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An Empirical Analysis of Household Survey Data from 1989 to 2006

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Abstract

Durable goods ownership is commonly seen as a 'defining gauge' for the stage of development of a country. Its unprecedented economic growth and the rise of a strong and steadily growing class of consumers make China a formidable case study for the investigation of durable goods diffusion. Drawing on a household-panel with a survey period from 1989 to 2006, the empirical analysis of the driving forces behind the diffusion of durable goods shows that growth of disposable income was not equally important for all goods in their diffusion process. Rather it was the fall of individual preference thresholds (explained in part by falling durable prices) that proved to have a significant influence on the diffusion process of some goods. As it turned out, this tendency was significantly stronger in rural areas and could have counterbalanced, therefore, welfare patterns in terms of ownership contrary to the stable urban-rural gap in economic performance. Apart from changes in income and durable prices, it was found, that improvement of public services had particularly strong effects for urban poor and in rural areas. A forecast exercise up to 2030 revealed that growth in ownership rates is expected to be particularly strong for durable goods like refrigerators and cars for which households already show (or are about to do so in the case of cars) high sensitivity towards further increases in their disposable income. For other durables, like colour TVs, that are already well spread in the population there are signs of saturation with lower expected growth rates of ownership. Additionally, ownership rates are expected to pick up stronger in rural areas were households are less saturated and show higher income elasticities. As a comparison with figures from the literature demonstrates, actual and projected ownership rates depend, to some degree, also on the choice of the data set. The projections based on CHNS data could, therefore, build a reference to other commonly used data sets from the Chinese National Bureau of Statistics.

JEL-Classification: C53, D12, E21, O16, Q56
Keywords: durable consumption in China, ownership analysis and forecast, household panel data

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1. Introduction

"The pilot lowers the plane's wheels and the sudden increase in noise wakes you up. […]Looking out of the window, you see a complicated highway intersection, busy with plenty of cars. You realise that you are about to land in an advanced economy, where you will transfer to another flight. A few hours later, you reach your final destination in one of the world's lowest income countries, where paved roads are few, and traffic mostly consists of a mix of carts and bicycles." Chamon (2008: 245)

Cars and with it durable goods in general are widespread in modern economies, making their presence *"a defining gauge for how we view a country's degree of economic development"* as Chamon (2008: 245) puts it. Durables ownership has major implications for everyday life, for countries' economies and government policies. Rodrik (2006) points out that consumer electronics and other advanced industrial sectors have been an important determinant of China's export-led 'growth miracle'. Yet, more recent developments have turned the public focus more to the demand side. On the one hand, the current global economic downturn has made foreign demand for Chinese products dwindle, calling for a reduction in the dependence on exports and the strengthening of domestic demand (Economist, 2009). On the other hand, domestic demand itself has been brought into the field with regard to environmental concerns. With an average growth rate of 9.8% per year according to official numbers[2] over the last three decades, at least 500 million people have been lifted out of poverty according to most recent estimations (Ravaillon, 2008a, 2008b) and helped developing a strong class of consumers in high- and middle-income population (MGI, 2006). In turn, energy consumption in China is expected to more than double until 2030 with an increasing share coming from private transportation[3] and residential energy demand (IEA, 2007). Thus, understanding the newly arising demand from Chinese consumers and the diffusion of durable ownership in its society is crucial to address these issues.

The *goal of this paper* is, first, to model empirically the changing demand for consumer durables in the developing Chinese economy. Given a micro-data panel from the China Health and Nutrition Survey (CHNS) the aim is to describe changes of durable goods ownership over the survey years from 1989 to 2006. Then, a second step intends to analyse which influence factors played an important role determining the diffusion of ownership in the changing Chinese society. In order to keep the analysis tight, the focus was laid on three goods with considerably different diffusion dynamics: colour TVs, refrigerators and cars. Thirdly, an exploratory attempt is made to project the examined demand for

[2] http://english.gov.cn/2008-12/18/content_1181443.htm (access 4.2.2009)
[3] According to estimations of the Asian Development Bank (ADB, 2006) China's energy use for transportation is expected to grow by 6-9% per year through 2025.

durables until 2030 in order to get an impression of how ownership patterns are going to evolve. In all three steps, a certain emphasise is put on differences between urban and rural areas.

Durable goods demand and diffusion has widely been studied in the economic literature and a number of really different approaches have been put forward depending on which durable characteristic was seen as crucial. As Deaton and Muellbauer (1980) point out, durable goods differ from non-durables with respect to their lumpy nature and their durability. The former means that durable goods can not be consumed over a continuous range like non-durable goods and their acquisition is more like a discrete choice between owning and non-owning. Because of their durability, durable goods do not quickly wear out and consumption and purchase decisions are not the same. Therefore, models of general consumption theory do not apply one-to-one for durable goods demand. In order to analyse the newly arising demand for durables in China and to examine when people move from non-ownership to ownership, this paper draws on a discrete choice model of durable goods ownership originally put forward by Farrell (1954) and developed further by Bonus (1973, 1975) and Chamon et al. (2008). In this model, households move from non-ownership to ownership when their actual income rises above a certain threshold. Individuals allocate this threshold towards ownership with respect to durable characteristics perceived (price & quality) and individual preferences. Durable goods diffusion in the society, then, can be driven by changes in these thresholds triggered by preferences or durable characteristics and by changes in individual incomes. Thus, the steady economic and social changes in China's transition period make the country a prime example to apply discrete choice theory and to study durable goods diffusion.

The econometric analysis draws on a household survey panel from the China Health and Nutrition Survey (CHNS) which covers about 4400 households in urban and rural areas. Until now, seven waves of data collections have been carried out between 1989 and 2006 with high follow-up levels of households that allow longitudinal data analysis. Econometrically, durable goods ownership is estimated with a logit model as the probability of ownership depending on income and other control variables.

The paper is structured as follows: In a first part theoretical concepts are introduced and empirical evidence from China is presented in order to provide the necessary basis for the subsequent analysis. Then, chapter three gives an overview of the data employed in the analysis, completes the picture on recent developments in the survey period with a descriptive illustration of the data and explains the empirical strategy. In chapter four, the results are displayed and discussed. The last chapter gives a summary of the findings and an outlook on further research.

2. Theoretical Framework and Empirical Evidence

This chapter intends, first, to put the research questions outlined in the introduction in a broader framework of economic theory and, secondly, to provide the theoretical way of thinking for the data analysis in the succeeding parts of the paper. If possible and helpful, theory is underpinned by empirical evidence from China or other developing countries.

2.1. General Consumption Patterns

Over the last three decades since Deng Xiaoping introduced his pro-market reforms in 1978, China has experienced unprecedented economic growth, lowering the country's poverty rate from one of the world's highest in 1980 to a slightly lower one than world average in 2004 (Ravallion & Chen, 2004). Recent studies estimate that through this process 500 to 600 million people have been lifted out of poverty depending on how poverty lines are measured (Ravallion & Chen, 2008). Developments in China must be seen, therefore, as the result of two overlaying processes: Economic development on the one hand and, on the other, a transition that entails moving to market determination of the valuation of incomes and productive endowments (Benjamin et al., 2005). Meanwhile, a strong urban middle class[1], generally younger than their western counterparts and better educated than their parents, is evolving. According to MGI (2006) this middle class is expected to grow considerably from a share of 43% of the urban population in 2006 to 77% in 2030 and will significantly transform consumer markets and the Chinese society. Yet, economic progress in China was uneven: As several scholars[2] point out, China has also experienced a large increase in income inequality with the Gini index rising from 28% in 1981 to 39% in 2001. Although inequality has increased in both, urban and rural areas, there is an interesting geographic component with higher poverty reduction achieved in coastal areas than western, landlocked ones. Recent research estimates, however, that the gap between urban and rural areas has not increased once the higher increase in living costs in urban areas is accounted for although rural areas still lag behind in terms of development (Benjamin et al., 2005).

Turning to consumption patterns in China, the question arises what do conventional inter-temporal models of consumption suggest for the consumption and saving behaviour of people in developing countries with high income growth.

[1] MGI (2006) defined 'economic classes' according to conventional definitions by the World Bank and some assumptions about definitions of lifestyles of the people in the income bands.
[2] Cf. Ravallion and Chen (2004a, 2004b, 2008a, 2008b), Benjamin et al. (2004, 2005).

Standard economic textbooks suggest that an individual's consumption in a given period is determined not by his income in that period, but rather by his or her income over the entire lifetime, the time-averaged "permanent income" (Friedman, 1957). This means that savings are high when current income is high relative to its life-time average. Consequently, when incomes are expected to increase with economic growth, an individual's actual income is less then permanent income, saving is negative and the individual may wish to smooth the path of consumption through depletion of past savings or borrowing, e.g. at credit markets. (Romer, 1996: 348) If the idea of consumption according the permanent income is transferred to an individual's life-cycle consumption behaviour, the individual saving profile depicts a classical humps-shape; this means that people are net-savers during their working years and dissavers during retirement and in their early life. This is the idea of the life-cycle model of consumption, originally proposed by Modigliani and Brumberg (1954).

In the case of a country like China, these theoretical models would suggest, households that look forward to higher earnings in the near future would try to smooth their consumption by borrowing against future income, especially if real interest rates are low. If this is not possible, e.g. because of incomplete credit markets, they (especially the younger ones) are at least expected to postpone their savings. Evidence from China, however, shows little consumption smoothing over the life cycle (Chamon & Prasad, 2007); instead saving rates are high and increasing across all demographic groups, including those who can expect fast income growth in the future. Thus, consumption tends to parallel current income which is more consistent with the buffer-stock model of savings.[3] Additionally, instead of the traditional "hump-shaped" profile of savings over the life cycle, a U-shaped pattern was found where saving is highest for the younger and older households.

