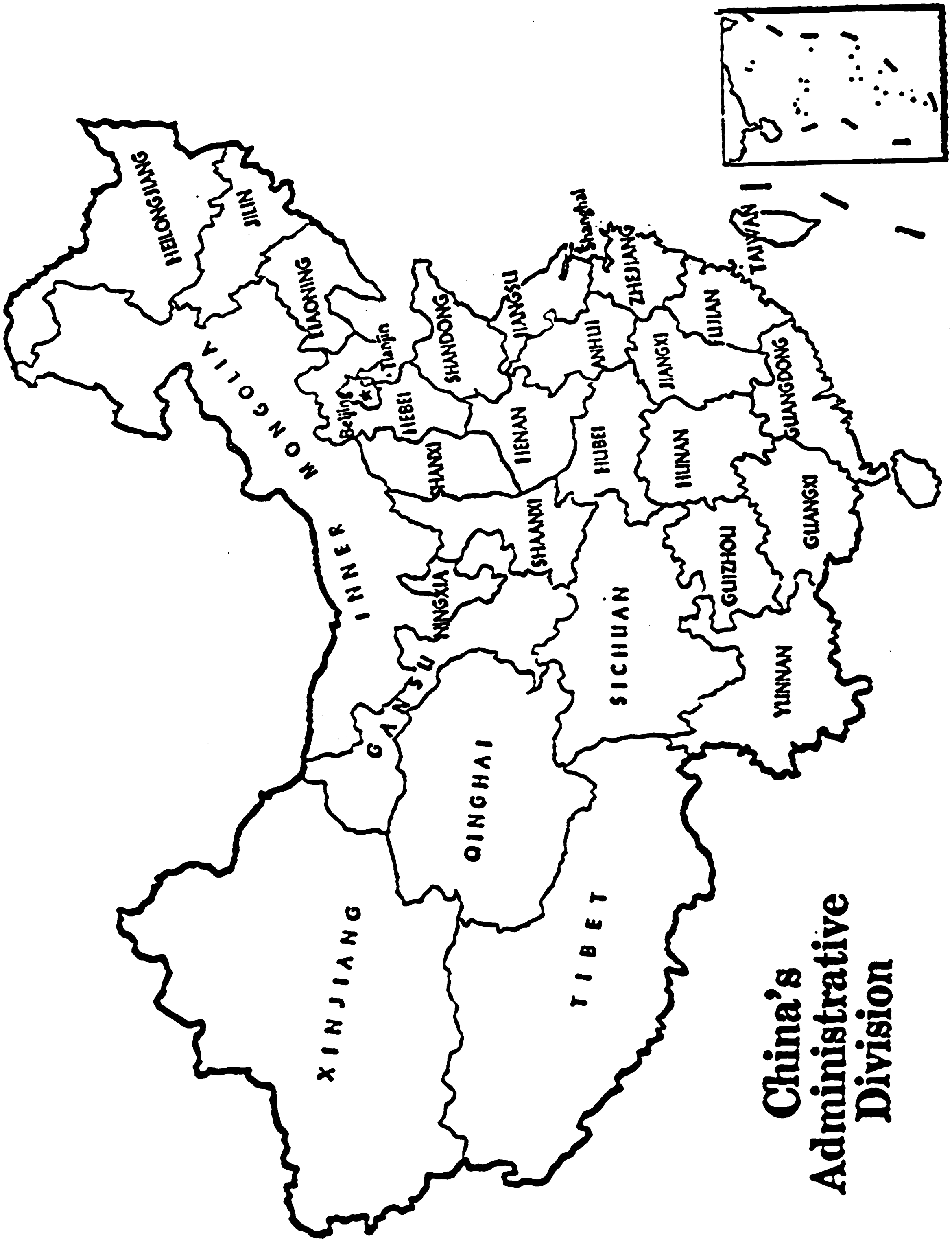
1) family size: it is the number of total family members, including children, elders and adults who are permanent residents of a household.

2) laborers: this is the number of total laborers available in a household which include male people aged between sixteen to sixty years old, female people between sixteen to fifty-five years old, and those who are capable to engage in manual work.

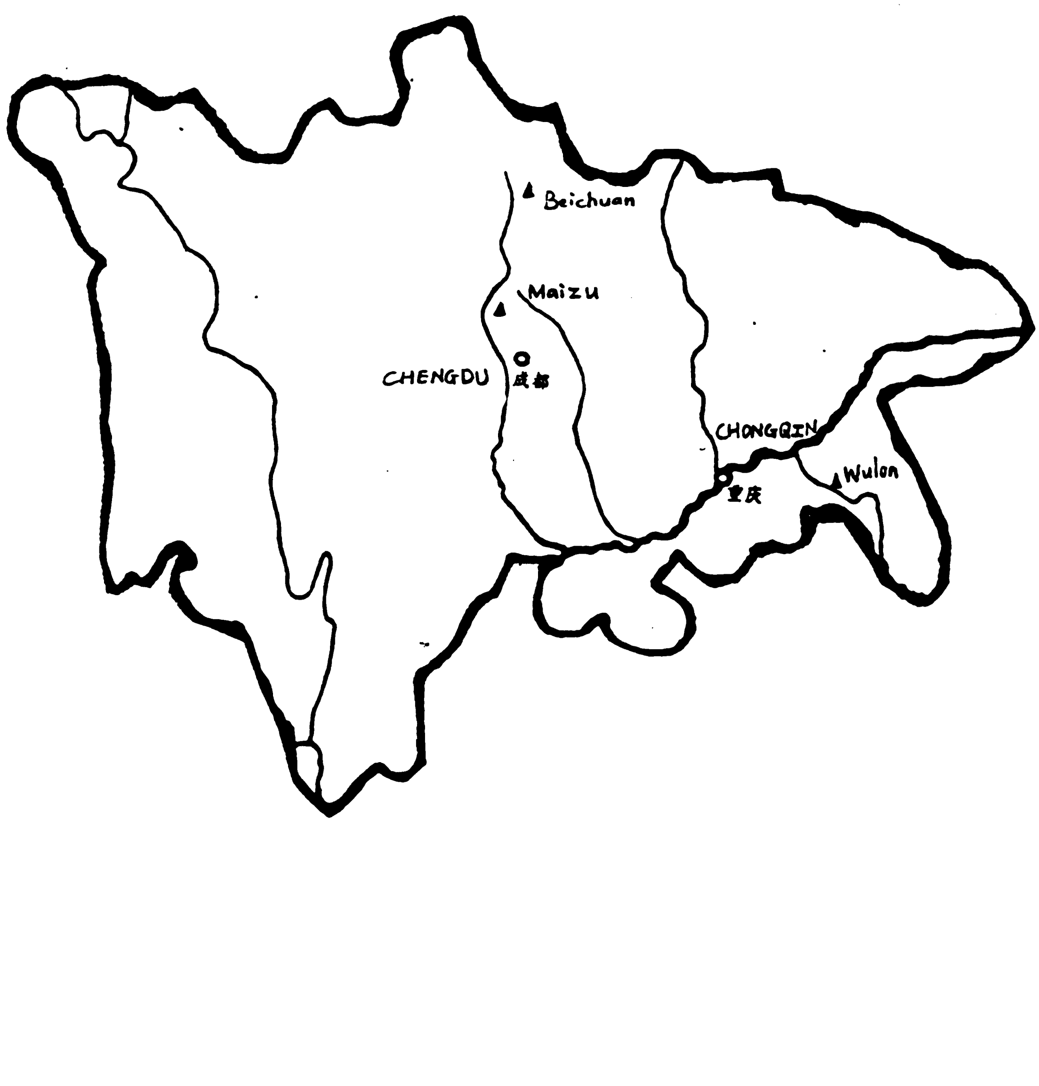
2.5 Conclusion

In this chapter we have introduced the data backgound and described the data we will use. Besides the category of money demand, we have also aggregated demands for detailed commodities into four categories as staple food, non-staple food, industrial consumer goods and industrial producer goods. Furthermore, we have defined five socio-economic variables: commercialized index, diversified index, investment indicator, family size and labor size. These variables characterize the features of rural households and the level of economic development, which may have significant impacts upon the general demand structure. In the next two chapters we will construct the theoretical general demand framework of rural households for goods and money, and then investigate the specifications of demand systems and discuss the methods of aggregation.

Map 1: Map of China



Map2: Map of Sichuan Province



CHAPTER THREE

THE NEW HOME ECONOMICS APPLIED TO RURAL HOUSEHOLD WITH INSTITUTIONAL VARIABLES AND MONETARY ASSETS

3.1 Introduction

The traditional demand theory, originated by Slutsky and completed by Allen and Hicks, specifies consumer's behavior by introducing the concept of the utility function. The utility function is the measurement of satisfaction which a consumer derives as he consumes a particular bundle of goods and services. Implicitly, goods and services are consumed through a time dimension so that a flow of consumption bundles has to be evaluated. A demand system for goods and services can be obtained from a wel-behaved utility function, given the expenditure constraint faced by a specific consumer. In other words, the consumer can maximize his utility function subject to the budget constraint:

$$\max U = U\ (\ q\ ) \qquad (3.1)$$

$$\text{st. } y = p.q$$

where U denotes direct utility function; y, p and q denote vectors of consumer's total expenditure, commodities' prices and quantities, respectively.

The demand system, thereafter, is expressed as:

$$q = q\ (\ p\ ,\ y\ ) \tag{3.2}$$

The consumer's demand expression for commodities is of function of price and income vectors.

The utility function (3.1) is theoretically assumed to be strictly increasing in q, twice continuously differentiable, and strictly quasi-concave. These assumptions ensure a behavioral consistent choice the consumer makes. Then the demand function $q = q(\ p,\ y\ )$ is characterized as homogeneous of degree zero in price and income vectors, symmetricity of slutsky matrix, and negative semidifinity.

Besides the conventional direct optimizing utility framework, the equivalent demand system can be acquired by an alternative and analytically convenient approach. That is, the formulation of a consumer maximizing behavior can be constructed by the duality theory initiated by Houthakker (1952), Hotelling (1952), Shepherd (1953), and then Hicks (1958). The alternative approach can be embodied in the expression:

$$V(p, y) = \max U(q) \quad (3.3)$$
$$\text{st. } pq = y$$

where V(p , y) is defined as the indirect utility function. If substituting demand function (3.2) into the direct utility function (3.1), we can obtain an equivalent expression:

$$U = U(q(p, y)) = V(p, y) \quad (3.3)'$$

The indirect utility function takes price and income vectors as arguments, and thus the demand system can be derived simply through differentiating the indirect utility function V(p, y) with respect to both price and income vectors and then applying Roy's identity:

$$q_i(p_i, y) = -[dV(p, y)/dp_i]/[dV(p, y)/dy]$$
$$i = 1, 2, \ldots n \quad (3.4)$$

Also, a direct utility function U(q) can be obtained from the indirect utility function, as to minimize the indirect utility V(p, y) with respect to prices and income and subject to the budget constraint. Thus, the relationship between the indirect utility function and the direct utility function is established via the concept of duality (Houthakker 1952). The indirect utility function is then characterized as continuously decreasing in prices, increasing in income, strictly quasi-convex in P, and homogeneous of degree zero.

However, the analytical powers of traditional theory are effectively circumscribed by the presence of some unidentified exogenous variables, for example, the consumer's preferences structure. Assigning sources of preferences over commodities contained into the utility function, the conventional demand model fails to explore the underlying structure. If some socio-economic factors such as demographic variables and parameters of income structure are considered within the demand system, the traditional analysis may attribute consumer's preferences to be functions of these variables. Unfortunately, this naive approach only partially captures the impacts of institutional factors on the demand system. If a rural household as both consumptive and productive unit is considered, the traditional theory becomes quite intricate to demonstrate the demand system. It has to associate the rural household's external production function into the framework, as the agricutural model constructed by Singh, I., Squire, L. and Strauss J. (1985).[1] Furthermore, the conventional theory tends to make such an abstract assumption of a money-free society. In any exchange economy, however, monetary assets always perform a very important role to facilitate economic activities, and it is quite necessary to incorporate money assets into the general demand structure.

In this chapter we will present the concept of the new home economics originally proposed by Becker, G. (1965) and Lancaster K. (1966), and then we will discuss its extension and implication on rural households incorporating socio-economic factors and money assets. Specifically, in the section 3.2, we will show how this new approach modifies the conventional demand theory through the introduction of internal household technology, then we will apply this concept to a rural household model and review some practical methods of incorporating socio-economic variables into the household demand system. In the section 3.3 we will discuss the new demand theory with the association of monetary assets, which completes the rural households' general demand framework.

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[1] Singh, Inderjit, Squire, Lyn and Strauss, John, "Agricutural houeshold models", the Johns Hopkins University Press, Baltimore, 1986, pp71-93.

3.2 The New Approach: Rural Households With Institutional Variables

The traditional theory is attacked by many writers such as Becker (1965), Lancaster (1966), Simon (1966), Shubik (1970), Furubotn (1974) and others. The new home economics approach, based upon the unit of household instead of unit of individual, is proposed to explore the structure of the transformation between commodities and elementary consumption characteristics, and it becomes the well-received method of modeling the structure of household preferences and internal household technology. As a consequence, the implication of the internal household structure has provided a sophisticated formulation for rural household model, revealing profound effects of institutional variables on the household demand system.

3.21 New approach of demand system

The new approach to consumer theory was proposed by Gary Becker (1965), Kelvin Lancaster (1966) and among others. This proposition views consumption as an activity, just as Lancaster wrote (1966):

> "...in which goods, singly or in combination, are inputs and in which the output in a collection of characteristics. Utility or preference orderings are assumed to rank collections of goods indirectly through the

characteristics they possess."[2]

The household is taken to be the decision unit in this new approach of the "home economics", hence, the household utility function may be defined in characteristics space:

$$U = U (x) \tag{3.5}$$

where the vector X denotes consumption characteristics which constitutes the direct ingredients of household preferences. The household, however, cannot directly purchase characteristics; instead it only confronts purchasable economic goods and services on the market. Via the household production process of combining market purchasing goods and services, the household can generate consumption characteristics. The market purchasing goods and services, or commodities, are not arguments in the household preference orderings, but they just act as inputs of producing consumption characteristics. Therefore, the implicit household production function is the key proposition of the new approach, which transforms characteristics vector (x) into a consumption bundle involving market purchasable commodities (q).