How can the puzzle of rising aggregate saving rates and the inverted life-cycle pattern of savings be explained? According to Chamon and Prasad (2007) it is the declining public provision of education, health and housing services (the end of the "iron rice bowl") that played an important role creating new incentives for savings. Expenses for both education and health together made up only 2 percent of total consumption expenditure in 1995 and rose to 14 percent in 2005. Moreover, the rate of private house-ownership was 17 percent in 1990 and rose to 86 percent in 2006 as urban housing stock was privatised. At the moment, Chinese consumers tend to rely on past savings to finance lumpy consumption goods such as durables and housing, because consumer financing is still limited in China although it has risen significantly (Chamon & Prasad, 2007).[4]

Looking at the life cycle, high saving rates among the young could be a sign of the need to build up an adequate buffer stock of savings to smooth income against adverse shocks and to

[3] According to this model, individuals build up a buffer-stock of savings to smooth against (unexpected) adverse future effects to their income (Carroll, 1997). Cf. also Giles et al. (2007) for a discussion of saving motives in China.

[4] According to Chamon and Prasad (2007) total consumer loans issued by all financial institutions rose from near zero in 1997 to around 2.2 trillion Yuan by the end of 2005 (12 percent of GDP).

finance housing and the purchases of major consumer durables. Higher saving among the older cohorts could reflect general uncertainties created by market oriented reforms (layoffs by state-owned enterprises) and not having many working years ahead to benefit from those reforms, as well as the rising burden of health costs which are increasingly shifted from the state to households (Chamon & Prasad, 2007).

2.2. The Demand for Durable Goods

Having envisaged consumption and savings more generally, the question arises whether the demand for durable goods can be dealt with in the same ways. First, let us take a more accurate look at durable goods by outlaying some of their important characteristics of them.

2.2.1. Definition of durable goods

Durable goods differ from non-durable goods in their characteristic lumpiness and in their durability. These characteristics have important implications; the latter means that durable goods do not quickly wear out and that they yield services and utility over time rather then being completely used up once they are consumed.[5] Therefore, in contrast to non-durables, consumption and purchase are not the same for durable goods; purchases are considered as adding or acquiring stocks, whereas consumption is regarded as the depletion or physical deterioration of these stocks. Additionally, the reason for purchasing a durable good could either be the new demand of a consumer who wants to acquire ownership for the first time or, on the other hand, it could be the replacement demand of an actual owner who wants to maintain a certain utility flow from a durable stock which has decreased because of depreciation. The second important characteristic, the lumpy nature of durables, implies that the choice whether or not to buy a durable is largely a choice between two discrete alternatives. It differs, therefore, from the purchase of non-durables which can be made over a more continuous, quantitative range. This, in consequence, implies that price decision is discontinuous too for durables; they have higher unit cost (Deaton & Muellbauer, 1980: 345ff).

The list of durable goods characteristics outlined above is not exclusive. It is clear that there are many other issues that are specific to durable goods or durable goods markets. Therefore, as Deaton and Muellbauer (1980: 345) put it, a broad variety of *"really different and seemingly contradictory approaches have been put forward"* in the literature, *"and agreement is far from*

[5] Most goods are durable goods to some degree. The degree of durability depends on the time horizon of interest. A perfectly durable good, like a paperweight for instance, never wears out. Examples of durable goods include cars, household appliances and so on.

universal as to what are the central issues". Consequently, the questions of interest and, in the case of an empirical research project, the data at hand determine which characteristics of durable goods are emphasised.

2.2.2. The Neo-Classical Perspective

In the conventional neoclassical approach durable goods consumption is modelled as the *replacement demand* of households that operate in perfect markets[6]. The purpose of a household's replacement demand is to compensate for the depreciation of the durable stock in possession with some new acquisitions in order to maintain a desired flow of utility from a given stock of the durable good. This approach transforms the demand for durable goods into a form analogous to the demand for non-durables. Models with stock adjustment have been put to empirical scrutiny. There is both pro and con evidence that has been put forward.[7]

The emphasis of this paper is, however, to investigate the newly arising demand of households and the diffusion of durable goods ownership in a population rather then the replacement demand of a society where diffusion has already taken place. Furthermore, in the analysis of microeconomic data on durable ownership (rather than aggregate data on durable sales) it is not useful to maintain the idea of a continuously variable stock of durables in the way of neoclassical modelling (Deaton & Muellbauer, 1980: 366).

2.2.3. Discrete Choice Modelling

Another approach is to look at the demand for durable goods as a discrete choice between ownership and non-ownership. As Deaton and Muellbauer (1980: 366) point out this particularly makes sense when working with microeconomic data where the pretence of continuous variable stocks of durables cannot be maintained as shown above.

The Household Production Approach

In one branch of literature, where discrete choice modelling of durable goods demand has been employed, scholars analysed the joint demand of durable goods usage and the demand for energy

[6] Having perfect markets means, in this context that households are able to borrow and lend quite freely at constant and identical rate of interest and that purchases and sales of the durable are allowed at a common price. Furthermore, purchases are allowed to be continuously variable in amount.
[7] See for instance Bernake (1984), Mankiew (1982).

(fuel or electricity).[8] In these models, based on the household production theory, the household obtains its utility not from the usage of durable goods directly but from its end-product, mobility in the case of cars for instance (Deaton & Muellbauer, 1980: 243). Mobility, then, is produced by the household itself through the employment of various input factors such as the durable good, fuel, labour and so on. Concerning energy demand, these models treat the demand for durable goods endogenously as a discrete choice which can be adjusted by the intensity of usage in the short run *(intensive margin)* and by the decision of owning or not-owning *(extensive margin)* in the long run. Although these models seem quite compelling in the case of joint modelling of energy and durable goods demand, they focus more on the household's choice between qualitatively different goods and their empirical estimation requires a lot of information. They particularly draw on information such as prices and further qualitative characteristics of durable goods and energy prices by modelling the household's choice between different durable good portfolios. As will be outlined in the data chapter, such information is not available in the data sets employed in the succeeding analysis.[9]

Empirical Evidence

However, the case of China as a developing country with rapid income growth makes it interesting to shed more light on the households' decisions when they intend to go from non-ownership to ownership taking into consideration their income level and other factors of influence. Thus, the focus lies on the diffusion[10] of durable goods ownership and the first demand for durable goods.[11] The motivation for this approach is best summarised by cross-country evidence. Figure 2.1 shows a cross-country scatter plot of car ownership, as an example of a typical durable good, against the logarithm of per capita incomes (in US dollars – PPP adjusted) for the years 1962 and 2002. A look at the data suggests a non-linear relationship between car ownership and the countries' average income level; typically, car ownership rates are minimal in the lowest income countries and do not show a high sensitivity to increases in average income levels. Then, as incomes rise and the country reaches a middle income level, ownership rates become very responsive to further increases in income. This means that income elasticity is highest when a significant share of the population

[8] Cf. Kiessling (2008), Bonomo (1998), Durbin & McFadden (1984), Conrad & Schroeder (1991), Matsukawa & Ito (2005).

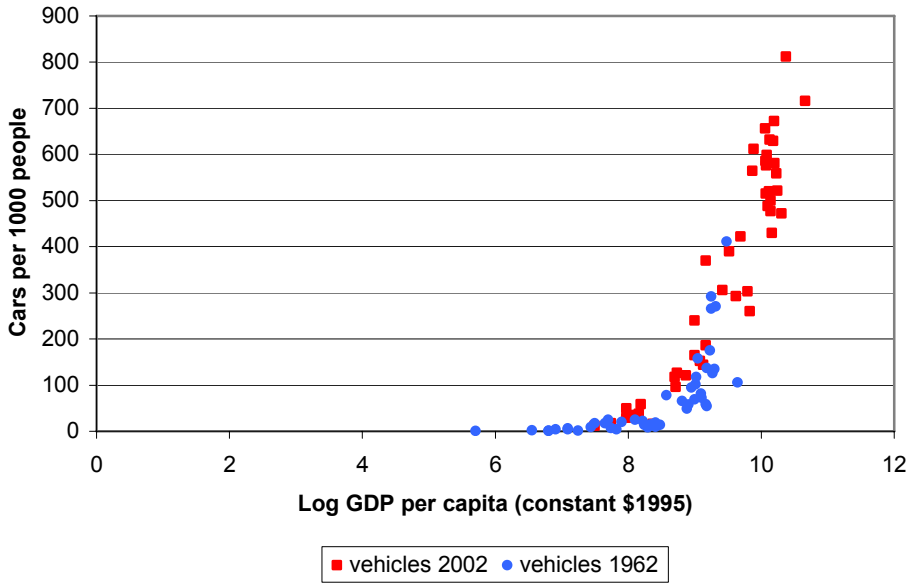
[9] As Storchmann (2005) shows, such information could be collected and applied by generalising the typical cost or quality characteristics of a certain durable. As in the case of Storchmann's paper, this makes more sense if the focus lies on the analysis of cross-country differences whereby data can be obtained more easily from national statistics then in the case of microdata information.

[10] Diffusion in general has been widely studied in the literature, not only in the case of durable goods. Cf. Gerolski (2000) for a good review of the literature and Grilliches (1957) with his seminal work on the diffusion of hybrid corn in the U.S.

[11] It is clear that studying the first demand for a given good has not to be restricted to developing countries; learning about diffusion patterns, e.g. in the case of new, innovative goods, could well be interesting in more advanced countries where consumers have more purchasing power but do not know yet about the products of interest.

reaches a critical income threshold where people above it are able to afford cars (Dargay & Gatley, 2007). In this context, Chamon et al. (2008) point out that the characteristic lumpiness of cars plays an important role in explaining why car ownership rates are typically low and insensitive to changes in income in low-income countries, whereas income becomes a major determinant of car ownership once a middle-income stage is reached. He argues that ownership rates might rise with per capita incomes even among the most advanced countries, although they are expected to level off gradually and a saturation point will be reached. Other empirical work with cross-country panels confirms this non-linear relationship between per capita income levels and car ownership.[12]

Figure 2.1 Cross-Country Scatter Plot of Car Ownership and GDP per Capita



Note: The data refer to 45 countries for the years 1960 (or the first year available) and 2002. GDP data are PPP-adjusted and in constant $1995.
Source: Data from Dargay & Gately (2007), own illustration.

The Theoretical Model

The association of durable goods ownership with the consumer's income being above a certain threshold in a discrete choice model was originally put forward by Farrell (1954) in his seminal work on the demand for motor cars in the pre-war United States. In this model individuals differ in their tastes with respect to ownership of durables, which in turn affects their individual "threshold", e.g. how rich they have to be before acquiring a certain good. More formally, an individual will

[12] Cf. Storchmann (2005) for a good survey over the most recent literature on cross-country evidence and Dargay & Gatley (2007) for their empirical work carried out with country panels including developing countries.

own a durable good, q_i, if his or her actual income, y_i, is higher then his or her individual threshold income, y_{0i},

$$q_i = 1 \; if \qquad y_i \geq y_{0i}$$
$$q_i = 0 \; if \qquad otherwise \tag{2.1}$$

Intuitively, someone who draws a high utility from the ownership of a certain durable is more willing to forsake the consumption of other goods and will buy it provided he or she can afford it. On the other hand, someone who has a lower utility from ownership will only acquire it if he or she is very rich (Chamon, 2008). This has important implications considering the difference between poor and more affluent household with more spending power: According to Engel's law (1857) a household's budget share devoted to food will increase, but under-proportionally with rising income whereas the share devoted to manufacturing goods rises.[13] This is why the budget share devoted to food, or conversely the budget share devoted to other goods such as durables, can be seen as an indicator of welfare or development (Deaton, 1997: 251).

Since preferences vary form individual to individual, so do the individual thresholds. Therefore, it is assumed that the threshold incomes are distributed independently of the actual income of a consumer and that this distribution is of the form $f_{y_{0i}}(y_{0i})$.[14] Then, the probability that an individual with a given income y_i will actually own a durable good is just the probability that her or his actual income is above his or her own threshold income level y_{0i} for the desired durable good. This can be written as

$$g(y_i) = P(q_i = 1 \mid y_i) = P(y_{0i} \leq y_i) = \int_o^{yi} f_{y_0}(y_0)dy_0 \tag{2.2}$$

Equation (2) denotes the Quasi-Engel curve[15] which assigns to each income level the corresponding fraction of owners. As Bonus (1973, 1975) shows in his work on the demand of durables in post-war Germany, there is an interesting link between the properties of these Quasi-Engel curves and

[13] Consider, for instance, two households with the same tastes (individual thresholds) but different income levels. At lower income levels, when non-durable consumption is low and more resources must be devoted to subsistence consumption, the utility from durable ownership is more likely to be lower then the utility from non-ownership. Then, the marginal disutility from forgoing consumption at the expense of durable ownership is large compared to the benefits of durable ownership. At higher income levels, non-durable consumption levels are higher and the disutility from having less at the expense of durable ownership will diminish. (Deaton, 1980: 367)

[14] Although it is a strong assumption that individual income levels and tastes are not correlated, this approach has been widely used by scholars. For econometric convenience it is assumed that the threshold incomes are distributed log-normally in the population, i.e. $f_{y_0}(y) = \Lambda(y_0 \mid \mu, \sigma^2)$

[15] The term is due to Cramer (1958) who reinterprets the traditional Engel-curve (Engel, 1857) to describe the relationship between the probability of ownership and income. Engel-Curves describe the ceteris paribus relation of any consumption behaviour to the income of the consumer and are traditionally deduced from household surveys (Cramer, 1972: 26).

the patterns of durables diffusion. The next section will provide a closer look on this topic. Employing microeconomic survey data on individual household, Quasi-Engel curves can directly be estimated by the principle of maximum likelihood. (Deaton, 1980: 369) The exact estimation equation is given in the data chapter in the section to the econometric strategy.

In his work on durables demand Bonus (1973, 1975) focuses on the relationship between ownership, income and threshold incomes of households without a further analysis what these thresholds exactly are. This is why an analysis entirely based on his work would lack some clarity of the driving forces behind the changes in thresholds which remain when income has already been accounted for. More recent work with this threshold approach has been done by Chamon et al. (2008) who estimate and project car ownership for both cross-country and household level data with a particular focus on India and China. In order to control for influences on ownership not captured by income alone they suggest including other factors, such as population characteristics and durable prices, into the estimation of the ownership equation. According to Deaton (1980: 367ff) the open framework of Quasi-Engel curves allows including such factors through the household's utility function in order to give a more precise picture of its threshold incomes.[16] Other closely related work from Rong and Yao (2003), for instance, highlights significant impact of the deficiency of public service provision, such as electricity supply, that is a major limitation for the demand of electric appliances in rural China. They suggest that improvement of such complementary public services would have strong impacts in rural areas not only by improving the people's livelihoods but also in terms of strongly boosting the demand for electric appliances. Furthermore, other studies[17] about expected and observed developments of durables demand in China and other developing countries point out the close ties to other trends such as urbanisation, private home ownership, regulation and, in the case of cars, public transport and road infrastructure.

2.2.4. Properties and Dynamics of Engle-Curve Diffusion[18]

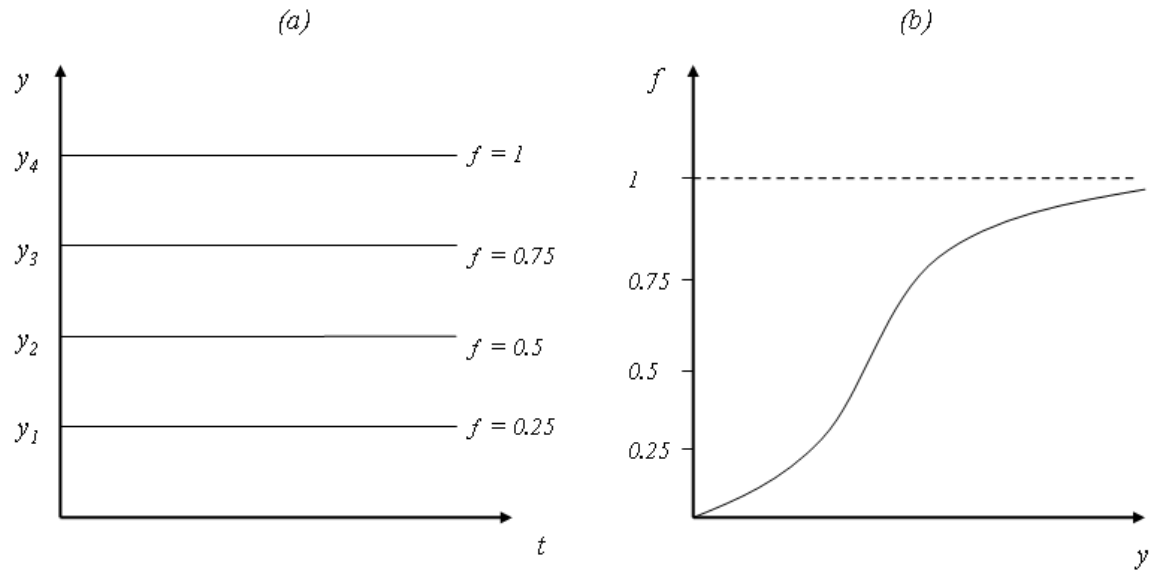
Having this concept in mind, it is now possible to distinguish between different factors that drive diffusion of durables in a population. According to Bonus (1975: 35ff), these are, on the one hand, *"autonomous"* socio-psychological factors that increase the intensity of the desire to own a certain good, i.e. change preferences and thereby threshold incomes. On the other hand, there are changing economic conditions which he calls *"triggering"* factors, like changing individual incomes, goods prices and quality.

[16] Factors from the utility function, i.e. the preferences, influence threshold incomes. A mathematical description has been omitted for the sake of brevity. A detailed derivation how preferences are included into Quasi-Engel curves can be found in Deaton and Muellbauer (1980: 366ff).
[17] Cf. ADB (2006), Zhou (2008), Fridley (2007), IEA (2007).
[18] Unless otherwise noted the following explanations and illustrations are based on Bonus (1975: 35ff)

The most obvious of these factors is *growth of individual incomes*. If the diffusion of durables is only driven by growth of incomes, the households' income thresholds do not change over time. Households simply acquire the durable good when their income rises above their individual threshold. Then, as incomes increase, the share of owners in the population follows an increasing S-shaped curve. This is illustrated in Figure 2.2 (a) and (b). In any income group *(y_1* to *y_4)*, a fraction of households, *f*, will have sufficiently low threshold income to be actual owners. Then, the fraction of owners in a certain income group just reflects the share of the people of that group whose income is above their individual thresholds.[19] In this example, the fraction of owners in the lowest income group, y_1, is 25% whereas that share is 100% in the highest income group. Although these proportions remain constant over time for each income group (horizontal isoquants in Figure 2.2 (a)), the proportion is higher in higher income groups. Hence, as average income increases and the entire income distribution is shifted, households are lifted into higher income groups and, eventually, over their individual thresholds. As was also demonstrated above by cross-country evidence, the stylist diffusion process following a sigmoid can be structured into three phases: First, at low levels of average income, only few people are rich enough to have an actual income above their threshold and hence to own the durable good. Later, as average incomes increases or prices fall, many households are close to their threshold income and further changes will have a much larger effect on aggregate ownership. In the final stage, the lowest income groups are lifted above their threshold, saturation is reached and aggregate ownership again becomes insensitive to changes in income or price. (Deaton, 1980: 370) It is worth noting that there is a direct link between the curvature of the sigmoid and the *distribution of incomes* (cf. Figure 7.1). With higher inequality, Quasi-Engel curves are flatter; although ownership rates are higher at low levels of average income than in more equal societies, the diffusion of ownership can be expected to be slow, only proceeding quickly in the final stages when the bulk of the people is lifted above their thresholds. Conversely, when incomes are more equally spread, the sigmoid becomes steeper, diffusion happens more rapidly and saturation levels will be reached faster (Deaton, 1980: 370)

[19] As Bonus (1975: 41) points out this assumes that the distribution of threshold incomes is the same for each income group as it is for the entire income distribution.