The internal household technology or production

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[2] Lancaster, Kelvin "A new approach to consumer theory", Journal of Political Economy, vol.74, April, 1966; pp133.

function is expressed as:

$$H (x , q) = 0 \tag{3.6}$$

where q denotes market purchasable goods and services. Since the combination of both the constraints of internal household production technology and total expenditure imposes limitations for household's consumption opportunities, Pollak and Wachter (1975) have shown that a cost function exists, such that c(p , x) is the least cost of commodities which are capable of producing households' consumption characteristics, and also equal to total expenditure:[3]

$$c (x , p) = \min p q \tag{3.7}$$

where p is the price vector of market goods q, pq is equal to total expenditure. The implicit price or shadow price of characteristics can be defined as follow:

$$h (p , x) = dc (p , x)/ dx \tag{3.8}$$

The vector of shadow price h(p , x) depends on both price

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[3] Pollak, R. and Wachter, M., "The relevance of the household production function and its implications for the allocation of time", Journal of Political Economy, vol.83, 1975; pp257-61.

vector of market goods and the level of "characteristics". If the shadow price becomes independent of x, so as to h* = h (p , x) = h (p) to be exogenous, we can access to the properties of the conventional demand theory and have no restriction of applying its results.

Pollak and Wachter have then defined and proved two necessary conditions for the employment of traditional theory's properties: 1) household's technology exhibits a constant return to scale, that is, c (p , x) = x c (p); and 2) there is no joint production among characteristics, i.e, the bundle of commodities (q) acts exclusively as the input for producing characteristics space (x):

$$c (p , x) = \Sigma_i c_i (p , x) \tag{3.9}$$

so that the cost function becomes:

$$c (p , x) = \Sigma_i c_i (p , 1) x \tag{3.10}$$

and shadow price is:

$$h_i = c_i (p , 1) = h_i (p) \tag{3.11}$$

Thus, the shadow price vector h's only depends on the price vector of commdities p and the internal technology H(x, q) = 0, and it becomes exogenous.

Pollak and Wachter believe that the joint production among characteristics breaks the link between the existing neoclassical demand theory and the implicit household production function, so that it confounds the household tastes and technology within the shadow prices. However, Barnett (1981) does not agree with this point. He argues that as the demand structure is overidentified, the joint production just increases the number of overidentifying restrictions. Furthermore, the joint production, in general cases, tends to assist the identification of demand system without introducing any non-neoclassical complication. Thus, Barnett concluded that there exists no problem of modeling a household structure while the joint production appears.[4]

Being exogenous variables, the shadow prices will reflect the changes in the commodities' prices and household's technology, but they are independent of the household's tastes. Hence, the household decision problem is:

$$\max U(x) \tag{3.12}$$
$$\text{st. } (\min pq \ \text{ st. } H(x, q) = 0) = y$$
$$= \max U(x)$$
$$\text{st. } h(p)\,x = y$$

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[4] Barnett, W. "Consumer demand and labor supply", North-Holland Publishing Co., 1981; pp243.

This is the expression of obtaining the optimal bundle of the characteristics x which generates utility for household. By the duality theory, equation (3.12) can be rewritten as follows:

$$V(h (p), U) \\ = \max U(x) \quad st. \; h (p) x = y \tag{3.13}$$

where the expression V(h (p) , U) is the indirect utility function. Correspondingly, the cost function can be obtained by inverting indirect utility function:

$$C (h (p) , U) \\ = \min x h (p) \; st. \; U (x) = U \tag{3.14}$$

Thus the solution is:

$$x = f (h (p) , y) = f (p , y) \tag{3.15}$$

This is the household demand function for characteristics x. If the above two assumptions hold, the vector x will exhibit all of the properties of the traditional theory. Thus the household maximizing decision process for characteristics can be translated into the optimal process for purchasable commodity bundle:

$$\max u (q) \tag{3.16}$$
$$= (\max (x) \text{ st. } h (q) x = y) \text{ st. } pq = y$$

Then the solution is the market goods demand function:

$$q = g (p , y) \tag{3.17}$$

The new approach of home economics shows that under both budget and technological constraints, the household optimizing decision for the bundle of characteristics is equivalent to the maximization of the inputs of characteristics, or the bundle of tangible market goods. That is, an original utility function is translated into a modified utility function which obeys all properties of the traditional theory. Thereafter, the optimal space of the unobservable characteristics is replaced by the maximum space of observable market goods.

The transformation has also distinguished both household tastes and technology, while the traditional demand theory just confounds both of them. Consequently, the traditional analysis always tends to attribute changes in household production function to changes in tastes.[5]

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[5] Pollak, Robert and Wachter, Michael "The relevence of the household production function and its implications for the allocation of time", Journal of Political Economy, vol.83, 1975; pp260.

The new approach of a household structural form, if obeying to restrictions given, will possess conventional theory's properties, and explicitly tell the difference of household tastes and technology. The causality of household demand system can then be imputed by the exogenous variables of household's total income and market goods price vector, and be also explainable with respect to household tastes change.

The preferences over the consumptive characteristics is usually assumed to be constant across households and over time. This is a not too strict assumption for rational decision makers, since the preferences are largely cultivated by the nature of consumptions as well as cultural background. Therefore, the differences across households are embodied in household's technology which can be a function of household's demographic parameters as household age, number and composition, and other institutional factors as different income structures.

If we assume that socio-economic variables are indexed in the parameter d,[6] the internal household technology will explicitly contain the parameter d, i.e. $H(x, q, d) = 0$; thus the equation (3.16) becomes:

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[6] Lewbel, Arthur "A unified approach to incorporating demographic or other effects into demand systems", Review of Economic Studies, vol.52, 1985; pp3.

$$\max u (q \mid d) = (\max U (x) \text{ st. } h (p, d) x = y$$
$$\text{st. } pq = y \tag{3.16)'}$$

and the equation (3.17) becomes:

$$q = h (p, y, d) \tag{3.17)'}$$

The result satisfies conventional theory's properties. The parameter d, representing random variations across households such as demographic variables or income structures, explicitly exhibits the impact of institutional factors on the household demand system.

3.22 New approach and rural household

When rural households in LDC countries are considered, we will observe at least two features: first, rural households will not only consume market goods and services, but some agricultural output produced by themselves as well. Second, rural households also purchase non-consumer goods as inputs for their agricultural production. The new demand theory characterized by the internal technology can be extended for rural households. We let A and I denote agri-output retained and agri-input purchased by a rural household; then the internal production function for households' consumptive characteristics is expressed as:

$$H (x, q, A, I) = 0 \quad (3.18)$$

We define characteristics' price vector as $h = (h_1, \ldots h_m)$, which is the implicit or shadow price vector implied by rural household internal technology. The shadow price vector for each characteristics is equal to its unit cost function:

$$h_i = C_i (p, p_a, p_i, 1) = h_i (p, p_a, p_i) \quad (3.19)$$

where p_a and p_i are market prices for agricultural product and industrial agri-input. The equations (3.18) and (3.19) show that agricultural output A is taken as an input of producing consumptive characteristics. Also, the rural households' external production function is contained into the internal technology, so that industrial agri-input I performs as another kind of input of producing characteristics.[7] Hence the equation (3.16)' can be

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[7] Pollak, R. and Wachter, M. have showed that labor input is one of the important ingredients in the household internal technology to produce consumptive characteristics, so that the modified utility function is expressed as u(q, T), where q and T are market goods and labor spent in the household internal production function to produce characteristics. "The relevence of the household production function and its implications for the allocation of time", Journal of Political Economy, vol.83, 1975; pp266-69.

extended as follows:

$$\max u (q, A, I \mid d) \qquad (3.16)"$$

$$= (\max U (x) \text{ st. } h (p, p_a, p_i, d) x = y)$$

$$\text{st. } pq + p_aA + p_iI = y$$

The demand equations will be:

$$q = h (p, p_a, p_i, y, d) \qquad (3.17a)"$$

$$A = h^a(p, p_a, p_i, y, d) \qquad (3.17b)"$$

$$I = h^i(p, p_a, p_i, y, d) \qquad (3.17c)"$$

The demand equations (3.17)" satisfy all traditional theory's properties. For simplicity, we let q denote all purchased consumer and non-consumer goods, as well as retained agri-output. Rural households will make their optimal decision based upon an original utility function U(x), which is equivalent to a modified utility function u(q) under the constraints of both budget and technology. These two constraints summarize the features of rural households:

1). The internal technological constraint x = H'(q,d) is of constant returns to scale and non-joint production and contains rural household external production function. This expression states that the households' characteristics is the function of economic goods q and socio-economic parameter d.

2). The budget constraint $y = pq$ is for maximizing economic goods q which households acquire to generate characteristics x. q can be market purchased consumer and non-consumer goods, or rural households retained agri-products.

3.23 Methods of combining socio-economic variables

The new approach of demand theory opens a way theoretically accessible to encompass the household demand system with some important socio-economic variables. Then we will ask how can we specifically incorporate those factors into the demand system. The most convenient method is to make estimated parameters of the demand system either implicit or explicit functions of the socio-economic factors such as demographic variables and to assume demand parameters vary freely across these factors.

Specifically, there are three main procedures incorporating demographic factors: the scaling procedure employed by Barten (1964); the translating procedure used by Pollak and Wales (1978, 1980, 1981); and the Gorman procedure proposed by Gorman (1976). Lewbel (1985) demonstrates that it is theoretically possible to unify these procedures, and he also provides a concise formation to generalize them. We will briefly review these three general techniques. They smoothly incorporate demographic variables or other factors into the household demand system, and they are concise specifications of demand functions with demographic variables.[8]

1). Equivalent scaling technique:

An equivalent scaling method was proposed by Engel (1893), which is a non-commodity specific scaling procedure. Barten (1964) first proposed a demographic scaling method systematically incorporating exogenous variables into the demand system. Barten style is commodity specific equivalent scales.[9] This procedure first introduces n parameters, ($t_1 \ldots t_n$) into the original demand system $Q = g (p , y)$, where $i = 1 \ldots n$; and vectors p, x, and y denote prices, quantities and expenditures, respectively. Furthermore, it assumes that only these parameters are implicit functions of demographic variables, that is, $t_i = T_i(D)$, where D denotes vectors of demographic factors. Thus the modified demand system is designated as :

$$q_i(p_i, y) = tg (p_1 t_1 , p_2 t_2 \ldots p_n t_n , y) \quad (3.20)$$

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[8] The key concept of the Lewbel's model is to define two modified functions, which permit socio-economic factors interact with price and income vectors. Lewbel, Arthur "A unified approach to incorporating demographic or other effects into demand systems", Review of Economic Studies, vol.52, 1985.

[9] Barten, A. P. "Family composition, prices and expenditure patterns", in Econometric Analysis for National Economic Planning: 16th symposium of the Colston Society; ed. by Hart, P. Mills, G. and Whitaker, J. K.; London: Butterworth, 1964.

The modified demand equations satisfy the first order conditions corresponding to the indirect utility function:

$$V (p , y) = V (p_1 t_1 \dots p_n t_n , y) \qquad (3.21)$$

and the direct utility function is:

$$\max U (q_1 /t_1, q_2 /t_2 ,\dots q_n /t_n) \qquad (3.22)$$
$$\text{st. } pq = y$$

where t measures the number of equivalent adults on a scale appropriate to good i as commodity specific scaling functions differ from one good to another. This procedure can be either scaling prices or quantities. Specifically, t can be designated as an exponential form for the ith scaling function:

$$t_i = \Sigma_j \delta_{ij} d_j \qquad (3.23)$$

where d_j is the jth demographyic factor and δ_{ij} denotes its estimated parameter. The value of t must be positive since it scales price or quantity vector. When D is defined as a vector of qualitative factors, the value of t does not need to be positive.[10]

2). Demographic translating technique:

This procedure was employed by Pollak and Wales.[11] It assumes $t_1 \ldots t_n$ as n translation paprameters which depend on demographic variables $t_i = T_i (d)$. These parameters are introduced into the original demand system [$Q = g (p, y)$] :

$$q^i (p , y) = t_i + e^i(p , y - \Sigma_{k=1}^{K} p_k t_k) \qquad (3.24)$$

Then the corresponding indirect utility function is:

$$V (p , y) = V^* (p , y - \Sigma_{k=1}^{K} p_k t_k) \qquad (3.25)$$

and the direct utility function is:

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[10] Barnes, Roberta and Gillingham Robert "Demographic effects in demand analysis: estimation of the quadratic expenditure system using micodata", Review of Economics and Statistics, 1984; pp 593.

[11] Pollak, Robert and Wales, T. J. "Estimation of complete demand systems for household budget data: the linear and quadratic expenditure systems", American Economic Review, vol.68, 1978; pp348-59. "Comparison of the quadratic expenditure system and translog demand systems with alternative specifications of demographic effects", Econometrica, vol.48, April,1980; pp595-612. "Demographic variables in demand analysis", Econometrica, vol.49, Nov. 1981, pp1533-51.

$$\max U(Q) \qquad (3.26)$$
$$\text{st. } p\,Q = y - \Sigma_{k=1}^{K} p_k t_k$$

This demographic translating procedure in practice specifies an addictive linear form for the translation function of the ith demand function:

$$t_i = \Sigma_j \tau_{ij} d_j \qquad (3.27)$$

where d_j is the jth demographic factor and τ_{ij} the unknown parameter to be estimated.

3). Gorman technique:

Gorman introduces two kinds of parameters d_i and m_i, (i = 1... n) into the demand system, where ony d and m depnd on demographic variables.[12] So that the demand function is:

$$q^i(p, y) = t_i + m\, q^{*i}(p_1 m_1 \ldots p_n m_n, y - \Sigma_{k=1}^{K} p_k t_k) \qquad (3.28)$$

Correspondingly, indirect utility function is:

[12] Gorman, W. M. "On a class of preference fields", Metroeconomica, vol. 13, 1961, pp53-56. "Tricks with utility functions" in Essays in Economic Analysis: Proceedings of the 1975 AUTE Conference, Sheffield, ed. by Artis, M. J. and Nobay, A. R., Cambridge: Cambridge University Press, 1976.

$$V(p, y) = V(p_1 m_1, \ldots p_n m_n, y - \Sigma_{k=1}^{K} p_k t_k) \tag{3.29}$$

and direct utility function is:

$$\max U(q_1 / m_1, q_2 / m_2 \ldots q_n / m_n) \tag{3.30}$$
$$\text{st.} \quad p\, q = y - \Sigma_{k=1}^{K} t_k p_k$$

The Gorman's technique is obtained by translating and then scaling specification, so that it is regarded as the combination of the above two procedures. Rather, Gorman presents a more general specification with a linear household technologies, where not only demographic translating and scaling are relevent, but also joint demographically varying effects across commodities are considered.