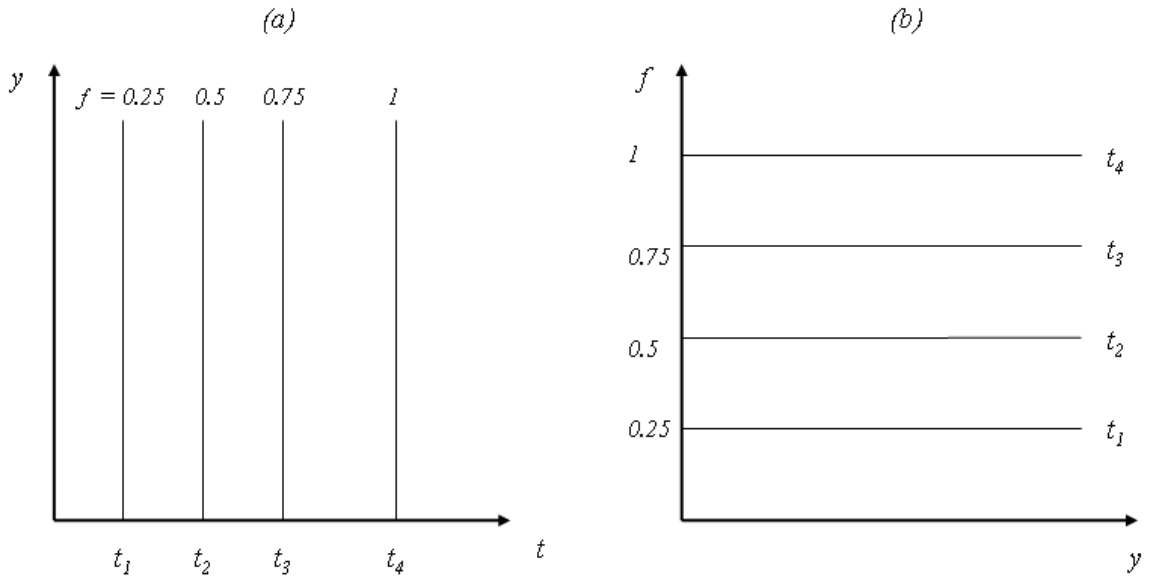
Figure 2.2 Income Induced Diffusion: Isoquants (a) and Quasi-Engel Curve (b)



A second process[20] can be distinguished if everybody who is *aware* of the durable good actually owns it (cf. Figure 2.3). Then, as time goes by, more and more people become aware of the good and acquire it. In this context, ownership is independent from the income level of a given household. Now, each phase of the diffusion process refers to a certain share of owners in the population whereas this share is similar for all income groups. Therefore, isoquants are vertical and "quasi"-Engel curves horizontal. Bonus (1975: 37) notes that the appearance of hula-hoops in the late 50s could be an example. Because of their low purchase costs, everybody who was aware of this new fashion actually bought it. As we will see later, though, the durable goods studies in this paper were well known in China from the very beginning of the survey period in 1989, making this driver of diffusion less likely.

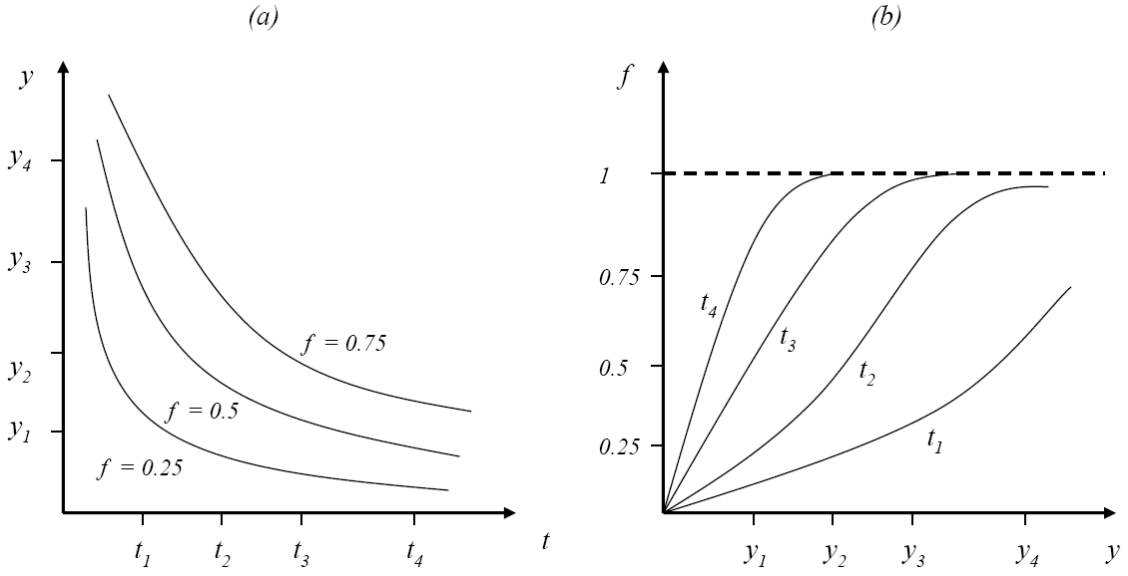
[20] Bonus (1975) notes that this kind of diffusion process might arise mainly for goods that are cheap enough to allow acquisition even in the lowest income groups without squeezing out other, necessary consumption expenditures.

Figure 2.3 Diffusion Through Rising Awareness: Isoquants (a) and Quasi-Engel Curves (b)



As a third process, diffusion of ownership in the population can be triggered when *threshold incomes decrease* over time. This means that more and more households will have higher preferences towards ownership and find themselves above the critical threshold and, hence, acquire the good even when their incomes remain constant. This is illustrated by falling isoquants and Quasi-Engel curves that shift to the left in Figure 2.4. If incomes are held constant (horizontal cut through isoquants, Figure 2.4 (a)), the share of owners in the population automatically increases with time (from t_1 to t_4) as thresholds are lowered exogenously. On the other hand, it can be observed that the fraction of owners is higher for more affluent income groups $(f(y_4) > f(y_3) > ...)$ at a given point in time (vertical cut through isoquants). According to Bonus (1973), the process of decreasing threshold incomes is accompanied by a rising variance of individual thresholds. This means that ownership becomes less concentrated among income groups whose income is above the average threshold income. Thus, the durable good becomes more 'popular' in the society and loses some of its exclusivity to higher income groups. Bonus (1973, 1975) points out that the variance of the threshold incomes can be seen as a luxury-necessity indicator; with a low variance of threshold incomes, ownership is largely concentrated in income groups with incomes above the average threshold income. Thus, the durable good has more of a luxury character.

Figure 2.4 Mixed Diffusion Through Rising Incomes and Decreasing Threshold Incomes: Isoquants (a) and Quasi-Engel Curves (b)



Additionally, Bonus (1973) shows that changes in individual threshold incomes cannot only be influenced by economically 'autonomous' changes in preferences, but also by changes triggered by the supply side. These could be spurred, on the one hand, by falling durables' prices that increase the households' spending power and thereby lower their threshold income. On the other hand, they could entail the appearance of cheaper substitutes which make the same durable good available for lower income groups as well. On the other hand, Bonus (1975) demonstrates that improvements in quality of durables could also lead to lower threshold incomes. Imagine, for instance, that a better TV signal or more TV programs to watch will increase the attractiveness of having a colour TV and, hence, shift preferences for ownership upwards. In sum, a thorough analysis should therefore include measures to control for changes on the supply side in order to disentangle these effects from 'autonomous' changes in the preference structure of households.

Now, if the assumption of constant incomes is relaxed and people experience increasing individual incomes while their thresholds gradually fall, households move diagonally in Figure 2.4 (a) to higher isoquants as time goes by. Then both components of the diffusion process, rising individual incomes and decreasing thresholds, reinforce each other.

As Bonus (1975) summarises, a 'typical' durable goods diffusion process includes all of the diffusion types outlined above (cf. Figure 2.4 (a)): At the outset of the diffusion process, knowledge about the good is the primary force behind acquiring ownership (shown with vertical isoquants). Then, in a second stage, there is a mixed type of diffusion process; the effect of rising individual incomes is reinforced by effect of decreasing threshold incomes (isoquants become flatter, but are not yet horizontal, people move diagonally). Finally, in the last stage, the decrease of

threshold incomes comes to a halt. This is the case because the average threshold income attains a low level where income groups are only scarcely populated. Then, the "Quasi"-Engel curve becomes more and more fixed and rising ownership rates are mainly driven by the rate with which people climb from lower into higher income groups (horizontal isoquants). The diffusion process stops in the end as income groups with a low share of owners run out of people.

To sum up, people acquire a durable good if their actual income is above their individual threshold income. Thus, the diffusion of durables in a society is driven, on the one hand, by autonomous changes of people's preferences towards the durable good that influences their threshold income. On the other hand, changes in aggregate ownership happen through changes of economic conditions on the demand side (changing individual incomes) or on the supply side (changing durable prices or quality). The latter, in turn, also influence individuals' threshold income towards ownership. In order to model changing patterns of durable goods demand, the understanding of these influence factors is necessary. The aim of the following analysis is to describe which of these processes are involved in the diffusion of major consumer durables in China from 1989 to 2006. With the insights gained from this analysis, there is an attempt to project how the ownership of some major durable goods is going to develop in the coming years.

3. Data and Empirical Strategy

The aim of this chapter is to introduce the data set employed in the subsequent econometric analysis. The longitudinal micro-data set contains data about the Chinese household's ownership patterns, incomes and some control variables. As outlined in the theory chapter, households make ownership decisions considering their actual income and their threshold income. Threshold incomes, in turn, are influenced by supply side effects, such as changes in durable prices or quality, or shifts in individual preferences. In order to scrutinise such supply side effects, a price measure of durable goods prices was included. Shifts in preferences can barely be measured directly. As shown in the theory chapter, however, both consumption theory and empirical evidence from China and other developing countries suggest that there are other influence factors that shape their consumption decision. In order to control for influences of such factors, a series of socio-economic characteristics of households have been integrated into the data set. Furthermore, variables on the household's livelihood conditions and public service provision are considered as controls.

3.1. Data Sources and Data Preparation

The main data source this analysis draws on is the China Health and Nutrition Survey (CHNS)[1]. The CHNS is an ongoing international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention. The first wave of CHNS data was collected in 1989 with six subsequent waves in 1991, 1993, 1997, 2000, 2004 and 2006. Further rounds of data collection are planned in 2009 and 2011. Each of these surveys was conducted by an interdisciplinary team of economists and nutritionists using a multistage, random cluster process to draw a sample of around 4400 households (or about 19'000 individuals) in nine provinces[2] that very substantially in geography, economic development and public resources. The high follow-up levels in the CHNS allow longitudinal data analysis although families that migrate from one community to a new one are not being followed. According to Benjamin et al. (2005) it is an important feature of this survey that it follows a panel of cities and villages across survey years. Therefore, the ratio of urban to rural households remains constant (at one-third) over the entire survey period even though rural areas might

[1] CHNS data on household assets, income and socioeconomic characteristics may be obtained directly from the website on http://www.cpc.unc.edu/projects/china upon registration. In order to obtain data on community level information an application is necessary.