3.3 New Approach With Money Assets

The conventional consumer theory has implicitly assumed an abstract money-free society, in which consumers are engaging in their economic activities. But in any exchange economy consumers have to deal with money assets so that a general utility theory must include monetary aspects and an explanation of consumers' demand for money. Neoclassical economists, like Hicks, Samuelson (1947), Morishima (1952), Patinkin (1965), Sidrauski (1967), Friedman (1969) and others, have made efforts to incorporate money assets into the general equilibrium framework so as to enable to deal with consumer's monetary behavior.

In spite of these endeavors, however, there still remains some troublesome drawbacks within the extended neoclassical model. Recently many researchers have reformulated the utility approach to money demand, such as Chetty (1969), Bisgnano (1974), Diewert (1974), Clements (1976), Offenbacher (1979), Barnett (1981), Ewis and Fisher (1984) and etc. Furthermore, the theoretical growth models of perfect foresight with money in the utility function have also been proposed by Brock (1974), Clavo (1979), Fisher (1979), and Obstfeld (1983), among others. These developments have added and revealed many profound aspects of modeling money demand in accordance with the old utility approach, which is again and again claimed to be a convenient as well as eligible method to treat consumers' money demand side.

On the other hand, some economists, such as Clower (1967), Niehans (1978), Kareken and Wallace (1980),and others criticized the approach that including money balances within the utility function as an argument is not an appropriate way to deal with consumers' demand for money balances.[13] They argued that the characteristics of money is not revealed as a medium of exchange or as a store of value; instead, money is euphemistically regarded as if it were a consumer's goods or a producer's goods. What we need rather is a theory that treats money assets not metaphorically "as if" it were a common goods, but as playing a special role in an exchange system. They also questioned that the consistency of the utility approach with money assets would be in doubt, and it might be difficult to identify the properties of the utility function. Instead, they proposed a solution through entering money assets into the budget constraint. This approach, by their point of view, will derive an appropriate demand function for money demand by avoiding confounding money with common goods.

Some researchers, however, have discovered that there is a functional equivalence of including money assets in the utility function as an argument and combining it into budget constraint as a liquidity cost. This issue was first explored by Fischer (1974) for money in the production function and then currently extended and synthesized by

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[13] Friedman, M. "The optimal quantity of money and other essays", Chicago: Aldine, 1969, pp14. Levhari, D. and Patinkin D. "The role of money in a simple growth model", American Economic Review, vol.58, 1968, pp713-53. Niehans, J. "The theory of money", the Johns hopkins University Press, Baltimore, 1980, pp1-19.

Feenstra (1986).[14]

In this section we will demonstrate that the new approach of home economics discussed in the section 3.2 can amend drawbacks of the neoclassical approach, so as to satisfy the criticism made by Clower, Niehans and others. The characteristics of money is not confounded with common goods, and it is valid to include money assets in an utility function while properties of the utility function may be checked through the duality of two approaches of dealing with money assets. We will consider a general household model with monetary aspects that investigates the occurrence of rural households' demand for stock of money and the flow of commodities under the impacts of some institutional variables.

3.31 Utility function and money assets

When we discuss a micro-oriented household model with money assets included, the basic question is, how can we incorporate money in the households' optimal decisions? The neoclassical approach is to extend the basic consumer's maximizing model by including real money assets as an argument in a utility function; the objection approach, on

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[14] Fischer, Stanley "Money and the production function", Economic Inquiry, vol.12, 1974, pp518-33. Feenstra, Robert "Functional equivalence between liquidity costs and the utility of money", Journal of Monetary Economics, vol.17, 1986, pp271-91.

the other hand, questions that it lacks integration and fails to reveal the characteristics of money assets. An alternative method is proposed to combine money assets in the budget constraint as a liquidity cost. Finally, the Fischer (1974)-Feenstra (1986) model proves that both approaches, by revealing different sides of the same consumer's optimizing behavior, is in principle equivalent, and also the properties of the utility function with money assets included can be specified. The following demonstration is based on Feenstra's synthesis.

The budget constraint approach to deal with money balances can be formulated by the below intertemporal expression:

$$\max \Sigma_{t=1}^{T} \delta^{t} U (c_t) \tag{3.31}$$

$$\text{st. } c_t + \phi (c_t , m_t) + m_t = y \qquad t = 1,2,\ldots T$$

where $y = w_t + m_t \phi(P_{t-1}/P_t)$ denotes wealth in period t; vector P is the general price level; δ^t denotes discount rate in period t; vecotr c_t denotes value of net consumption in period t; vector m_t is the real money balances in period t, and $\phi (c_t , m_t)$ is the liquidity cost in period t.

We consider that a household makes an intertemporal decision in period t , then the utility function is $U(c_t)$ with $U'>0$ and $U''<0$. Also, we assume that m is the only financial assets. The liquidity cost is contained in the household budget constraint which represnets the costs a household has to pay for the value of net consumption c_t . Then we will propose a general set of hypotheses for the liquidity cost function contained in the budget constraint:

THEOREM 1: for all $c_t > 0$, and $m_t > 0$, the liquidity cost $\phi (c_t , m_t)$ is twice continuously differentiable and satisfies the following conditions:

(1) $\phi > 0$, $\phi (0 , m) = 0$;

(2) $\phi_c > 0$, $\phi_m < 0$;

(3) $\phi_{cc} > 0$, $\phi_{mm} > 0$, $\phi_{mc} < 0$;

(4) ϕ is quasi-convex and thus $c_t + \phi(c_t, m_t)$ is also quasi-convex with non-negative slope for Engel expansion path.

After discussing the budget constraint approach, we will now turn to the utility approach of money assets. We assume that a household will optimize its gross consumption goods q_t and money assets m_t in the period of t through the utility function U^*_t:

$$\max \Sigma \delta^t U^* (q_t , m_t) \tag{3.32}$$

$$\text{st. } q_t + m_t = y$$

where q_t is the value of real gross consumption and equal to the sum of both value of net consumption c_t and liquidity costs $\phi(c_t , m_t)$:

$$q_t = c_t + \phi (c_t , m_t) \tag{3.33}$$

Now the utility approach of incorporating money assets and the budget constraint approach of combining money assets are in principle equivalent. The difference between them appears to be the different functional notation. That is , we can write:

$$\begin{aligned} U (c_t) &= U^* (q_t , m_t) \\ &= U^* [c_t + \phi (c_t , m_t), m_t] \end{aligned} \tag{3.34}$$

where the utility function $U(c_t)$ in the liquidity approach is equivalent to the utility function $U^*(q_t , m_t)$ in the utility approach, if above expressions hold for all c_t and m_t. This equivalence indicates that the household can solve $U(c_t)$ to obtain the space (c_t , m_t) which is corresponding to solve $U^*(q_t, m_t)$ with the demand space (q_t, m_t). Moreover, this duality can be expressed by another way; let us define:

$$W (q_t , m_t) = U^{-1} [U^*(q_t , m_t)] \tag{3.35}$$

Then we have the equation (3.34) as:

$$c_t = W [c_t + \phi (c_t , m_t)] \tag{3.36}$$

If this expression holds for all c_t and m_t , then the liquidity cost function ϕ will be equivalent to the utility function W, and vice versa. Therefore, given the utility function W, the utility function U* is simply obtained by the concave transformation expressed as follows:

$$U^* (q_t , m_t) = U [W (q_t , m_t)] \tag{3.37}$$

where the first and second derivatives are assumed as $U' > 0$, and $U'' < 0$.

Corresponding to the liquidity approach, we hence define a set of hypotheses for the utility maximization approach with money assets incorporated as an arguement.

THEOREM 2: for all $q_t > 0$, $m_t > 0$, the utility function $W(q_t, m_t)$ is twice continuously differentiable and satisfies the following conditions:

(1) $W > 0$, $W (0, m_t) = 0$, $W (q_t , m_t) \to 0$; as $q_t \to 0$ and fixed $m_t > 0$;

(2) $W_m > 0$, $0 < W_q < 1$;

(3) $W_{qq} < 0$, $W_{mm} < 0$, $W_{qm} > 0$;

(4) W is quasi-concave with Engel curves exhibiting a non-

negative slope.

COROLLARY: given the equation $q_t = c_t + \phi(c_t , m_t)$, if the liquidity cost function $\phi(c_t , m_t)$ satisfies theorem 1, then there exists an equivalent utility function $W(q_t , m_t)$ which satisfies theorem 2, and vice versa.

Given the liquidity cost function $\phi(c_t , m_t)$ with a demand space (c_t , m_t), the utility function $W (q_t , m_t)$ with space (q_t, m_t) can be obtained by inverting the gross consumption $q_t = \phi_t + c_t$ to get the net consumption function $c_t = W (q_t , m_t)$, which depends on gross consumption and money holdings. Essentially, the above duality theory will attribute the liquidity cost function ϕ_t as an implicitly indirect utility function which is equivalent to the direct utility function W_t with the demand space (q_t , m_t), since the space of (c_t, m_t) can be easily transformed into the space (q_t, m_t). As the above two theorems are satisfied, the duality theory works and therefore either approach would provide an identical solution for the household optimizing decision in an exchange system. Combining the both methods we obtain an integrative utility theory with money assets included, for which all properties of the utility function are still valid.

3.32 Implication of the new approach on money assets

The above demonstration based on the Fischer-Feenstra model shows us that it is eligible to incorporate money assets as an argument in a utility function, for which the features of the integration and duality of demand theory are still preserved. Due to the unobservable structure of an utility function, the issue is not whether money assets are in an utility function as an argument, but whether it is helpful to analyze the actual household's demand system for commodities and money assets as if they are arguments in the household's utility function.

As for the utility of money assets there are two aspects: a flow aspect of money and a stock aspect of money. The first aspect has to do with the marginal utility of money spent by households on commodities, reflecting the market goods money can purchase. The stock aspect refers to the utility of money balances held by households. It is the direct motivation of households to demand for money balances because the stock of money is regarded as the means of transferring wealth from one time period to the next in any exchange economy.[15] We can employ a simple exhibition below to explain this idea.

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[15] Patinkin, D. "Money, interest and prices", 2nd ed. New York, Harper & Row, 1965, pp580. Niehans J. "The theory of money", the Johns Hopkins University Press, Baltimore, 1980, pp14.

Let us suppose a household lives in two periods, with its endowment $q_1 > 0$ and $q_2 = 0$. Then the household will maximize a utility function $u(q_1, q_2)$ subject to $q_1 > 0$, $q_2 > 0$ and $p_1 q_1 = y$; p and y are prices and income. The optimal consumption bundle (q_1, q_2) cannot be achieved unless the household holds some real money assets $m_1 < p_1 q_1$ by the end of the first period. Where $m_1 = M_1/P_2$ denotes the ratio of nominal money and the second period price vector; the second period price vector is expected upon the first period price vector $p_2 = E(p_2 | p_1)$. With the above assumptions, then the household's optimal decision over two periods can be expressed as follows:

$$\begin{array}{lcl} \max u(q_1, q_2) & = & \max v(q_1, m_1) \\ \text{st. } q_1, q_2 > 0 & & \text{st. } q_1 > 0 \\ \quad y = p_1 q_1 & & \quad y > p_1 q_1 + m_1 \end{array} \tag{3.38}$$

This analysis shows that money balances included in the utility function are relevant to the stock of money, or, equivalently, a household's money demand function is related to the stock of money. In order to make things precise, we assume that, in an exchange system there exists a large number of households with low and middle levels of income, so that they practically keep money balances as their needs of transaction other than investment in interest-bearing financial assets, which insures the assumption of money assets being only financial assets meaningful.

So far we have considered money balances in the conventional utility function other than postulating it by the concept of new home economics approach. However, by the study of the above sections of this chapter, we have shown that the unobservable consumption characteristics space (x) can be translated into the observable commodities space (q), and we can acquire the demand functions from a modified function system which exactly obey the properties of the conventional demand theory.

The new home economics approach is relevant to the modified functional framework containing a money market. The new approach implicitly assumes that the household internal production structure may experience changes in the mode of transforming economic goods into consumption characteristics, but the demand for comsuptive characteristics may remain stable. As money market is included, the households' demand for money balances implicitly implies the demand for "monetary characteristics" which is generated by money balances. The changes in demand for money balances in various forms may just reflect how efficiency changes in the household internal monetary productive technology; while household's tastes for means of transaction, store of value or other kinds of monetary characteristics stay unchanged.

The new approach of demand theory distinguishes the difference of "monetary characteristics" generated by money balances and money balances itself, just like the similiar statement that consumption characteristics is different from its inputs as goods and services. Therefore, this new treatment amends the neoclassical theory's drawbacks of confounding money with common goods in the utility function, failing to express the special characteristics of money balances. In the new model, money balances, like other economic goods, act as an input of producing household consumption characteristics; as a consequence, it is valid to list money balances as an argument in the modified utility function.

When we add the money market into the analysis, the new approach postulated by Becker and Lancaster becomes unitary in an exchange economy. The consumption for monetary characteristics can then be translated into the demand for money balances. Therefore, we can transform the consumption space of characteristics (x) in term of market demand space (q , m) from a well modified function system with all required properties. Hence let us turn back to equation (3.16)':

$$\max u (q \mid d) = \max [U (x)$$
$$\text{st. } h (p, d) x = y] \text{ st. } pq = y$$

The parameter d stands for institutional index, which will alter the household internal production technology as $H = H(x, q, d)$; via this internal technology, household can transform goods q into consumption characteristics x. The above expression should be adjusted or extended as a general structure with money market is taken into consideration. Specifically, the modified utility function $U(q|d)$ and its constraint $pq = y$ need to be extended.

Since money holdings perform the means of transferring wealth from one time period to the next, a household will make the optimal decision intertemporally. In the current period t, the household's optimal bundle of demand for goods and money assets (q_t , m_t) can be obtained through the maximization of a modified utility function:

$$\max \Sigma_{t=1}^{T} \delta^{t} U (q_t , m_t \mid d_t) \tag{3.39}$$
$$\text{st. } p_t q_t + r_t m_t = y_t + r_t(1 + \tau) m_{t-1}$$

where m denotes vector of money holdings, δ denotes discount rate $0 < \delta < 1$, and $r =[1 + (R - \tau)/(1 + R)] + \pi$. R and τ denote interest rate of money assets and rate of a long period deposit, respectively; $(R-\tau)/(1+R)$ is the user's cost derived by Barnett,[16] which states the discounted interest foregone by holding money assets. π is the annual inflation

[16] Barnett, W. "Consumer demand and labor supply", North-Holland Publishing Co., New York, 1981; pp196.

rate. Thus, r expresses the total costs of having money assets: the first part consists of the opportunity cost, and the second part is the inflation cost of money holdings.

Further, we assume that the utility function is varying over time and the household has to adjust its planning over time so that the household behavior is only bounded by decisions concerning the current demand (q_t , m_t), subject to the current budget constraint. If household's current demand functions are determined, then the following period demand function system will be adjusted according to the current demand functions and future budget, and so on. So that we may regard household's utility function as separable in T blocks:

$$\Sigma_{t=1}^{T} \delta^{t} U (q_t , m_t \mid d_t) \tag{3.40}$$
$$= U^1(q_1 , m_1 \mid d_1) + U^2(q_2 , m_2 \mid d_2) + \dots + U^T(q_T , m_T \mid d_T)$$

The first block contains current demand space (q_t, m_t) and other blocks contain future demand spaces. Therefore, we can take the household's current optimal decision as independent of future's desisions, or it depends only on the current condition and last period's left-over money holdings. The household decision is then simplified as:

$$\max u (q_t , m_t \mid d_t) \tag{3.41}$$

$$\text{st. } p_t q_t + r_t m_t = y_t + r_t (1 + \tau_t) m_{t-1}$$

In the current period, $\delta = 1$. The utility function is assumed twice differentiable, monotonically increasing and also strictly quasiconcave. According to the duality theory, we have a corresponding indirect utility function structure which can derive the equivalent demand system. Some writers, as Dornbusch and Mussa (1975), for the purpose of explaining the gap between real money holdings and desired money holdings, assume a utility function $U(q_t, m_t)$ being homogenous of degree one;[17] and in order to apply the aggregate theory, Barnett (1981) assumes a utility function $U(q_t, (m_t - em_{t-1}))$ to be homogenous of degree one.[18] We do not adopt this assumption since it is too restrictive which requires household's Engel curve being identical linear line, though it exhibits some convenient features.

The above extension of a modified functional system has already implicitly assumed money assets incorporated in the internal household production technology H = H(x, q, m, d)

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[17] Dornbusch, R. and Mussa, M. "Consumption, real balances and hoarding function", International Economic Review, vol.16, 1975; pp415-20.

[18] Barnett, W. "Consumer demand and labor supply", North-Holland Publishing Co., New York, 1981; pp193-204.

which plays an important role of generating household's consumption on monetary characteristics; so that the equation (3.16)' could be rewritten as the current period household's maximization problem:

$$\max u(q_t, m_t, | d_t) = \{ \max U(x_t) \text{ st. } h(p_t, r_t, d_t) x_t = y_t \} \text{ st. } p_t q_t + r_t m_t = y_t - r_t(1 + \tau_t) m_{t-1}$$

If we consider m as the difference of period t and t-1, we can eliminate the subscript t and result in a cross-sectional model. Therefore, we obtain an unitary household modeling with money market included, for which given desired properties of traditional demand theory, we can employ the modified utility function to acquire rural household demand functions for both goods and money assets under the influence of some socio-economic factors, such as and demographic variables or income structures; the results will be equivalent to household demand for consumption characteristics produced by goods and money assets.

3.4 Conclusion

In this chapter, we have already demonstrated that it is eligible to extend the new home economics to rural households under the influence of some socio-economic variables. We have also shown that it is valid to regard money assets as an argument in the modified utility function system which observes all required properties of the traditional theory.

The extension of new home economics introduces a new regime: as arguments in the rural households' modified utility function, the market purchased consumer goods, producer goods and retained agri-output aa well as money assets perform the role of inputs for producing household consumptive characteristics; the socio-economic variables, such as demographic variables or income structures, are systematically combined into the demand system. Moreover, the extension of new approach opens a way to investigate the relationship of current demand of goods and demand of money assets. Therefore, we have constructed a general demand framework for economic goods and money assets, for which we can investigate the rural households' simultaneous demand decision upon goods and money. In the next chapter, based upon this general demand structure, we will specify some demand framework to engage in our empirical studies.

CHAPTER FOUR

SPECIFICATIONS OF DEMAND SYSTEMS

4.1 Introduction

In the last chapter we presented extensions of the new home economics from which we constructed a general demand structure. The framework of this new approach satisfies features of rural household modeling with money assets and institutional factors included, and it then amends drawbacks of the conventional consumer theory. In this chapter, based upon this theoretical structure, we will investigate some specifications for demand system which are available for us to conduct estimations with our cross-sectional and panel rural household data.

Corresponding to a utility maximization problem, there are two major approaches to specify functional forms of demand system in contemporary economic literature. One approach is to specify a direct or an indirect utility function, and sometimes cost or expenditure function from which demand system specifications can be developed. Many authors attributed to this approach, such as Klein and Rubin (1947-1948), Stone (1954), Frisch (1959), Houthakker (1960), Parks (1969), Yoshihara (1969), Diewert (1971), Christensen, Jogenson and Lau (1975), Berndt, Darrough and Diewert (1977) or Deaton and Muellbauer (1980) and others. Alternatively, demand system specifications can be expressed directly with certain restrictions imposed. This is represented by Theil-Barten procedure, Barten (1964, 1968, 1969, 1977), Theil (1967, 1971, 1975, 1976) and Powell specification (1966).

We will follow these two approaches to obtain our demand system framework. In the section 3.1, we will discuss Rotterdam model and its extension; in the section 3.2, we will investigate Deaton and Muellbauer model and its extension; and in the section 3.3, we will bring some special aggregation methods of dealing with data as part of the models.

4.2 The Differential Modeling

The framework of demand system can be constructed from differential approaches. One of examples is the Rotterdam model.[1] Corresponding to an implicit utility function maximization which is assumed to be symmetric negative definite, this approach specifies demand equations as the

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[1] Theil, H. "Theory and measurement of consumer demand", Amsterdam: North-Holland Publishing Co., 1975-76, pp2. Theil, H. "the system-wide approach to microeconomics", The University of Chicago Press, 1980, pp12-15.

function of prices and real income in logarithmic differential forms. The specification can be written as:

$$d\ (\log q_i) = \Sigma\ e_{ij} d\ (\log p_j) + \eta_i d\ (\log Q) \qquad (4.1)$$

$i= 1,2, \ldots n.$

where e_{ij} is the cross price elasticity of the ith commodity with respect to the jth price vector and η_i is the income elasticity of the commodity i; vectors q_i, p_i and Q_i are the ith quantity demanded, the ith price and real income, respectively. The individual commodity demand functions as (4.1) are then multiplied by their corresponding expenditure proportions or budget share $w_i = p_i q_i/M$:

$$W_i d(\log q_i) = \theta_i d(\log Q) + \Sigma_{j=1}^{n} \pi_{ij} d(\log p_i) \qquad (4.2)$$

where coefficient $\theta_i = p_i(dq_i/dM)$, the marginal budget share of the ith commodity; and the slutsky price coefficient π_{ij} $=(p_i p_j/M)(q_i/p_j)$ is the cross price elasticity e_{ij} weighted by the ith budget share; with the assumption of utility function being symmetric negative definite, the n x n matrix [π_{ij}] is then negative semidefinite with rank n-1; which satisfies homogeneity and symmetry. If time series data are employed to estimate the model, we can obtain the Rotterdam model in relative prices through replacing infinite logarithmic changes by finite log-changes from period t-1 to t, and also the budget share w_i (where i = 1 ,..., n) by the arithmetic average of w_i in period t-1 and t.[2] If cross-sectional data are used, Theil, Chung and Seale (1989) provided another solution:[3] since the differential of the budget constraint can be written as $dM_i = \Sigma\, q_i dp_i + \Sigma\, p_i dp$, which is a decomposition of dM in terms of a price component and a volume component; i = 1...n. Then dividing both sides by M:

$$d(\log M) = d(\log P) + d(\log Q) \qquad (4.3)$$

where $d(\log P) = \Sigma w_i d(\log p_i)$ and $d(\log Q) = \Sigma w_i d(\log q_i)$. Also, the budget share $w_i = p_i q_i/M$ in logarithmic form is $\log w_i = \log p_i + \log q_i - \log M$. if taking total differential of this equation:

$$dw_i = w_i d(\log p_i) + w_i d(\log q_i) - w_i d(\log M) \qquad (4.4)$$

Then substitute (4.2) and (4.3) into (4.4), we can obtain equation (4.5):

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[2] Theil, H. "Theory and measurement of consumer demand",Amsterdam: North-Holland Publishing Co., 1975-76, pp3.

[3] Theil, H., Chung, C. F. and Seale, J. K. "Advances in econometrics, international evidence on consumption patterns", Greenwich, Conn. JAI Press, 1989.

$$d\bar{w}_i = (\theta_i - \bar{w}_i)d(\log Q) + w_i[d(\log p_i) - d(\log P)] + \Sigma_i^n \pi_{ij} d(\log p_j) \quad (4.5)$$

Partially differentiating this equation with respect to the log real income $y \equiv d(\log Q)$, we can express expected budget share $\bar{w}_i$ as:

$$d\,\bar{w}_i / dy = \theta_i - \bar{w}_i \quad (4.6)$$

to reverse (4.6), there is:

$$\bar{w}_i = \alpha_i + \int f_i(y)dy \approx \alpha_i + \beta_i y \quad (4.7)$$

the expression $\bar{w}_i$ reflects the income effect on demand, the difference of real budget share w_i and $\bar{w}_i$ will be accounted by the price effects, which are equal to the last two terms in equation(4.5); hence there is:

$$\begin{aligned} w_i &= \bar{w}_i + \bar{w}_i[\, d(\log p_i) - d(\log P)\,] + \Sigma_{j=1}^n \pi_{ij} d(\log p_j) \\ &= \alpha_i + \beta_i y + (\,\alpha_i + \beta_i y\,)[\, d(\log p_i) - \Sigma_{j=1}^n (\,\alpha_j \\ &\quad + \beta_j y\,) + d(\log p_j)\,] + \Sigma_{j=1}^n \pi_{ij} d(\log p_j) \end{aligned} \quad (4.8)$$

To define real income as an independent of variants of the observed prices for each observation, it is necessary to assume there is a set of central prices $\bar{p}_i$, which are constant across observations. The real income term can then be obtained by the central prices, on which income effects are based; while the price effects are expressed as the difference of observed prices p_{ic} for each observation c and central prices $\bar{p}_i$, which are defined as $\log(p_{ic}/\bar{p}_i)$. Therefore, the Linear Slutsky (LS) model is expressed:

$$w_{ic} = \alpha_i + \beta_i y_c + (\alpha_i + \beta_i y_c)[\log(p_{ic}/\bar{p}_i) - \Sigma_{j=1}^{n}(\alpha_j + \beta_j y)\log(p_{jc}/\bar{p}_j)] + \Sigma_{j=1}^{n}\pi_{ij}\log(p_{jc}/\bar{p}_j) \quad (4.9)$$

where i=1,...,n for goods, and c=1,...,N for observations; α, β, and π are estimated parameters. The system satisfies adding-up restrictions $\Sigma\,\alpha_i = 1$, $\Sigma\,\beta_i = \Sigma\,\pi_{ij} = 0$; $[\,\pi_{ij}\,]$ are Slutsky coefficients. Due to the strong assumption of a negative definite utility function, the Slutsky coefficients meet negative semi-definity, as well as homogeneity $\Sigma\,\pi_{ij} = 0$ and symmetry $\pi_{ij} = \pi_{ji}$. There are $2n+(n^2-n)/2$ parameters to be estimated in this model.

Theil, Chung and Seale derived another model under the assumption of preference independence, where $\pi_{ij} = \phi\theta_i(1-\theta_i)$ if i=j, and $\pi_{ij} = -\phi\theta_i\theta_j$ if i=/=j (Theil 1975); so that the cross-price effects are eliminated and Slutsky coefficients are reduced to be a single parameter ϕ. Furthermore, by the equation (4.6), $\theta_i = \beta_i + \bar{w}_i = \alpha_i + \beta_i(y + 1)$; let $y* = (y + 1)$, the linear preference independence model (LPI) can be expressed as:

$$w_{ic} = \alpha_i + \beta_i y_c + (\alpha_i + \beta_i y_c)[\log(p_{ic}/ \bar{p}_i) - \Sigma_{j=1}^{n}(\alpha_j + \beta_j y_c) \log(p_{jc}/ \bar{p}_j)] + \phi (\alpha_i + \beta_i y_c^*) \cdot [\log(p_{jc}/ \bar{p}_j) - \Sigma_{j=1}^{n}(\alpha_j + \beta_j y_c^*) \log(p_{jc}/ \bar{p}_j)] \quad (4.10)$$

This model also satisfies adding-up restrictions, where $\Sigma\alpha_i = 1$ and $\Sigma\beta_i = 0$; since the utility function is assumed to be negative definite, income flexibility ϕ is negative. The LPI model emphasizes on the income effects on demand system with assumption of no any direct price effects.

If in the equation (4.5) the term $\int f_i(y)dy$ is specified by a quadratic form of y, then $\bar{w}_i = \alpha_i + \beta_i y_c + \delta_i y_c^2$, so that in the LS and LPI models the term $(\alpha_i + \beta_i y_c)$ can be replaced by $(\alpha_i + \beta_i y_c + \delta_i y_c^2)$ and $(\alpha_i + \beta_i y_c^*)$ by $(\alpha_i + \beta_i y_c^* + \delta_i y_c^{**2})$, where $y_c^{**} = (y_c + 2y_c)$. The new quadratic models are referred as the Quadratic Slutsky (QS) model and the Quadratic preference Independence (QPI) model.