[2] These provinces are Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, Shandong. Note that, Liaoning did not take part in the CHNS in 1997 and Heilongjiang was added to the survey in 1997. A map of the survey regions is provided in the appendix (cf. Figure 7.2).

have developed further and become more urbanised. The CHNS consists of surveys carried out at three different levels; on the individual level (children and adults separately), on the household level and on the level of communities. Although the survey is mainly intended to study health and nutrition in a rapidly changing society there is an abundance of variables of economic interest on each of the three collection levels.

3.1.1. Ownership – The Independent Variable

The independent variables on the ownership of various durable goods are provided on the household level, like a household's ownership of a car, for instance. Therefore, other variables from CHNS and other data sources had to be set on the household level and merged into base data set.

In the basic CHNS data set on household assets there are variables with respect to the ownership of household appliances, of means of transportation and of farming machinery. As will be explained below, the subsequent analysis is restricted to three different durable goods: colour TVs, refrigerators and cars. No further information about characteristics, age or quality of the durables[3] owned is provided. Therefore, the emphasis of the subsequent analysis is on ownership versus non-ownership. There is information, however, about how many items of a specific durable good are owned by the household:[4] For instance, how many colour TVs a household owns. Since a certain proportion of households possesses more than one item of certain durable, information only about ownership versus non-ownership alone underestimates the general stock of durable goods in the entire population. As will be shown below, ownership patterns and durable goods stock virtually converge for some goods whereas they differ by a large degree for other goods.

[3] Although questions about the total value of all items of a specific durable good are asked, these were answered very rarely, leaving most of the observations in data set missing. Therefore, this information was not used, e.g. as an information about durable goods prices or expenditures.

[4] The variables on 'multi-ownership' had to be cleaned, since non-ownership was given as missing values instead of zero-values for this variable in the original data set. In order to disentangle non-ownership from 'real' missing values, missing values in the 'multi-ownership' variable were converted to zero values if the household was a non-owner according to the 'single-good-ownership'-variable (only information about ownership vs. non-ownership).

3.1.2. Explanatory Variables

Household Disposable Income

The main explanatory variable, per capita household income, is provided by the CHNS in longitudinal data-files[5] and was merged with the longitudinal assets file by the household identity number. Household disposable income[6] in the CHNS is conceptualised as the sum of all sources of market and non-market incomes or revenues minus expenses on the household or individual level.[7] Information from individuals was simply aggregated to the household level with missing values imputed. In questionnaires, information from nine potential sources of income was collected: business, farming, fishing, gardening, livestock, non-retirement wages, retirement income, subsidies and other income. According to Benjamin et al. (2005), the better coverage of non-monetary government subsidies and some other sources of income - particularly from non-farm self-employment – display an important advantage of the CHNS data in measurement of income in China. Per capita incomes were simply constructed by dividing total household income by household size[8]. It is an interesting aspect of income that migrant workers are supposedly not covered by the CHNS (as it is the case in most household surveys), though their remittances are (Benjamin et al., 2005). According to Ramstetter et al. (2006), it is because of the Chinese residency registration system *(*the so-called *hukou system)* that a large number of rural-to-urban migrants were not able to acquire urban resident permits and are counted as rural residents or simply ignored. Hetel and Fan (2006) reckon the scale of this problem is large with 19% of rural labour falling in this category in 2001. This is why the number of poor and the scale of inequality are likely to be higher than reported by most household surveys.

[5] A new income measure was provided by the CHNS staff in mid-November 2008, leaving aside many of the problems associated with income measures provided earlier. Detailed description of the new income files can be obtained on http://www.cpc.unc.edu/projects/china/data/datasets/convar.html (access: 6.12.2008)

[6] The term 'disposable income' is used nowhere by the CHNS in their income description files. However, several authors working with total income measures from the CHNS use the term explicitly or implicitly. Whereas Wagstaff (2005) refers directly to the CHNS total income measures as disposable income other scholars (cf. Benjamin et al. (2004, 2005)) compare total and per capita household income from the CHNS with disposable income measures from the National Bureau of Statistics. Therefore, total and per capita household income from the CHNS is seen as disposable income in the following analysis.
Disposable income is defined as *"the part of income that remains after deduction of income tax, social security contributions and any other statutory obligations that the household may incur"* (Cramer, 1972: 174).

[7] Note that some households report negative values for their net household income. According to the CHNS staff this can be due to the cyclical nature of farming and livestock and other business, differences in weather and changing market prices.

[8] Household size in the CHNS is defined as the sum of the number of household members that participated in any part of the household survey and the number of household members that appear in the household roster but did not participate in the survey because of absence, e.g. working elsewhere or being at school.

Prices

In order to make incomes comparable across survey years, total and per capita household incomes were deflated to constant 2006 Yuan. The price deflator[9] used is also provided by the CHNS and is based on a common consumer basket for urban and rural areas that allows for spatial differences in prices. In order to make welfare comparison across heterogeneous provinces, this approach is advantageous since it allows controlling for differences in the cost of living between urban and rural areas. According to Liu (2008) this price indicator fills a gap in the official published price data from the National Bureau of Statistics (NBS), which does not provide different rural and urban price indices at the provincial level. As Benjamin et al. (2005) note, income and prices levels are expected to be positively correlated. For instance, the cost of the same basket of goods in 2006 is more than thirty percent higher in urban areas than it is in rural areas of the province Jiangsu. Neglecting these differences in the cost of living could lead to an overestimation of inequality.

Supply-Side Effects

As described above, there is no (or no reliable) direct information about durable goods quality or prices in the CHNS data set. In order to still get an idea of influences from changes on supply side patterns, a measure for the relative development of durable prices was included in the data set. This approach is inspired by Chamon et al. (2008), who used a similar approach to control for changing car prices.

Data on changing durable prices are available in the China Statistical Yearbooks from the NBS (2008) in subsections[10] of data on the general consumer price index (CPI). Those CPI measures describe the development of durable prices relative to the year earlier for both urban and rural areas. Following Chamon et al. (2008) those CPI measures were divided by the general CPI measure in order to get the development of durable prices relative to general development of prices. Then, in a second step, a time-series was constructed showing the entire change of relative durable prices throughout the survey period setting the first survey year available to 1. More formally,

$$(\text{durable price level})_t = \frac{CPI_t^{durable}}{CPI_t^{general}} (\text{durable price level})_{t-1} \tag{3.1}$$

[9] An exact description of the price deflator employed by the CHNS in order to get an adjusted income measure is available on the web: http://www.cpc.unc.edu/projects/china/data/datasets/convar.html (access: 6.12.2008)

[10] Two different subsections were chosen: Concerning electrical appliances, such as colour TVs and refrigerators, a CPI measure of "durable consumer goods" was chosen from the section "household facilities, articles and services". In order to control for price developments of cars, the CPI measure "means of transportation" from the category of "transportation and communication" was selected. These were the closest CPI measures available for the respective durables from the Statistical Yearbooks for the time period in question. Data taken from www.chinadataonline.org (access 12.12.2008).

For example, the measure of household electric appliances shows that their relative price decreased by nearly 50% between 1993 and 2006 (cf. Figure 4.4 below in the results section). Since these price measures were only available from 1995 onwards, the 1994 measure was constructed from the average of the three following years. This allowed building a time-series of the development of the relative durable goods prices based on 1993, the third wave of the CHNS. Otherwise the effect of a relative price change of durable could have only been studied for the last four surveys, a much shorter time horizon.

Other Control-Variables

Variables on household characteristics were included to the main data set from a bunch of different other CHNS data sets. Family or household size was available in the same longitudinal data set on household assets as the ownership variables. Other characteristics, such as education and age of the household head[11], were included from two separate longitudinal files[12] on the individual level and merged into the main data set through their household identification number. The education variable from the individual's education survey was transformed from an ordinal variable indicating the household head's highest level of education attained to a continuous variable showing the number of years of education according to the Chinese Ministry of Education (CME, 2008)[13]. Having a continuous education variable allows to estimate the effect of a further year of education on durable goods ownership.

Graduation from primary school	6 years
Lower middle school degree	9 years
Upper middle school degree	12 years
Technical or vocational degree	at least 11 years
University or college degree	at least 16 years
Master's degree or higher	at least 18 years

[11] As Deaton and Paxson (2000) point out, working with characteristics specific to the household head is the usual approach when working with household survey data since information (about ownership in this case) is given at the household level. This approach implicitly assumes that decisions (about ownership) made by the household are usually made by the household head (or married couples of same-aged people) and that people normally become household heads at adulthood and remain so for the rest of their lives.

[12] These are the longitudinal files of the individuals' roster and the file on education of individuals.
One problem arising was that for some 71 cases there were two individuals per household declared as household heads in the same survey year. Since those cases varied substantially and there was no general rule for exclusion of double households, their age and education variables were set to missing values.

[13] confer http://www.edu.cn/20041203/3123354.shtml (access: 30.12.2008)

Acknowledging that development measures vary considerably with location, two geography indicators were included; one to distinguish between urban and rural areas and another for coastal eastern provinces and landlocked interior provinces.[14]

With regard to living conditions or the provision of public services and infrastructure, some further control variables were included in the data set. Some of those were integrated from the CHNS community level data, which was surveyed for each sampling unit, i.e. each village or neighbourhood in the CHNS sample.[15] Data from the community survey provides information on community infrastructure, a variety of services, general population characteristics in that community and free market price data.[16]

Following Rong and Yao (2003), indicators of electricity supply were included as preconditions for electrical appliances. Thereby the dummy variable for the usage of electric lighting was taken as an indicator for the availability and usage of electricity[17] from the household assets data set and the variable on the number of hours of electricity available per day was taken from the community level data set. A dummy variable for the availability of running water (from the household assets data set) was constructed as a further development or infrastructure indicator for households. Lastly, variables on the availability of bus stops or train stations (from the community level data sets) were chosen as controls for outside opportunities of car ownership.