Now we will extend the LS and LPI models to include monetary assets. In the last chapter we have demonstrated that it is legitimate to contain monetary assets in a modified utility function, which is equivalent to the original utility function of maximizing consumptive characteristics space (x), and from which a general household demand system for goods and monetary assets bundle (q, m) can be derived. We recall that our rural household would maximize its modified utility function subject to the budget constraint:

$$\max u (q_t, m_t \mid d_t)$$

$$= [\max U (x_t) \text{ st. } h (p_t, r_t, d_t) x_t = y_t]$$

$$\text{st. } y_t + r_t (1 + \tau_t) m_{t-1} = \Sigma p_{it} q_{it} + r_t m_t$$

The subscript t in the equation can be eliminated by assuming m to be the difference of period t and t-1, so as to result in a cross-sectional modeling. At this stage the institutional factors d will not yet be specificied. With the above underlining utility structure, the general demand system for both goods and money can be obtained. Therefore, the differential approach specified as the LS demand model can be extended as households' general demand for both goods and money:[4]

[4] Clements, K. and Nguyen, P. "Money demand, consumer demand and relative prices in Australia", The Economic Record, Dec. 1980, pp339-40.

$$w_{im} = \alpha_m + \beta_m y_c + (\alpha_m + \beta_m y_c)[\log(r_{mc}/ \bar{r}_m) - \Sigma_{j=1}^{n} (\alpha_j + \beta_j y_c)\log(p_{jc}/ \bar{p}_j)] + \Sigma_{j=1}^{n}\pi_{ij}\log(p_{jc}/ \bar{p}_j) - [(\alpha_m + \beta_m y_c)(\alpha_j + \beta_j y_c) - \pi_{mm}]\log(r_{mc}/ \bar{r}_m)$$

(4.11a)

$$w_{ic} = \alpha_i + \beta_i y_c + (\alpha_i + \beta_i y_c)[\log(p_{ic}/ \bar{p}_i) - \Sigma_{j=1}^{n} (\alpha_j + \beta_j y_c)\log(p_{jc}/ \bar{p}_j)] + \Sigma_{j=1}^{n}\pi_{ij}\log(p_{jc}/ \bar{p}_j) - [(\alpha_i + \beta_i y_c)(\alpha_m + \beta_m y_c) - \pi_{im}]\log(r_{mc}/ \bar{r}_m)$$

(4.11b)

where r_{mc} denotes the opportunity cost or actural price of holding monetary assets for each household c, while $\bar{r}_m$ is the central price of holding monetary assets; w_{mc}= mr/y is the budget share for money holdings. The above general household demand system explicitly reflects the interactions of demands for goods and money; and it satisfies adding up restrictions, homogeneity, symmetry and semi-negativity. The Slutsky coefficients [π] can be expressed by Barten's expression:[5]

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[5] Barten, A. P. "Consumer demand functions under conditions of almost addictive preferences", Econometrica, vol.39, Jan.-April, 1969, pp2.

$$\pi = dq / dp = \mu U^{-1} - \mu/\mu_y Q \quad Q' q_y'$$

where U^{-1} is the inverse Hessian,

$$U^{-1} = \begin{vmatrix} d^2u/d^2m & d^2u/dmdq' \\ d^2u/dqdm & d^2u/d^2q \end{vmatrix}^{-1}$$

Since the sufficient condition for utility maximization as symmetric negative definite Hessian U is assumed, the inverse Hessian U^{-1} must exist, and it is negative semi-definite. Therefore, the existence of the Slutsky coefficients are insured, and they express the relationship of monetary assets and goods in the household demand system. If there is no relationship of goods' demand and monetary assets' demand, we must then have $d^2U/dqdm = d^2U/dmdq' = 0$, i.e. off-diagonal terms are zeros, so that Hessian and its inverse must be a block diagonal.[6]

With the underlining modified utility maximization structure obtained in last chapter, we can also extend the LPI demand specification to be a general demand system which incorporate both goods' demand and monetary assets' demand:

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[6] Clements, K. and Nguyen, P. "Money demand, consumer demand and relative prices in Australia", The Economic Record, Dec. 1980, pp340-41.

$$w_{mc} = \alpha_m + \beta_m y_c + (\alpha_m + \beta_m y_c)[\log(r_{mc}/\bar{r}_m) - \Sigma_{j=1}^{n}(\alpha_j + \beta_j y_c)\log(p_{jc}/\bar{p}_j)] + \phi(\alpha_m + \beta_m y_c^*)[\log(r_{mc}/\bar{r}_m) - \Sigma_{j=1}^{n}(\alpha_j + \beta_j y_c^*)\log(p_{jc}/\bar{p}_j)] - [(\alpha_m + \beta_m y_c)(\alpha_m + \beta_m y_c) + \phi(\alpha_m + \beta_m y_c^*)(\alpha_m + \beta_m y_c^*)]\log(r_{mc}/\bar{r}_m) \qquad (4.12a)$$

$$w_{ic} = \alpha_i + \beta_i y_c + (\alpha_i + \beta_i y_c)[\log(p_{ic}/\bar{p}_i) - \Sigma_{j=1}^{n}(\alpha_j + \beta_j y_c)\log(p_{jc}/\bar{p}_j)] + \phi(\alpha_i + \beta_i y_c^*)[\log(p_{ic}/\bar{p}_i) - \Sigma_{j=1}^{n}(\alpha_j + \beta_j y_c^*)\log(p_{jc}/\bar{p}_j)] - [(\alpha_i + \beta_i y_c)(\alpha_m + \beta_m y_c) + \phi(\alpha_i + \beta_i y_c^*)(\alpha_m + \beta_m y_c^*)]\log(r_{mc}/\bar{r}_m) \qquad (4.12b)$$

The above equations reveal the effect of cost of holding monetary assets on the real income. Also, they satisfy the restrictions on the original LPI model.

Again, when we replace the linear terms $(\alpha + \beta\ y\ )$ and $(\alpha + \beta\ y^*\ )$ by the quadratic terms $(\alpha + \beta\ y + \delta\ y^2)$ and $(\alpha + \beta\ y^* + \delta\ y^{*2})$, respectively, we can obtain the general QS and QPI demand systems with monetary assets included.

Now we will consider explicitly incorporating demographic variables, rural development indecies and investment indicator into the demand system of rural households. In the last chapter we demonstrated that socio-economic factors would be encompassed in the internal household technology, and they would alter the parameters of the demand system; hence the estimated parameters of the demand system may be explicit or implicit functions of the households' socio-economic variables. We also discussed some specific procedures which express the functional relationship between the estimated parameters and demographic variables. These methods can be used in our model. For convenience, we will explore the idea of the translating procedure: the original demand framework as a function of households' socio-economic variables, not merely the demographic profile.[7] Therefore, we assume the estimated parameters in our extended LS and LPI models $\alpha*$ and $\beta*$ to be additive linear functions of all institutional or socio-economic variables:

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[7] Pollak, R. and Wales, T. initiated the translating procedure, which defined demand system to be a function of households' demographic factors. "Estimation of complete demand systems from household budget data: the linear and quadratic expenditure systems", American Economic Review, vol.68, 1978, pp349-59. "Comparison of the quadratic expenditure system and translog demand systems with alternative specifications of demographic effects", Econometrica, vol.48, April, 1980, pp596-99. "Demographic variables in demand analysis", vol.49, Nov., 1981, pp1534-40.

$$\alpha^*_i = \alpha_i + \Sigma_{k=1}^{K} \sigma_{ik} d_k \quad (4.13a)$$

$$\beta^*_i = \beta_i + \Sigma_{k=1}^{K} \mu_{ik} d_k \quad (4.13b)$$

where $k = 1...K$, d_k is the kth socio-economic variables, σ_{ik} and μ_{ik} are unknown parameters which need to be estimated. This procedure will add $2(n \times K)$ independent parameters to the original models. For the quadratic models, we can also make δ^* to be an addictive linear function of all socio-ecomonic variables d:

$$\delta^*_i = \delta_i + \Sigma_{k=1}^{K} \tau_{ik} d_k \quad (4.13c)$$

Again, where τ_{ik} is an unknown parameter. Then we will have $3(nxK)$ more independent estimated parameters comparing with the original quadratic models.

4.3 AIDS Modeling

The model of an almost ideal demand system is proposed by Deaton and Muellbauer.[8] This specification of demand system is originated from a specific class of preferences, represented by a cost or expenditure function that defines

[8] Deaton, A. and Muellbauer, J. "An almost ideal demand system", American Economic Review, 1980, pp312-325.

the minimum expenditure necessary to obtain a specific utility level at given prices:

$$\log c(u, p) = \alpha_\circ + \Sigma_k \alpha_k \log p_k + 1/2\, \Sigma_k \Sigma_j \tau^*_{kj} \log p_k \log p_j + \mu\, \beta_\circ\, P_k\, p_k^{\beta k} \quad (4.13)$$

where α, β and τ are estimated parameters; according to Sheperd's lemma, demand functions can be directly derived from the cost function. The price derivatives of the cost function are quantities demanded, $q_i = d\log c(u, p_i)/d\log p_i$; if multiplying it by the ratio $p_i/c(u, p_i)$, we obtain budget share of good i. Thus the demand system is expressed as in budget share form:

$$w_i = \alpha_i + \beta_i \log(M/P^*) + \Sigma_{j=1}^{n} \tau_{ij} \log p_j \quad (4.14)$$

where M is total expenditure and P* is a price index which is defined as:

$$P^* = \alpha_\circ + \Sigma_k \alpha_k \log p_k + 1/2\, \Sigma_k \Sigma_j \tau_{kj} \log p_k \log p_j \quad (4.15)$$

The term (M/P*) is interpreted as "real expenditure". The restrictions on parameters are 1) $\Sigma\, \alpha_i = 1$, $\Sigma\, \tau_{ij} = 0$, $\Sigma\, \beta_i = 0$; 2) $\Sigma\, \tau_{ij} = 0$; and 3) $\tau_{ij} = \tau_{ji}$. The demand system can add up to total expenditure as restriction 1) meets; it will satisfy the homogeneity and Slutsky symmetry as the restrictions 2) and 3) hold. In the AIDS demand system, in order to eliminate some parameters, we need an additional restriction on cross price parameter γ_{ij} . For some pairs (i, j), γ_{ij} should be zero; that is, for such pairs of goods, one budget share is independent of another's price. But Deaton (1978) rejected an extreme restriction of all γ_{ij} being equal to zero.[9]

The AIDS cost function is such a flexible functional form that the demand functions obtained are so general as first order approximations to any set of demand functions derived from a utility maximizing behavior. Even if a household maximizing behavior is not assumed, i.e. second order condition can not be satisfied, and thereafter homogeneity $\Sigma\, \gamma_{ij}= 0$ and slutsky symmetry $\gamma_{ij}= \gamma_{ji}$ can not hold. This flexible specifications for demand system derived from the cost function still have its meaning: demand functions are still continuous in expenditure and prices and then provide local first order approximation. Due to this characteristic of flexible functional forms, the property of negativity can not be guaranteed by the

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[9] Deaton, A. "Specification and testing in applied demand analysis", Economic Journal, vol.88, Sept. 1978, pp524-36.

restrictions on parameters.[10]

Deaton and Muellballer estimated the system through substituting the price index in the equation (4.15) into the demand equations (4.14). Since there is a problem of practically identifying parameters $\alpha_{\circ}$, they suggested to assign a value to $\alpha_{\circ}$ prior to the estimations. But this practice, pointed by Chung (1989), can not guarantee to obtain the right value.[11]

However, Theil, Chung & Seale (1989) indicated that, we do not need to use equation (4.15) to implement the AIDS model. The price index log P could be replaced by the approximation equation without unknown parameters:

$$\log P \approx \Sigma_{i=1}^{n} w_i \log p_i \qquad (4.16)$$

This price index approximation has some limitations.[12] If the equation (4.16) is used, w_i will appear on both sides of the equation (4.14); this raises problems: if $\Sigma\, w_i \log p_i$ on the right-hand side is treated as exogenous, then w_i on

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[10] Deaton, A. and Muellbauer, J. "An almost ideal demand system", Amerian Economic Review, 1980, pp316.

[11] Chung, C. F. "A cross-sectional demand analysis with an application to Spanish provincial food consumption", forthcoming publication, pp4.

[12] Theil, H., Chung, C. F. and Seale, J. "Advances in econometrics, international evidence on consumptions",Greenwich, Conn. JAI Press, 1989,pp184-186.

the left-hand side should also be regarded as exogenous. Further, P is a price index in a limited sense, since it fails to satisfy an identity test which requires price index unchanged when all individual prices do no change, but P may change due to change in w_i. So they proposed another more satisfactory approximation: the cross-sectional data for the LS and LPI models provide a choice to replace (M/P) in equation (4.14) by real income term Qc based on the concept of central prices $\bar{P}$ in the LS and LPI models. Again, it should subtract $\log\bar{p}_j$ from $\log p_{jc}$ for j=1...n in the price term. By making $y=\log Q_c$, we obtain an AIDS cross-sectional demand model:

$$w_{ic} = \alpha_i + \beta_i y_c + \Sigma_{j=1}^{n} \gamma_{ij} \log(p_{jc}/\ \bar{p}_j) \qquad (4.17)$$

The AIDS demand form is an alternative for LS model, but with these differences between them: AIDS model has just one price term, and its matrix [γ_{ij}] does not satisfy the negative semi-definity, though it satisfies the symmetry and homogeneity.

In the last chapter we have demonstrated that it is equivalent to contain monetary assets in a utility formation or to include them in an expenditure function from which a demand functions of goods and money can be simultaneously derived. Hence, as we consider a general demand system with monetary assets, the expenditure function should explicitly contain cost for money demand. The extended cost equation would then look like:

$$\log c(u,\ p,\ r) = \alpha_\circ + \alpha_r \log r + \Sigma_k\ \alpha_k \log p_k + 1/2(\ \Sigma \tau_j \log r_{rj} \log p_j + \Sigma_k \Sigma_j \tau_{kj} \log p_k \log p_j\ ) + \mu \beta_\circ P_k p_k^{\beta k} r^{\beta r} \quad (4.18)$$

Thus the demand system in budget share form is expressed as:

$$w_{mc} = \alpha_m + \beta_m y_c + \tau_{mm} \log(r_{mc}/\ \bar{r}_m) + \Sigma_{j=1}^{n} \tau_{mj} \log(p_{jc}/\ \bar{p}_j) \quad (4.19a)$$

$$w_{ic} = \alpha_i + \beta_i y_c + \tau_{im} \log(r_{mc}/\ \bar{r}_m) + \Sigma_{j=1}^{n} \tau_{ij} \log(p_{ij}/\ \bar{p}_j) \quad (4.19b)$$

where the restrictions on parameters are the same: for the adding-up restrictions, $\Sigma\alpha_i + \alpha_m = 1$, $\Sigma\beta_i = \Sigma\tau_{im} = \Sigma\tau_{mj} = \Sigma\tau_{ij} = 0$; the AIDS coefficients [τ] satisfy the homogeneity $\Sigma\tau_{im} = \Sigma\tau_{mj} = \Sigma\tau_{ij} = 0$ and the symmetry $\tau_{im} = \tau_{mj}$, $\tau_{ij} = \tau_{ji}$. They can not satisfy the slutsky negativity, since the AIDS function is such a flexible form that there may not exist a second order derivative required as the approximation of utility maximization. That is, for this flexible formation, we can not assume a negative definite utility function. The parameters τ_{mj} represent effects of prices for money demand on goods in budget share. If some pairs of τ_{im} or τ_{mj} are equal to zero, they will indicate that money demand is independent of goods' prices; or, goods demand independent of the price of monetary assets.

Like the LS and LPI models, AIDS model can become a quadratic form by replacing the term $(\alpha_i + \beta_i y_c)$ with $(\alpha_i + \beta_i y_c + \delta_i y_c^2)$. Also, we can incorporate all institutional variables into the demand functions by making estimated parameters α_i, β_i, and δ_i to be additive linear functions of the institutional variables d.

4.4 Methods of Aggregation

In our cross-section and panel data, we aggregate detailed items of economic goods listed in the chapter II into four categories: staple food, non-staple food, clothing & footware, and agricultural input. Also, we aggregate cash holdings and demand deposits into the catergory of monetary assets. In order to obtain "prices" of these five aggregate categories from detailed items for each household, we employ the average weight procedure expressed as follows:

$$p_{ic} = \Sigma_{j=1}^{M}(E_{jc}/E_{ic})p_{jc} \qquad (4.20)$$

We define the expenditure on ith category as:

$$E_{ic} = \Sigma_{j=1}^{M} E_{jc} \qquad (4.21)$$

where j = 1...M stands for detailed items; i = 1...n for five categories of aggregates; and c = 1...N for observed households. p_{ic} denotes the aggregate price of ith group for household c, p_{jc} denotes the price of jth detailed good for c's household, and E_{jc} is the c's household expenditure on jth good, where $E_{jc} = p_{jc}q_{jc}$. The ratio of jth good in ith group (E_{jc}/E_{ic}) for household c acts as the wight for the contribution of jth good's price in the aggregate price of ith group.

However, as price variants in aggregate price vectors of each group across households exist, it is necessary to construct central price vectors $\bar{p}_i$ as a benchmark for every observation; furthermore, central price vectors $\bar{p}_i$ are so important as to obtain real income Q for each observation required by the modelling.

The concept of central prices can obtained through Geary (1958) - Khamis (1967, 70, 72) procedure.[13] This

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[13] Geary, R. C. "A note on the comparison of exchange rates and purchasing power between countries", Journal of the Royal Statistical Society, Series A, 1958, pp97-99. Khamis, S. H. "Some problems relating to the international comparability and fluctuations of production volume indicators", Bulletin of the International Statistical Institute, 1967, 42, Part1: pp213-30; "Properties and conditions for the existance of a new type of index

procedure gives a set of parameters called household purchasing power ratios ϵ_c for household c: c=1,...N

$$\epsilon_c = \frac{\Sigma_{i=1}^{n} p_{ic} q_{ic}}{\Sigma_{i=1}^{n} \bar{p}_i \; q_{ic}} \qquad (4.22)$$

where central price $\bar{p}_i$ is defined as:

$$\bar{p}_i = \frac{\Sigma_{c=1}^{N} p_{ic} q_{ic} / \; \epsilon_c}{\Sigma_{c=1}^{N} q_{ic}} \qquad (4.23)$$

Simultaneously solving (4.21) and (4.22), we can obtain the central price vector, which is linear homogeneous in each household's price p_{ic}. Then we can get real income by the expression:

$$Q_c = \Sigma_{i=1}^{n} (\; E_{ic} / \; p_{ic}) \; \bar{p}_i \qquad (4.24)$$

where the term (E_{ic}/p_{ic}) is the cth household expenditure on the ith aggregate group divided by its observed price, which is regarded as "quantity demanded" for the ith aggregate by c. Then multiplying this "quantity demanded" by the ith

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numbers", Sankhya, 1970, Series. B. 32, pp81-98; "A new system of index numbers for national and international purposes", Journal of the Royal Statistical Society, 1972, Series A, 135: pp96-121.

central price vector $\bar{p}_i$, we obtain the "real expenditure" on the ith group. Thus, the aggregation of real expenditures on all five groups makes up of cth household real income Q_c. As a consequence, the Geary-Khamis procedure renders central prices $\bar{p}_i$ and real income Q_c, which constitute an integral part of the model discussed in last two sections.

CHAPTER FIVE

RESULTS OF ESTIMATIONS

5.1 Introduction

In this chapter we will present the results of empirical estimations of the general demand systems based upon Chinese rural household data.

We will discuss these questions: whether the socio-economic variables we chose to represent features of rural households and the process of rural development really matter in the general demand system fo goods and money? Do the money demand and goods demand interact with each other? What is the relationship between home-produced agri-goods and market-purchased goods? Moreover, what kinds of policy implications can we derive from the empirical studies?

In Section 5.2 we will discuss the importance of the socio-economic factors in the general demand framework and the possible directions of their influences; in Section 5.3, we will present income and price elasticities derived from the models and the explanations; in Section 5.4, we will briefly summerize some important policy implications.

5.2 Analysis of Estimated Results

In Chapter four we have specified six linear and quadratic general demand systems as LS, LPI, DM, QS, QPI and QDM. We can obtain stochastic specifications for these demand systems by adding the vector of disturbances to each equation. We will assume that the disturbance term e_i is independently and identically distributed across households with a zero mean and a positive definite variance-covariance matrix. Because the dependent variables and the non-stochastic terms in the equations are in share forms which can be added to one and the covariance is singular, we have to drop any equation in order to estimate the general demand system.

With above assumptions we can estimate general demand systems by the maximum likelihood method. We use Gauss program (version 2.0, 1988) to conduct the estimations.

We have made twelve estimations as two groups for the six models. The first group of estimations does not explicitly the associate socio-economic factors, that are labeled as LS0, LPI0, DM0, QS0, QPI0, and QDM0; the second group systematically incorporates socio-economic factors in the demand frameworks according to the method we have described in Chapter four, and they are called as LS1, LPI1,

Table 12: Log Likelihood Values for Alternative Model Formations.

Estimated procedure estimated	Socio-economic variables affecting parameters: α	β	δ	Log likelihood values	Number of parameter
LSO	ignore			4245.39	18
LS1	d1,d2,d3,d4,d5	d1,d4,d5	-	4452.75	50
LPIO	ignore			4172.07	9
LPI1	d1,d2,d3,d4,d5	d1,d4,d5	-	4385.10	41
DEO	ignore			4247.20	18
DM1	d1,d2,d3,d4,d5	d1,d4,d5	-	4445.70	50
QSO	ignore			4260.84	22
QS1	d1,d2,d3,d4,d5	d1,d3,d5	-	4465.73	50
QPIO	ignore			4184.62	13
QPI1	d1,d2,d3,d4,d5	d1,d3,d5	d4	4403.97	49
QDMO	ignore			4258.99	22
QDM1	d1,d2,d3,d4,d5	d1,d3,d5	-	4461.70	54

Note: socio-economic variables: d1: family size; d2: labor size; d3: monetized index; d4: diversified index; d5: investment indicator.

DM1, QS1, QPI1, and QDM1.

Our results show that the socio-economic variables have important impact upon rural households' general demand system for goods and money. In Table 12, we present log likelihood values for all twelve linear and quadratic models. The six estimates belonging to the first group are procedures without combining socio-economic variables, and the second group estimates are best values of the models incorporating socio-economic variables which are selected from the likelihood ratio tests.

Table 13: Likelihood Ratio Test Statistics for Estimations.
(x-distribution at the .05 level in parentheses)

Null hypothesis hypothesis	Alternative
LS0 vs. LS1	414.73 (41.94)
LPI0 vs. LPI1	426.06 (41.94)
DM0 vs. DM1	397.00 (41.04)
QS0 vs. QS1	409.78 (40.10)
QPI0 vs.QPI1	438.7 (49.77)
QDM0 vs. QDM1	405.42 (41.94)

The report exhibits that, the parameter $\alpha*$, as the constant terms in the models, are highly affected by all five socio-economic variables, except in the QS model which is not affected by the household investment indicator. The parameters $\beta*$, as the coefficients of real income, are significantly affected by family size, labor size and diversified index in the linear forms; in the quadratic models, however, $\beta*$ is affected by family size, monetized index and investment indicator. The socio-economic variables have almost no significant impacts on parameters $\delta*$, which are the coefficients of squared real income, except in the QPI model which is affected by diversified index.

Now the question is whether the models of incorporating the socio-economic variables significantly improve the estimations? The likelihood ratio tests are reported.

In Table 13 the nested hypothesis tests are such that the null hypothesis states no difference between the models without incorporating socio-economic variables and the corresponding models with those variables. The testing results clearly indicate the latter very superior to the former, so as to highly significantly reject the null hypothesis. Therefore, we will only report the estimates with the socio-economic factors incorporated.

Since the linear models are special cases of the quadratic models, we will conduct the nested likelihood ratio test with hypothesis of linear models against their corresponding quadratic forms. The test statistics are reported in Table 14. The numbers of estimated parameters in the LS model are equal to those in the QS model, so that the likelihood ratio statistics indicates the quadratic model QS better than the linear model LS. Also, the quadratic models QPI and QDM are superior to their corresponding linear forms LPI and DM.

However, since the quadratic forms QS, QPI and QDM are not nested specifications for each other, we cannot directly conduct the significance tests of the differences in the likelihood values. Then we will present estimates of all quadratic specifications: QS, QPI and QDM. Tables 15.1-15.3 below will show all estimated parameters obtained from these three quadratic forms.

Table 14: Likelihood Ratio Test Statistics between Linear and Quadratic Models. (x-distribution at the .05 level in parentheses)

Null Hypothesis	Alternative Hypothesis
LS vs. QS	25.96 (-)
LPI vs. QPI	37.74 (15.51)
DM vs. QDM	32.00 (9.49)

Table 15.1: Maximum Likelihood Parameter Estimates QS (t-statistic in parentheses)

Estimated parameters	Staple food	Non-staple food	Clothing& footware	Agri-inputs	Money assets
α*:					
constant	.2418	.1396	.0679	.0444	.5063
	(9.0309)	(5.4617)	(4.1850)	(2.9745)	(13.6893)
d1	.1564	-.0455	.0063	.0331	-.1504
	(9.3543)	(-2.8107)	(.6343)	(3.6450)	(-6.5144)
d2	-.0157	.0159	.0124	-.0091	-.0395
	(-1.3046)	(4.5500)	(1.7575)	(-1.4207)	(-2.3947)
d3	-.0350	.0816	.0003	.0570	-.1040
	(-1.7523)	(4.2389)	(.0232)	(5.0264)	(-3.7213)
d4	.1405	.1957	.0380	-.1100	.0167
	(5.9367)	(8.6794)	(2.6618)	(-8.4785)	(.5109)
β*:					
con	-.3068	-.0965	-.0402	-.0420	.4856
	(-6.3636)	(-2.1217)	(-1.4092)	(-1.5882)	(7.2724)
d1	.0222	.0373	.0328	.0222	-.1145
	(.9201)	(1.6273)	(2.2855)	(1.7022)	(-3.4426)
d3	.1706	.0327	-.0373	-.0315	-.1345
	(3.9051)	(.7937)	(-1.4418)	(-1.3016)	(-2.2216)
d5	.0588	-.0432	-.0027	.0041	-.0169
	(3.1187)	(-2.4714)	(-.2573)	(.4013)	(-.6532)
δ*:					
con	-.0777	-.0211	.0012	-.0101	.1077
	(-5.2116)	(-1.5200)	(.1367)	(-1.2076)	(5.1837)
π:					
Staple	-.2229				
	(-6.0889)				
Nonstaple	.1811	.0646			
	(5.7185)	(1.2713)			
Clothing	.0110	-.0237	-.1117		
	(1.0961)	(-1.1414)	(-7.6286)		
Agri-input	-.0617	.0373	.0010	-.0357	
	(2.6336)	(1.4547)	(.7503)	(-1.4867)	
Money	.0836	-.2593	.1054	.0501	.0202
	(1.7505)	(-4.5843)	(3.7420)	(1.1336)	(.2042)

Table 15.2: Maximum Likelihood Parameter Estimates QPI (t-statistic in parentheses)

est.parameters	Staple	Non-staple	Clothing	Agri-input	Money
α*:					
con	.02381	.1295	.0539	.0500	.5285
	(8.9538)	(5.1524)	(3.2178)	(3.5002)	(14.2978)
d1	.1465	-.0655	.0214	.0307	-.1331
	(8.9388)	(-4.2134)	(2.0430)	(3.5008)	(-5.8424)
d2	-.0127	.0545	.0103	-.0077	-.0441
	(-1.0389)	(4.7218)	(1.3568)	(-1.1974)	(-2.6000)
d3	-.0162	.0990	-.0169	.0471	-.1130
	(-.7773)	(5.0884)	(-1.3315)	(4.2119)	(-3.8978)
d4	-.1266	.2285	.0516	-.1155	-.0381
	(-4.2938)	(8.2261)	(3.0113)	(-7.617)	(-.9381)
d5	.0003	.0046	.0056	.0123	-.0229
	(.0417)	(.5764)	(1.0949)	(2.7490)	(-2.0025)
β*:					
con	-.2936	-.0307	-.0279	-.0409	.3931
	(-5.7548)	(-.6247)	(-.8411)	(-1.6671)	(5.5361)
d1	.0190	.0123	.0318	.0118	-.0747
	(.7583)	(.5076)	(1.8717)	(.9739)	(-2.1909)
d3	.1656	.0184	-.0515	-.0245	-.1079
	(3.6647)	(.4198)	(-1.7329)	(-1.0978)	(-1.7299)
d5	.0574	-.0403	-.0113	.0026	-.0084
	(3.0233)	(-2.1462)	(-.9055)	(.2689)	(-.3220)
δ*:					
con	-.0812	.0121	.0442	-.0070	.0319
	(3.6306)	(.5634)	(2.8642)	(-.7258)	(1.0429)
d4	-.0223	-.1230	-.1271	.0190	.0319
	(-3.6306)	(.5636)	(2.8642)	(-.7258)	(1.0429)
φ:	-.9376 (-11.2019)				

Note: Staple: staple food; Nonstaple: non-staple food; Clothing: industrial consumer goods; Agri-input: industrial agri-producer goods; Money: money assets.