[14] Liaoning, Shandong and Jiangshu were classified as coastal provinces and Heilongjiang, Henan, Hunan, Hubei, Guangxi, Guizhou as interior provinces.

[15] Accordingly, sampling units or communities are administrative districts, not natural population clusters.

[16] Although information from the community survey seems impressive on first sight, the data do not come without significant shortcomings such as missing data for many survey years, unclear and changing definitions and so forth. This is why, for instance, prices of fuel and electricity were not considered for the analysis although several authors (Chamon et al. (2008), Rong and Yao (2003)) point to significant effects on durable ownership. Comparable problems also arise with data from the household assets data set; several authors (Chamon and Prasad (2007), IEA (2007)) point out that the privatisation of housing stock in Chinese urban areas had significant impacts on furnishing and durables demand. However, a variable of whether households own their home could not be included in the analysis because of its unreasonable high ownership rates in early survey years: In the CHNS, households that own or partially own their home have a share of 52% in urban areas in 1989 whereas Chamon and Prasad (2007) report only 17%. Considering such variables would require a more thorough pre-investigation which was beyond the scope of this paper.

[17] Note that households reported non-electric lighting (e.g. candles, kerosene) as most common source of light although community survey data (filled out by a knowledgeable person of the administrative units) affirmed the availability of electricity. That is why the variable on electric light usage on the household level was chosen as a better indicator for electricity usage of households than an available variable on electricity supply from the community level.

3.2. Descriptive Statistics and Data Quality Issues

Taking together all households from all survey years, 27'983 numbers of observations are available for the econometric analysis. Although the panel is not perfectly balanced, an average household participated more than four times out of seven possible survey years and some 2044 households show up in every wave. Table 3.1 shows some descriptive statistics for the variables employed in the succeeding econometric analysis and their number of observations. As it turns out, most variables employed have fewer observations because of missing values. The relatively lower numbers of observations of variables on relative durable goods prices are explained with by their being available only from 1993. Since the following analysis is largely about the relationship between income and ownership, it is worth to shed more light on the developments of these two variables.

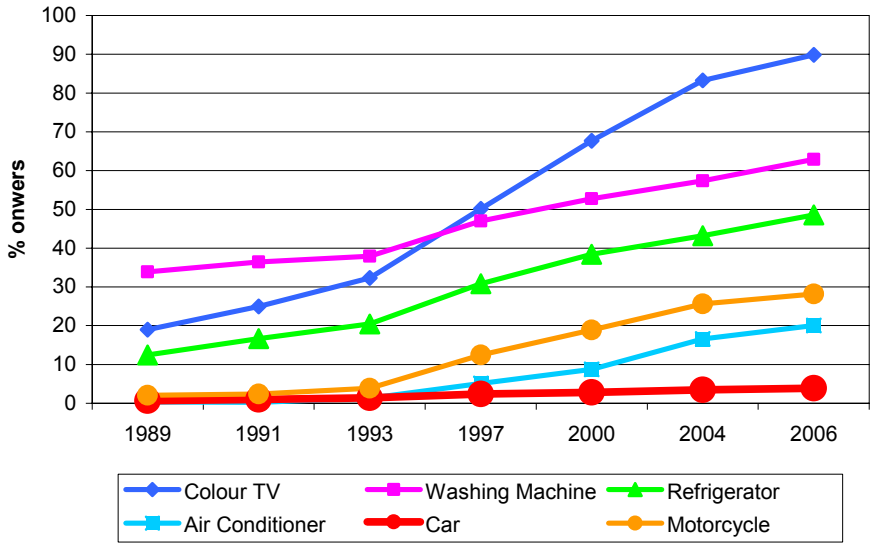
Table 3.1 Descriptive Statistics of Regression Variables

Variable	Description	N	mean	sd	min	max
The dependent variables						
ctv	dummy variable for colour TV ownership	27704	0.55	0.50	0	1
fridge	dummy variable for refrigerator ownership	27789	0.31	0.46	0	1
car	dummy variable for car ownership	27600	0.02	0.15	0	1
The independent variables						
ln_pcinc_ad06	logarithm of household income per capita adjusted to 2006 Yuan	27328	7.95	1.01	0.35	12.26
GEOGRAPHY INDICATORS						
urban	dummy variable for urban areas	27983	0.33	0.47	0	1
coastal	dummy variable for coastal provinces	27983	0.33	0.47	0	1
HOUSEHOLD CHARACTERISTICS						
hhsize	number of people living in the household	27677	3.74	1.48	1	14
hhhage	age of the household's head	27733	49.32	13.85	12	99
hhhyredu	number of years of education of the household head (a)	26586	6.60	4.62	0	18
PUBLIC SERVICE PROVISION						
tapwater	dummy variable for households that obtain drinking water as in-house tap water	27714	0.49	0.50	0	1
hrs_el	number of hours electricity supplied in the neighbourhood/village	27064	22.45	4.45	0	24
el_light	dummy variable for households that use electric light normally instead of other non-electric lighting	27669	0.98	0.14	0	1
bus	dummy variable for neighbourhoods/villages with a bus stop	27217	0.60	0.49	0	1
train	dummy variable for neighbourhoods/villages with a train station	27300	0.18	0.39	0	1
DURABLE GOODS PRICES						
ln_relcpidur	logarithm of relative CPI of household durable goods	20573	-0.38	0.21	-0.72	0
ln_relcpitrans	logarithm of relative CPI of transport measures	20573	-0.40	0.19	-0.56	0

Durable Goods

Figure 3.1 plots diffusion patterns as ownership rates of some interesting goods that are available from the CHNS. It can be seen immediately that each good reveals its own characteristic spread in the population throughout the survey period; ownership rates of colour TVs have increased tremendously since 1989, showing sings of saturation in more recent years, whereas ownership of cars has barely changed within the same time. A middle path is presented by refrigerators which show interesting differences between rural and urban areas (cf. also Table 7.1 in the appendix). In order to shed more light on the processes behind the spread of ownership in the survey population, goods with three different diffusion patterns are chosen for the following analysis: colour TVs, refrigerators and cars.
It is worth noting that ownership rates also depend on the selection of the data set. Table 7.2 shows ownership rates taken from the CHNS and the NBS for urban and rural areas for 2006. This table accounts for the fact that households may own more than one piece of a durable good, e.g. that in a given family each member may possess its own TV device. A comparison reveals that urban ownership rates are higher for most durable goods when taken from the NBS, and rural ownership rates generally higher in the CHNS population.[18] An additional observation from this table in comparison with the previous figure is that multi-ownership differs by a large amount for colour TVs, but much less for refrigerators and cars.

Figure 3.1 Diffusion Patterns of a Selection of Durable Goods



[18] The conjecture why ownership rates in the CHNS are generally lower for urban areas and higher for rural areas than the numbers taken from the NBS goes into the same direction as will be shown below for incomes: Because of the positive reclassification of rural areas as urbanised ones, the NBS understates rural livelihood patterns and overstates urban patterns relative to the CHNS.

Incomes

Table 3.2 displays average disposable household income per capita for both urban and rural areas throughout the survey period and some additional measures. The table shows that average incomes grew with an annual average of 6.4% in urban areas and 6.2% in rural areas, holding the urban-rural gap more or less constant. Meanwhile, as Figure 3.2 shows, the distribution of incomes broadened and inequality in urban and rural areas and in the total sample increased considerably. As mentioned in the theory chapter, growth in disposable incomes also increased the number of households that can be counted as middle-class from a mere 3% in 1989 to around 25% in 2006, with the share being considerably stronger in urban areas.[19]

Like in the case of durable goods, measures of disposable income are also, to some extent, a matter of choice of the data set. As Benjamin et al. (2005) point out, it is tempting to compare income measures from different household surveys since they cover different provinces, use a different sampling frame and not exactly the same definitions of income. However, it is reassuring that both the CHNS and the NBS household survey paint a comparable picture; as Table 7.1 in the appendix shows, urban income measures from the NBS and CHNS surveys largely converge to the same levels, whereas rural income measures from the CHNS are generally lower. Benjamin et al. (2005) demonstrate, how these discrepancies arise, at least in part, due to different definitions of locality and income. Whereas the CHNS uses a constant definition of urban and rural areas, rural areas are positively reclassified as urban areas based on their stage of economic development. Furthermore, the authors add that farm output is likely to be valued higher in the CHNS. This may help explaining why rural income levels and growth rates are generally lower in the CHNS.

There is a lot of discussion about the notorious untrustworthiness of Chinese official data. However, this problem seems less evident when working with household survey data, where considerably less scepticism is involved compared with other sorts of data on more aggregate levels (e.g. unemployment rates) which are of more political content (cf. e.g. The Economist, 2008).

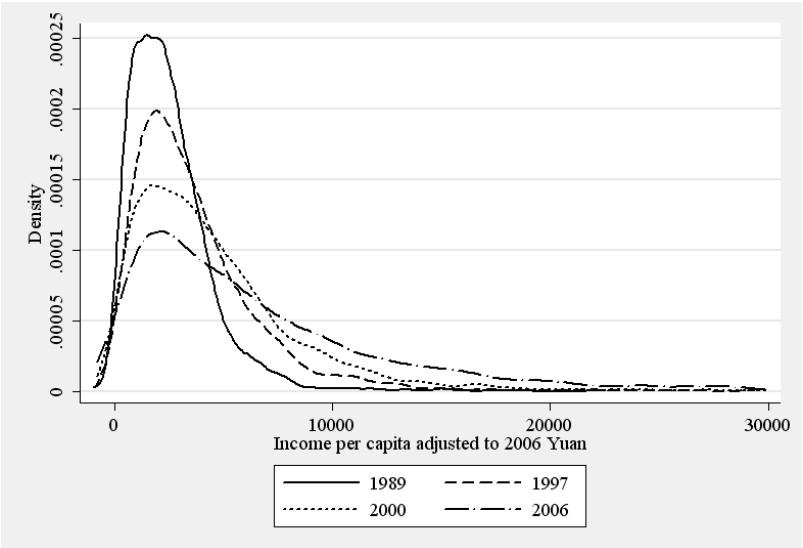
[19] Population shares of income classes in Table 3.2 were calculated according to household income boundaries provided in MGI (2006). The MGI boundaries in 2000 constant Yuan were reconverted to constant 2006 Yuan. Households with a disposable income of more than 211'000 Yuan (in constant 2006 Yuan) were classified as rich and those with less than 26'400 were grouped as poor.