Table 15.3: Maximum Likelihood Parameter Estimates QDM

	Staple	Nonstaple	Clothing	Agri-input	Money
α*:					
con	.2427	.1435	.0680	.0483	.4974
	(8.8539)	(5.6386)	(4.0984)	(3.2706)	(13.0108)
d1	.1549	-.0460	.0054	.0307	-.1450
	(9.1047)	(-2.8491)	(.5248)	(3.3309)	(-6.0373)
d2	-.0138	.0520	.0125	-.0083	-.0425
	(-1.1235)	(4.5834)	(1.6987)	(-1.2716)	(-2.4713)
d3	-.0345	.0790	-.0029	.0485	-.0901
	(-1.6353)	(4.0236)	(-.2326)	(4.3056)	(-3.0376)
d4	-.1397	.1846	.0309	-.1055	.0296
	(-5.7331)	(8.1665)	(2.1119)	(-8.1006)	(.8663)
d5	.00001	.0038	.0010	.0010	-.0237
	(.0005)	(.4831)	(1.9879)	(2.2232)	(-2.0150)
β*:					
con	-.3072	-.0915	-.0403	-.0373	.4762
	(-6.1947)	(-1.9752)	(-1.3470)	(-1.4065)	(6.7906)
d1	.0174	.0354	.0390	.01717	-.1090
	(.7047)	(1.5301)	(2.6275)	(1.2896)	(-3.1130)
d3	.01771	.0296	-.0468	-.0283	-.1316
	(3.9459)	(.7118)	(-1.453)	(-1.1857)	(-2.0955)
d5	.0622	-.0465	-.0095	.0016	-.0078
	(3.1889)	(-2.5719)	(-.8132)	(.1545)	(-2.0955)
δ*:					
con	-.0753	-.0171	.0013	-.0053	.0974
	(-4.9512)	(-1.1894)	(.1382)	(-.6437)	(4.4843)
τ:					
Staple	.0165				
	(.4464)				
Nonstaple	.1012	.2390			
	(3.2433)	(4.5586)			
Clothing	-.0182	-.0480	-.0272		
	(-1.0077)	(-2.3271)	(-1.9452)		
Ag-input	-.0979	.0172	-.0004	.0571	
	(-4.2774)	(.6740)	(-.0333)	(2.232)	
Money	-.0016	-.3093	.0938	.0240	.1930
	(-.0336)	(-5.4552)	(3.2873)	(.5354)	(1.9801)

As the intercept of all quadratic models, parameter vector α^* represents the basic demands for goods or money which are free from changes in income vector. But the parameter α^* can be divided into two parts, the first part is the constant term which is independent of socio-economic factors, and the second part is the portion of α^* which is affected by socio-economic variables.

The constant terms of α^* express the independent or constant demands which are not affected by income, price and socio-economic vectors. They are positive and variant across goods and money demand, the averages are .05, .07, .14, .24 and .5 for the demands of industrial producer

Table 16: Significant Effects of Socio-economic Variables upon α^* Parameters.

	Staple	Nonstaple	Clothing	Agri-input	Money
α^*:					
d1	+	-	+	+	_
d2		+			-
d3		+		+	-
d4	+,-	+	+	-	
d5			+	+	-

goods, industrial consumer goods, non-staple food, staple food and money assets,respectively.

Another portion of intercepts $\alpha*$, however, is influenced by the socio-economic variables. In order to make things clear, we tabulate the positive and negative influences of all socio-economic variables upon economic goods and money assets which are significant in t-statistics in Table 16.

Specifically, demographic variables have significant impacts on the intercepts of all goods and money demand. As family size (d1) becomes larger, constant demand for staple food, industrial consumer and producer goods will rise, while intercepts for non-staple food and money demand will decline. When labor size (d2) rises, constant demand for non-staple food will increase but the demand for money will drop. This result indicates that, increase in demographic variables will increase rural households' basic demand for "necessary" goods, while decrease their base for relatively "unnecessary" demand, especially basic demand for money assets.

The indices of rural development level are important factors influencing households' basic demand. On the one hand, the monetized index (d3) will positively affect intercepts for non-staple food and industrial consumer goods while negatively affect money. The increase in the monetized index reflects the fact that rural households have higher purchasing power and potentiality of accessing money assets, and hence they tend to expand their "constant bundle" of market consumer goods and evaluate opportunity cost of money holdings higher than before. On the other hand, the diversified index (d4) will affect all constant demand for goods but money. Along with the rise of this index, the constant demand for market consumer goods (non-staple food and clothing) will increase, the demand for home-produced staple food can move in either direction, but demand for agri-input will decline. The increase of diversified index reveals the fact that rural households engage in more other non-farming production activities than agricultural activities, thus the constant demand for agri-input naturally decreases, while the demand for market consumer goods such as non-staple food and clothing goods increase.

The investment indicator affects clothing and agri-input positively, but affects money negatively. It may express the relationship between non-durable goods, money and household investment in this way: in order to invest in new houses or durable goods, households have to restrict their basic needs for market goods and claim money balances. As the investment is achieved, however, this restriction is lifted so that the constant demand for market goods rises and the desire for money drops.

Also, the socio-economic factors have important impacts upon ß*, the parameter vector of log real income. The constant terms in ß* are all negative for good demands, arranged as -.3, -.09, -.04, -.04 for staple food, non-staple food, clothing, and agri-input, respectively; but it is positive and valued about .5 for money demand. This phenomenon can be explained as follows: along with the increase in income, a decreasing portion of income is allocated to good demands while an increasing portion is directed to money demand.

Table 17: Significant Effects of Socio-economic Variables upon Parameters ß* and δ*.

	Staple	Nonstaple	Clothing	Agri-input	Money
ß*:					
d1			+		-
d3	+				-
d5	+	-			-
δ*:					
d4	-		+		

The δ^* is the parameters of squared log real income. In the QS and QDM models, the constant terms in δ^* are negative for staple food, non-staple food and agri-input demand, with the values of -.08, -.02 and -.01; those for clothing and money demand are positive, valued as .001 and .1, respectively. In the QPI model, constant terms in δ^* for staple food and agri-input demand are negative with the values of -.08 and -.007; but those are positive for non-staple food, clothing and money demand, ranging .01, .04 and .03, respectively. This fact may hint at an increasing portion of real income being directed to market goods such as clothing, which is relatively less "necessary".

In Table 17 above, we demonstrate the effects of the socio-economic variables upon all quadratic forms' parameters β^* and δ^* with significant t-statistics, which are the direct coefficients of real income.

The parameters β^* are significantly affected by family size, monetized index and investment indicator, while the parameters δ^* are only affected by diversified index. Specifically, as family size rises, a higher portion of the increase in real income will be directed to the demand of industrial consumer goods, and a lower portion to the demand of money assets; the high monetized index will allocate more of the increased real income to the demand of staple food and less to money assets. When household investment has been achieved, the increased income will be allocated to the demand for staple food and less to money. It is interesting to observe that, for parameters δ^*, diversified index does not significantly affect money demand, but does affect staple food negatively and clothing positively.

The summerization is that the socio-economic variables have significant influences upon the general demand framework for goods and money. Specifically speaking, demographic variables, rural economic development level and fixed investment will not only affect constant portions of the demand systems, but will also greatly influence the allocation of change in real income as well. The very important fact is that these socio-economic variables will affect money demand only negatively, though their affects of goods are in either the positive or negative direction. The explanation may be stated as follows: more household members or working people will require more goods and less money. The upgrade of development level characterized by the indices of income monetization and diversification of production activities will decrease household demand for money, since rural households have enlarged capacity and sources to obtain money assets. The households' investment are complements of money assets, as a certain satisfactory level of households' investment is achieved, the motivation of holding money declines.

5.3 Income and Price Elasticities

In the above section, we have tested that the quadratic specifications of demand equations are better than the linear forms, and we have also exhibited the impacts of socio-economic factors upon general demand systems through influencing parameters. In this section we will present income elasticities and compensated price elasticities for the quadratic forms (in order to make comparisons, we will report both income and price elasticities of the linear equations in Appendix 2).

The income elasticities of demand equations are the marginal share divided by the budget share. The marginal share is:

$$\theta_i = \beta^*_i + \bar{w}_{ic} = \alpha^*_i + \beta^*_i + \beta^*_i y_c + \delta^*_i y^2_c \qquad (5.1)$$

While budge share is:

$$\bar{w}_{ic} = \alpha^*_i + \beta^*_i y_c + \delta^*_i y^2_c \qquad (5.2)$$

Then the income elasticity is expressed:

$$e^I_{ic} = \theta_i / \bar{w}_{ic} = 1 + (\beta^*_i + 2\delta^*_i y_c)/ \bar{w}_{ic} \qquad (5.3)$$

where parameters α^*, β^* and δ^* are:

$$\alpha^*_i = \alpha_i + \Sigma_{k=1}^{K}\sigma_{ik}d_k \ ,$$
$$\beta^*_i = \beta_i + \Sigma_{k=1}^{K}\mu_{ik}d_k \ ,$$
$$\delta^*_i = \delta_i + \Sigma_{k=1}^{K}\tau_{ik}d_k \ .$$

The compensated price elasticity e_{ij} is the ratio of Slutsky price coefficients π_{ij} to the budge share of the ith good w_{ic}. Since the QS model has Slutsky price coefficients [π], its price elasticity can be directly derived:

$$e_{ij} = \pi_{ij} / \bar{w}_{ic} \qquad (5.4)$$

Since the QPI and QDM models, however, do not directly express the Slustky price coefficients, it is necessary to derive them first, with which the corresponding price elasticities are obtainable. In the QPI model the Slutsky price coefficients are:[1]

$$\pi_{ij} = \phi\theta_i(1-\theta_j) \qquad \text{if} \quad i=\backslash=j \qquad (5.5)$$
$$\pi_{ij} = -\phi\theta_i\theta_j \qquad \text{if} \quad i = j$$

where $\theta_i = \beta^*_i + \bar{w}_{ic}$ is the marginal share, and ϕ is the income flexibility. For the model GDM, the Slutsky price

[1] Theil, H., Chung, C. F. and Seale, J. K. "International evidence on consumption patterns", Greenwhich, Conn. JAI Press 1989, pp155.

coefficients [π] can be expressed as:[2]

$$\pi_{ij} = \tau_{ij} + \beta^{*}_{i}\beta^{*}_{j}y_{ic} + \bar{w}_{i}\bar{w}_{j} \qquad \text{if} \quad i \neq j \qquad (5.6)$$

$$\pi_{ij} = \tau_{ij} + \beta^{*2}_{i}y_{ic} + (\bar{w}_{i} - 1)\bar{w}_{i} \qquad \text{if} \quad i = j$$

where [τ] are the AIDS price coefficients.

In Table 18, the mean income elasticities of the all three quadratic forms will be reported. The term of "income" indicates the total expenditure on goods and money assets. The income elasticities of these three models are quite similar, especially the models QS and QDM. They have exhibited that all aggregate goods and money are normal "goods". However, all the four aggregate goods are "necessities", though the "necessary degrees" of these goods are different. As income increases by 10 percent, demand for staple food rises about 6.5 percent, non-staple food rises about 8.4 percent, clothing around 7.8 percent and agri-input by 6.1 percent. For rural households, industrial agri-input is listed as the most "necessary" demand while staple food as the second necessary demand, the values of both elasticities are quite similar. Clothing and non-staple food are listed as less "necessary" goods, or, relatively more elastic ones with respect to income change.

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[2] Theil, H. "Theory and measurement of consumer demand", Amsterdam: North-Holland Publishing Company. "The system-wide approach to microeconomics", The University of Chicago Press, 1980.

It is very interesting to notice that the rural households' demand for money (precisely, narrowly defined money M1) is highly elastic comparing with aggregate goods. When real income rises by 10 percent, the money demand will increase by more than 22 percent. This observation is quite important: there is a very high desire for Chinese rural households to hold money assets as their income increases while their demand for market and home-produced goods are relatively constant.

In Table 19, the mean compensated price elasticities are reported. The Theil model suggests that the utility function is negatively definite, so that the matrix [π] is negatively semidefinite and own compensated price elasticities are negative. The estimated results indicate

Table 18: Estimated Income Elasticities of QS, QPI and QDM.

	Food	Non-staple food	Clothing & footware	Agri-inputs	Money assets
QS	.6430	.7914	.8012	.6652	2.2031
QPI	.6087	.9146	.7496	.5713	2.1247
QDM	.6896	.7907	.7928	.6053	2.2967

Table 19: Estimated Price Elasticities of QS, QPI and QDM.

	Staple	Nonstaple	Clothing	Agri-input	Money
QS:					
Staple	-.5759	.9047	.2113	-.26801	.5634
Nonstaple	.4678	.3226	-.2504	.4147	-1.7482
Clothing	.0516	-.1182	-1.1827	.1108	.7110
Ag-input	-.1593	.1862	.1055	-.3823	.3378
Money	.2159	-1.2954	1.1164	.5371	.1361
QPI:					
Staple	-.4582	.2234	.1922	.1520	.5749
Nonstaple	.1113	-.7014	.1207	.0890	.3588
Clothing	.0478	.0651	-.6519	.0449	.1705
Ag-input	.0394	.0509	.0451	-.4905	.1349
Money	.2597	.3620	.2939	.2046	-1.2391
QDM:					
Staple	-.5688	.8948	.1984	-.7480	.4731
Nonstaple	.4559	.3939	-.3026	.4169	-1.9590
Clothnig	.0502	-.1413	-1.1952	.0928	.7632
Ag-input	-.1391	.1849	.0955	-.2288	.2803
Money	.2016	-1.3322	1.2020	.4671	.4422

that the QS model does not satisfy this restriction, while the QPI model does it since its all diagonal terms are negative. As far as the QDM model is concerned, it is so flexible that no restriction on the utility function and the negativity does not apply.

We observe that in the models QS and QPI, the own price responsiveness of clothing are elastic, valued about -1.2 for both models; own price responsiveness of staple food and agri-input are inelastic, with values of -.57 and -.35, respectively. But the own compensated price elasticities for non-staple food and money in the two models are positive, This is not unusual for money demand: a rise in inflation rate indicates a higher general price level so that the demand for money may increase given households' inflation expectation constant; even though a high level of general prices produces higher opportunity cost of holding money than before. In the QPI model, own compensated price responsiveness of money demand are elastic and those of all goods are inelastic.