Table 3.2 Descriptive Statistics of Household Income per Capita

	1989	1991	1993	1997	2000	2004	2006
Urban areas							
mean pc income	3436.18	3293.88	4082.36	4551.86	6330.06	8854.31	9897.33
Gini Coefficient	0.31	0.32	0.37	0.37	0.43	0.46	0.47
share classified rich	0.24	0	0.09	0.08	0.96	1.72	1.99
share classified middle	6.13	5.45	11.66	12.68	20.61	31.52	34.89
share classified poor	93.62	94.55	88.25	87.24	78.43	66.76	63.13
Rural areas							
mean pc income	2169.45	2187.39	2435.30	3224.48	4016.59	5093.94	6103.79
Gini Coefficient	0.42	0.38	0.41	0.41	0.44	0.47	0.52
share classified rich	0.08	0	0.08	0.08	0.3	0.51	1.03
share classified middle	2.66	2.15	4.53	8.19	12.09	16.5	20.41
share classified poor	97.26	97.85	95.39	91.74	87.6	82.99	78.56
Total							
mean pc income	2583.56	2540.88	2938.83	3665.10	4774.67	6335.26	7341.42
mean ratio, urban/rural	1.58	1.51	1.68	1.41	1.58	1.74	1.62
Gini Coefficient	0.40	0.38	0.42	0.41	0.45	0.49	0.52
share classified rich	0.13	0	0.09	0.08	0.52	0.91	1.34
share classified middle	3.8	3.21	6.71	9.68	14.9	21.48	25.13
share classified poor	96.07	96.79	93.2	90.25	84.58	77.61	73.52

Note: All figures are reported in the spatially deflated, constant 2006 Yuan. Shares are given in percent.

Figure 3.2 Distribution of Household Income per Capita for a Selection of Survey Years



3.3. The Econometric Model

The diffusion of durable ownership is now modelled through the estimation of Quasi-Engel curves, given in equation (2) in the theory chapter. Recall that Quasi-Engel curves simply link durables possession to the income level by giving a randomly selected household its probability of ownership conditional on its income level. Following Bonus (1973), this relationship is estimated by a logit model assuming a log-normal distribution function of threshold incomes:

Logit model: $$P(q=1) = \Delta(\beta_0 + \beta_1 \log(income) + v) = \frac{exp(\beta_0 + \beta_1 \log(income) + v)}{1 + exp(\beta_0 + \beta_1 \log(income) + v)} \quad (3.2)$$

whereas q indicates whether a household owns a durable good. In this logit model, the odds of the probabilities in favour of ownership are a log-linear function of the household's income.[20] Chamon et al. (2008) made use of the same theoretical model, but enlarged it through the inclusion of further control variables. In this way, the estimation model (3.1) is enhanced in a second step through the inclusion of further variables. These control for effects not captured by income alone as discussed above. Thus, the estimated equation is

Logit model: $$P(q=1) = \Delta(\beta_0 + \beta_1 \log(income) + \beta x' + v) = \frac{exp(\beta_0 + \beta_1 \log(income) + \beta x' + v)}{1 + exp(\beta_0 + \beta_1 \log(income) + \beta x' + v)} \quad (3.3)$$

whereas x' is a vector of control variables.

Unless otherwise noted, regression tables report marginal effects at the mean, in the case of dummy variables the effect of a discrete change from zero to one. Income and relative durable good prices are taken in logarithms in order to allow interpretations as income- and price-elasticity, respectively (Winkelmann et al. 1998, 2004).

[20] Equation (3.1) could also be written as $\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \log(income) + v$.

4. Results and Discussion

Having observed the broad dynamics of aggregate durable goods ownership in the population of the sample provinces and knowing the broad patterns of income developments, the focus now turns to the interrelations of the two and other factors that influence ownership patterns. As noted above, the analysis will be restricted to three durable goods (colour TVs, refrigerators and cars) which differ considerably in their diffusion patterns. This allows getting a broad view of the dynamics involved in durable goods diffusion without losing the sharpness by looking at too many goods.

In a first step, the focus is on the demand side looking at the interrelations between the household's ownership of a durable and the household's income per capita following the approach of Bonus (1973, 1975). Thereafter, a second step based on Chamon et al. (2008) sheds more light on factors other than income which influence ownership decisions by altering threshold incomes through changes in the preference structure or in supply side patterns. In a third step, the acquired understanding of changing durable patterns will be used to get an idea how ownership is going to evolve in the near future by extrapolating the favourite models from step two.

4.1. Demand Analysis

Bonus (1973) starts his analysis on the diffusion dynamics of durables by describing the broad patterns of Quasi-Engel curves from subsequent survey years. Comparing the shape and position of Quasi-Engel curves therefore allows getting some first ideas about the underlying processes that drive the diffusion in the society. In the following, the relation between ownership and income is estimated for colour TVs, refrigerators and cars through separate logit regressions on the first and on the last survey year, 1989 and 2006 respectively.[1] These graphs assign a predicted probability of ownership from the model to each household over the entire income distribution of the survey population.

[1] Estimations with cross-section data often do not meet the assumption of constant variance of the error term (homoscedasticity). Although this has no effect on the consistency of the estimator (estimated coefficients), standard errors could be biased in the case of heteroscedasticity. This is why robust standard errors were estimated (Cameron & Trivedi, 2008: 705).

4.1.1. Demand Patterns of Colour TVs

Figure 4.1 Probability of Colour TV Ownership vs. Income 1989 and 2006

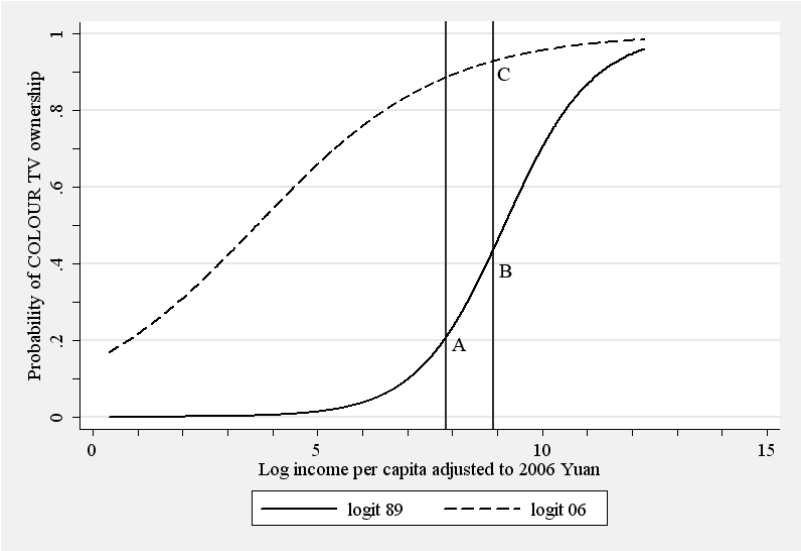


Figure 4.1 plots the predicted probabilities of colour TV ownership versus the logarithm of per capita income for 1989 and 2006.[2] The vertical lines represent the logarithm of mean[3] income in 1989 and 2006. It can be seen immediately from the graph in 1989 that the probability of colour TV ownership is relatively low for low income levels, sharply increasing in mid-income levels without levelling off clearly at the upper tail of the income distribution. In 2006, the chance of owning a colour TV increased over the entire income range, being positive even for households in the lowest income groups.[4] Meanwhile, the logit curve is considerably less steep in 2006 than in 1989.[5] This means that an increase in income had a much stronger effect in 1989 than in 2006 for a given household. This can be demonstrated quite intuitively at the respective mean of the income distribution: In 1989 (point A), a marginal increase of income by 1% at the mean income led to an increase of the probability of ownership of 14 percent points whereas the same effect was only 4 percent points in 2006 (point C).

[2] Table 7.3 in the appendix shows the coefficients of the associated logit regressions. Unlike the marginal effects, the coefficients of a logit regression cannot be interpreted directly. It can be highlighted, though, that coefficients generally have the same sign and the same standard errors as the marginal effects. As Cameron and Trivedi (2005: 473) point out, as a rule of thumb the coefficients translate to marginal effects by a division of four.

[3] Mean disposable household income per capita is 2583 Yuan (refers to a logarithm of 7.8) in 1989 and 7314 Yuan (refers to a logarithm of 8.9) in 2006.

[4] The probability of colour TV ownership in 2006 at zero income is 15% (=exp(-1.77)/(1+exp(-1.77))). In fact, there are 61 household in 2006 (of 4452) which report zero income and 54 of them owning a colour TV.

[5] Note that the lower slope of the logit curve in 2006 means also that income has lost some explanatory power towards the ownership of colour TVs. In fact, the R-squared decreased from 8% for the 1989-logit to 5% for the 2006-logit.

However, the probability of colour TV possession at mean income increased considerably from around 20% in 1989 to 92% in 2006.[6]

Now, how can the slopes and intercepts of these graphs be interpreted to explain the underlying processes of diffusion? Recall from the section on diffusion processes outlined in the theory chapter that a stable Quasi-Engel curve could be observed if relationship between income and colour TV was static. Then, households would simply move to higher ownership rates as their individual income increases and they move to higher income groups (horizontal isoquants in Figure 2.2). Here, however, there is a large upward shift of the Quasi-Engel curve between 1989 and 2006. This means that the change in the overall ownership patterns cannot be attributed to income alone. In fact, looking at mean income again, the increase in the probability of ownership attributed to the increase in income corresponds to the vertical distance between point A and point B. This is what Bonus (1973) calls *income induced diffusion*. If the change in ownership was only income induced and nothing had happened to average threshold income levels (stable graph), the probability of ownership at mean income in 2006 would be at a low 43.4%.[7] Now, since the probability of ownership at the mean in 2006 lies at 92%, the vertical distance between point B and point C, a 49% increase in the ownership probability, must be attributed to something Bonus (1973) calls a *"diffusion effect"*. As sketched in the theory chapter, rising ownership in stable income groups (falling isoquants in Figure 2.4) could be induced by decreasing threshold incomes as people get higher preferences towards ownership. On the other hand, it was shown that the same effects could also be due to changes in the supply side patterns.