We are very interested in the cross price elasticities of staple food with respect to market goods, elasticities of agri-input to consumer goods, and elasticities of money to all goods. The cross price elasticities of staple food with respect to market goods and the elasticities of agri-input to consumer goods are positive in the QPI model. In the both QS and QDM models, the elasticities of staple food with respect to agri-input are negative, but positive to other goods; the elasticities of agri-input to staple food are negative, but positive to other consumer goods. This fact indicates that home-produced staple food and agri-input are complements while staple food and market consumer goods, agri-input and market consumer goods are substitutes. The higher price of agri-input will increase the cost of producing staple food so that the demand for staple food tends to decline. As prices of market consumer goods increase, rural households have to sell more home-produced staple food to trade the same amount of market goods; and it is relatively cheaper to retain more staple food. Also, a rise in the prices of market consumer goods tends to drive demand for agri-input upward because agri-input becomes relatively cheaper and the demand for staple food higher.

The cross price responsiveness of money and goods are all positive in the QPI model, and also positive in the QS and QDM models except price elasticity of money with respect to non-staple food. This result is quite important, indicating money and non-durable goods are substitutes for each other. When market prices of goods increase, the demand for money tends to rise since rural households may regard this time as not right time for "spending" and decide to hold money for the future expenditure.

5.4 Policy Implications

Quite a few government policy issues can be discussed within the general demand framework we have developed and estimated. We can directly derive some important policy implications from the empirical results.

Since money demand in the rural areas consists of a major part of all society's money demand in developing countries, it is very important to explain systematically rural households' money demand. What we have discovered in the estimations is that two groups of exogenous variables may affect rural households' demand for money assets: socio-economic variables positively influencing the money demand, and all prices of non-durable goods negatively affecting the demand for money. Specifically, on the one hand, along with fewer family members, higher economic development levels, or investment in durables and new houses, the momentum of rural households' demand for money will decline. On the other hand, if prices for agri-output, industrial agri-input and market consumer goods increase, the money demand will move upward.

If the People's Bank of China (the central bank) aims to stabilize the money market by providing an adequate money supply, it has to consider the contrary influences of these two groups of exogenous variables upon the money demand of rural households. Unfortunately, the monetary authorities tend to emphasize only the income and interest rate effects of money demand while ignoring the changes in the income structure and effects of specific goods'prices. This result has important monetary policy implications: the estimations have exhibited that money demand is greatly influenced by socio-economic factors and interacted with the demand for goods, the equilibrium of the money market, therefore, cannot be achieved without taking these exogenous variables into consideration.

The Chinese government, as the main supplier of industrial goods, determines the prices of most industrial consumer and producer goods; and as the monopolistic purchaser of major agricultural products through allocating annual procurement quotas to rural households, it directly controls or tightly intervenes over the prices of most agricultural products. The pricing policy is regarded as a very important policy instrument to adjust national income distribution and is enforced by the Department of Commerce. Because this maneuver will deeply affect the money demand behavior of rural households, it appears quite necessary for the People's Bank of China to coordinate the monetary policy with the pricing policy which is enforced by the Department of Commerce.

In most developing countries the government is always involved in some way in determining the prices of agri-output and agri-input. The goal of government intervention focuses on how to promote rural development, to increase rural households' welfare and to guarantee the supply of agricultural output. If price of agricultural product rises, though its own price elasticity indicates a declining demand for staple food, the cross price elasticities may suggest that it has positive impact upon households' expenditures on market goods. Every 10 percent of a staple food price increase will decrease consumption of it by 5 percent, with demand for non-staple food rising by 9 percent and clothing by 2 percent. Hence it is likely to enhance the welfare of rural households. An opposite effect occurs when industrial agri-input price increases. In this case, rural households have to sacrifice more home-produced output to obtain the same quantities of industrial agri-input: every 10 percent increase in the price of agri-input will decrease the households' consumption of staple food by about 1.5 percent. And moreover, rural households will reallocate their budget by purchasing less market agri-input good and more market consumer goods. For every 10 percent increase in the price of agri-input, its purchase will decrease by more than 3.5 percent, while purchases on non-staple food and clothing will increase about 1.8 and 1.0 percent. Of course, the agricultural production and the supply of agri-output will be hurt, and the welfare of rural households will then inevitably decrease.

When monetary authorities change interest policies, the demand for goods will also be affected. Generally, interest rate is tightly controlled by the central bank and it is quite stable for a long period. Any increase in interest rates will hint a high inflation level for the public which tends to encourage the expansion of rural households' current expenditure on non-durable goods.

The government may have some specific plans to enhance rural socio-economic development such as demographic policies, rural small scale industry projects, rural non-farming employment plans, rural infrastructural enforcement or others. These policies and plans' effects upon the rural households general demand for goods and money could also be analyzed through our modeling.

CHAPTER SIX

SUMMARY

In order to explain the general demand structure of rural households in developing countries, especially the money demand behavior, this thesis has constructed a general demand model for both goods and money and tested it with Chinese rural household data. Our framework differs from the prevailing neoclassical money demand model through incorporating some quite important institutional impacts upon money demand and also considering the interaction of goods demand and money demand.

The traditional money demand model implicitly assumes the total separability of money demand and goods demand, and confines the determinants of money demand as income level, interest rates and general price level. These hypotheses, unfortunately, fail to describe rural money demand which is the major portion of money demand in developing countries. The striking facts in developing countries are that rural households perform in a semi-commercialized economy, in which their annual income is simultaneously allocated upon home-produced agri-output, market industrial consumer and producer goods, as well as money assets. Institutional changes such as monetized level of rural economy and diversification of rural production activities may have strong impacts upon rural households' demand behavior; and moreover, governmental pricing policies of specific agricultural and industrial goods will heavily affect rural demand structure.

The theoretical model we constructed is based upon the new home economics. It is so general that in developing countries rural households' demand for industrial consumer and producer goods, and home-produced agricultural output as well as money assets can be simultaneously analyzed within this structure. The analytical power of the framework could overcome drawbacks of the traditional procedure which usually ignores the interaction of demand for goods and demand for money assets.

In addition, we also explicitly incorporate socio-economic variables into the general demand system. The socio-economic variables we have specified are family size, labor force, monetized index, diversified income index and investment indicator. The first two variables are rural household demographic factors, the third and fourth indices characterize the economic development level of rural households, and the last one indicates rural households' investment in house construction and durable purchases.

The estimations are based upon the Chinese rural household data. Our empirical results can lead to the following results:

First, the rural household demand for non-durable goods are highly influenced by socio-economic variables, although these socio-economic factors affect different goods in different directions depending upon the nature of the goods. Specifically, demand for staple food is positively affected by family size, the monetized index, and the investment indicator, but negatively by the diversified index. Demand for non-staple food is positively affected by labor force, the monetized and the diversified indices, while negatively affected by family size and the investment indicator. Demand for industrial consumer goods is just positively affected by family size and the diversified index. Finally, demand for industrial producer goods is positively affected by family size, the monetized index, and the investment indicator, but negatively by the diversified index.

Second, the socio-economic variables will significantly affect rural household demand for cash and demand deposits (M1), but all demographic factors and the development indices, as well as the investment indicator, will negatively affect demand for M1.

Third, all non-durable goods belong to "necessary" goods for rural households, although their degrees of "necessity" are different. Industrial producer goods are the most "necessary" good, staple food is listed as the second "necessity" one, while industrial consumer goods and non-staple food are placed as the least "necessary" good for rural households.

Fourth, money assets (M1) are a "luxury" demand for households: as rural households' income rises by 10 percent, the demand for M1 will increase by more than 22 percent. That is, there will be an increasing desire of rural households to hold money.

Fifth, demand for money assets (M1) may rise even if actual cost or price of holding cash balances or demand deposits increase which can be originated from decreases in interest rates or increases in inflation rate.

Sixth, demands for home-produced staple food and industrial producer goods are highly correlated, they appear as substitutes for each other. Demands for staple food and industrial consumer goods are complements, and so are the demand of industrial producer goods and other market goods.

Seventh, rural households' demands for non-durable goods interact with their demand for money. Increases in the prices of non-durable goods tend to enhance households' demand for money.

The high income elasticity of M1 demand is an important feature and agrees with the neoclassical theory of money demand; also the fact that money demand is positively related with inflation rate and negatively with interest rates are explainable by the established theory. Except for these, the new discoveries in the thesis which have not yet been explored by the conventional monetary theory are: (1): rural households' demand for M1 is positively affected by relative prices of specific non-durable goods which are usually manipulated by government policy; (2): M1 demand is negatively influenced by the rural economic developmental level, rural households' fixed investment and demographic variables.

Therefore, the major conclusion can be stated that along with the process of rural economic development, there exist two contradictory effects upon demand for M1: As rural households' income level increases, on the one hand, they have a strong drive to obtain M1; on the other hand, as an upgrading of the monetized income level, the diversified level of rural production activities, and an achievement of fixed investment, rural households tend to hold less M1. Besides, governmental relative pricing policies on specific goods may exert positive impacts upon demand for M1.

Our findings have direct policy implications. In order to inject an adequate money supply and to reach money market equilibrium, other than emphasizing income and interest rates the People's Bank of China (the Central Bank) has to consider those respects: First, since rural money demand consists of over 60 percent of the whole society's demand for M1, the Central Bank of China needs to systematically distinguish the money demand in rural areas and in cities. Second, it must pay attention to the two contradictory trends along with the economic development. A rise of the rural income level will stimulate rural households to allocate an increasing proportion of income upon money assets, but upgrading of the monetized level of income structure, the diversified level of rural production activities and the rural household investment will decrease the incentive of holding money. Third, the Central Bank needs to coordinate its monetary policy with the pricing policies conducted by the Department of Commerce, because changes in relative prices of specific industrial and agricultural goods tend to positively influence rural households' demand for M1. That is, the empirical results highlight the important roles of analyzing the rural development level, the rural households' fixed investment, demographic factors and relative price changes of specific goods in the process of the monetary authorities' decision of money supply; and the results indicate the requirement of coordination of monetary policy and pricing policy.

Also, the results suggest that the combination of pricing policies upon staple food and industrial producer goods is crucial for enhancing the rural welfare and development. For example, on the one hand, if government increases prices of agricultural products, rural households will reallocate their income from home-made agri-products to industrial consumer goods, their welfare tends to rise; on the other hand, if prices of industrial producer goods rise, there will be a negative effect on households' expenditure of both home-made agri-products and industrial goods.

Again, the monetary authorities' interest policy may have a quite significant effect upon demand for goods. Any rise in interest rates by the Central Bank's manipulation will hint an increase in inflation, so that the public tends to expand the expenditure on non-durable goods.

Moreover, these analyses could be further employed to discuss government rural policies such as a small scale industry policy, demographic policy, and non-farming employment policy.

APPENDIX

APPENDIX 1: Proof of the Corolary in Chapter 3.3:

According to Feenstra, the proof can be stated as follows: Assuming that ϕ_t satisfies the theorem 1, then define $q_t = c_t + \phi(c_t, m_t)$, or $c_t = W(q_t, m_t)$, where $0 < q < \infty$, and $m > 0$. Then checking the conditions (1) and (2) in the theorem 2, we have:

1) $W(0, m_t) = 0;$

2) $W_q = 1 / (1 + \phi_c);$

3) $W_m = - \phi_m / (1 + \phi_c).$

So that $0 < W_q < 1$ and $W_m > 0$.

Since ϕ is a non-decreasing and continuous function of c_t, if $q_t = c_t + \phi_t$ for fixed $m_t > 0$, then $c_t = W - \infty$. Then assume W satisfies the theorem 2, so $\phi(c_t, m_t) = q_t - c_t = q(c_t, m_t) - c_t$. To check the conditions (1) and (2) in the theorem 1, we get

4) $\phi(0, m_t) = q(0, m_t) = 0;$

5) $\phi_c = q_c - 1 = (1 / W_q) - 1 > 0;$

6) $\phi_m = q_m = - (W_m / W_q) < 0.$

Now consider the relations between the second derivatives of W and ϕ:

7) differentiate 2) with respect to q_t,

$$W_{qq} = - W_q \phi_{cc} / (1 + \phi_c)^2 .$$

8) differentiate 2) with respect to m_t ,

$$W_{qm} = - W_q d[\phi_m / (1 + \phi_c)] / dc.$$

9) differentiate 6) with respect to q_t ,

$$d(- W_m / W_q) / dq = \phi_{mc} / (1 + \phi_c).$$

10) differentiate 6) with respect to m_t , holding q_t fixed,

$$d(- W_m / W_q)/ dm = (1 + \phi_c) d[\phi_m / (1 + \phi_c)] / dm.$$

11) use 8) and 10),

$$d[\phi_m / (1 + \phi_c)] / dc - [(1 + \phi_c) / \phi_m] \cdot d[\phi_m / (1 + \phi_c)] / dm = - W_{mm} / W_m .$$

12) differentiate 6) with respect to m_t with c_t fixed,

$$\phi_{mm} = d(- W_m / W_q) / dm + \phi_m d(- W_m / W_q) / dq.$$

Thus, if the theorem 1 holds, it implies that the theorem 2 holds; and vice versa.

APPENDIX 2:

Table 21: Estimated Price Elasticities for Linear Models.

	Staple	Nonstaple	Clothing	Ag-input	Money
LS1:					
Staple	-.6342	.8249	.2439	.6893	.9824
Nonstaple	.4425	.2931	-.2295	.2242	-1.9550
Clothing	.0622	-.1091	-1.2027	.1272	.8902
Ag-input	-.1702	.1032	.1232	-.4812	.6632
Money	.2998	-1.1121	1.0651	.8196	-.5809
LPI1:					
Staple	-.4400	.2158	.1886	.1482	.5616
Nonstaple	.1009	-.6923	.1198	.0917	.3625
Clothing	.0462	.0646	-.6516	.0437	.1682
Ag-input	.0385	.0531	.0464	-.5049	.1351
Money	.2544	.3588	.2968	.2212	-.2274
DM1:					
Staple	-.5941	.8400	.2401	-.7970	1.6150
Nonstaple	.4529	.3945	-.2902	.3240	-6.4760
Clothing	.0580	-.1368	-1.2028	.1156	2.2200
Ag-input	-.1684	.1463	.1140	-.3027	1.1612
Money	.2545	-1.2398	1.1475	.6600	1.4802

Table 22: Estimated Income Elasticities for Linear Models.

	Staple	Nonstaple	Clothing	Ag-input	Money
LS1	.6230	.8143	.7940	.6643	2.9955
LPI1	.6382	.8926	.7596	.5801	2.2460
DM1	.6184	.8079	.8008	.6100	6.0437

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