Furthermore, apart from a decrease of the average threshold income the flatter Quasi-Engel curve suggests also that the *variance of threshold income* became higher; there are poor households having a low enough threshold so that their actual income is above it and, on the other hand, there are still richer households that do not really appreciate owning a colour TV, having a high enough threshold income to refrain from acquiring the durable. This, in turn, means colour TV ownership lost some of its appeal and exclusivity to household that have such high income levels that they are very likely to be owners. Referring to the denotation of Bonus (1973), colour TVs changed from having characteristics of a luxury good in society of 1989 towards being a necessity in 2006.[8]

[6] The probability of ownership can be calculated directly from the estimated logit coefficients in Table 7.3 using the mean income of 2006, $\bar{y}_{06}$: $prob(q_i = 1 \mid \bar{y}_{06}) = \frac{exp(\beta_0^{06} + \beta_1^{06}\bar{y}_{06})}{1 + exp(\beta_0^{06} + \beta_1^{06}\bar{y}_{06})}$.

[7] The probability of ownership at the average income of 2006, $\bar{y}_{06}$, can be calculated using the coefficients from the logit regression of the survey year 1989 $prob(q_i = 1 \mid \bar{y}_{06}) = \frac{exp(\beta_0^{89} + \beta_1^{89}\bar{y}_{06})}{1 + exp(\beta_0^{89} + \beta_1^{89}\bar{y}_{06})}$.

[8] According to Bonus (1973) the variance of threshold incomes can be calculated directly from the coefficients of the logit regression, $\sigma^2 \approx 2/\beta_1$. Plugging in the regression coefficients reveals that the variance of threshold incomes for colour TVs rose from 1.89 to 8.43.

Figure 4.2 Probability of Colour TV Ownership in Urban and Rural Areas 1989 and 2006

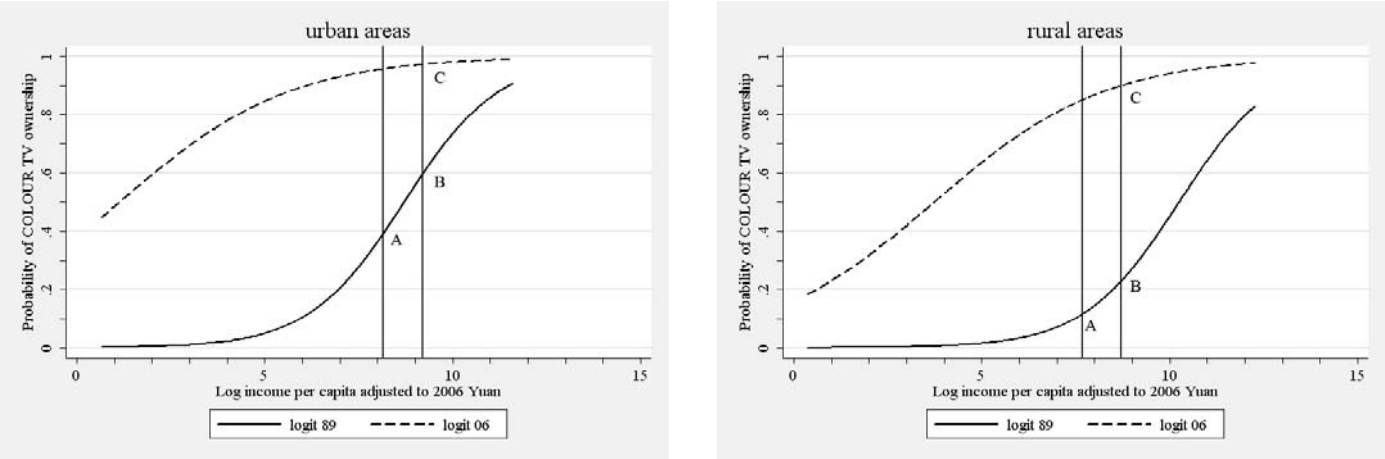


Figure 4.2 draws the same graphs of predicted probabilities for colour TV ownership distinguishing between urban and rural areas.[9] Looking at the change between 1989 and 2006, it is interesting to notice that the probability curve of ownership shifted upwards to a much higher extent in urban areas then in rural areas.[10] Although there is still a significant rise of the probability of colour TV ownership for higher income groups in 2006, the probability of ownership is considerably high, at 40%, even for the lowest income groups. Therefore, colour TV ownership is quite common in cities and seems much more a matter of preferences rather than income. This tendency is less pronounced in rural areas, where the logit curve starts from lower probability levels and increases more steeply, meaning that income still plays a role defining ownership patterns. This means, however, that changes in income lead to larger increases in the probability of ownership. A marginal increase of income by 1% at the rural mean in 2006 led to an increase in the probability of ownership by 4.4 percent points (compared to only 1.7 percent points in urban areas). These results support the findings of McKinsey (2006b), who, based on qualitative interviews, reports higher shopping intentions[11] of TVs and other durables in rural areas and smaller cities than in larger cities where the market is becoming more saturated. Thus, further growth of ownership of colour TVs will come mainly from rural areas. In urban areas, the

[9] As pointed out above, the figure plots predicted probabilities of colour TV ownership versus the logarithm of per capita income from a simple logit regression with robust standard errors. Additionally, a dummy variable to distinguish between urban and rural areas was included. Again, the vertical represent urban and rural mean income in 1989 and 2006, respectively. Urban mean income increased from 3436 Yuan in 1989 to 9897 Yuan in 2006, whereas rural mean income rose from 2169 Yuan to 6103 Yuan. More information can be taken from Table 3.2 in the data chapter.

[10] However, the probability of ownership at the mean income has changed by a much larger extent through '*diffusion effects*' in rural areas than in urban areas. Whereas income would have led only to rough increase of 10 percent points, the upward shift of the logit curve made up an increase of 70 percent points. This proportion is much lower in urban areas, about 20 percent to 30 percent points. Therefore, it can be noted that the "diffusion effect" benefited the rural areas over-proportionally, counter-balancing to some extent the lag in income that prevailed over the survey period. (cf. Figure 4.2).

[11] According to McKinsey (2006b), only 8% of all interviewees in larger cities report the intention to purchase a TV, compared to 13% in midsize cities and 15% in rural areas.

demand for colour TVs will rather represent the '*replacement demand*' for old TV sets, as outlined in the theory chapter.

4.1.2. Demand Patterns of Refrigerators

Figure 4.3 Probability of Refrigerator Ownership in 1989 and 2006

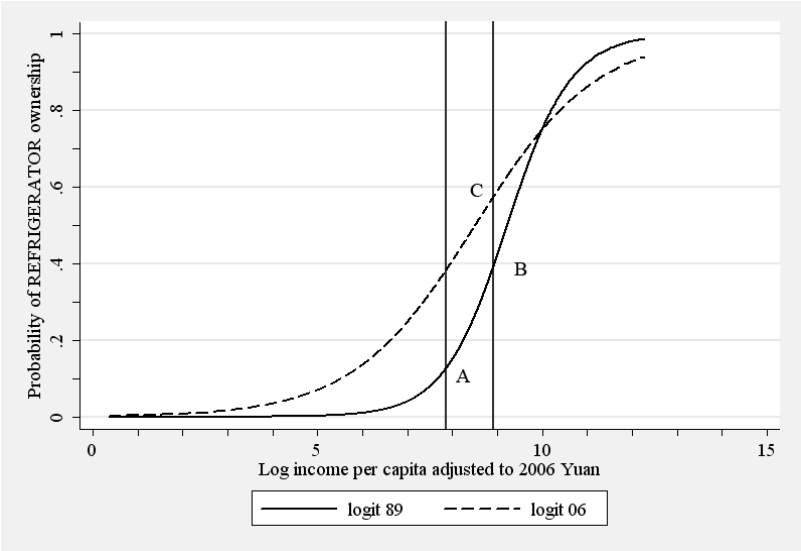
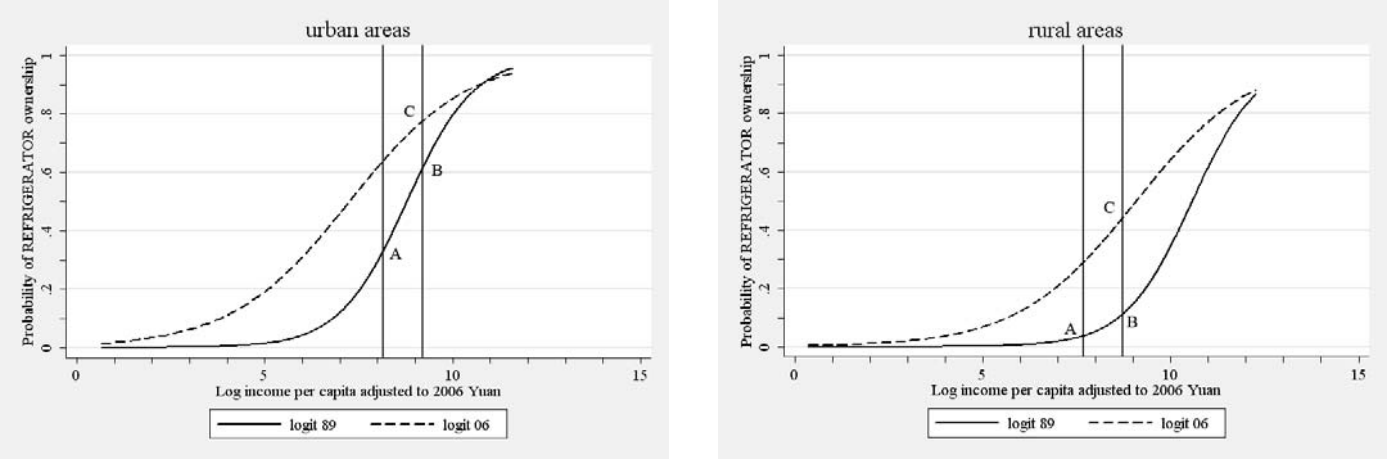


Figure 4.3 shows the predicted probabilities of refrigerator ownership versus the logarithm of per capita income for 1989 and 2006. The first obvious characteristic compared to colour TVs is that the difference between the Quasi-Engel curves in 1989 and 2006 is much smaller although the logit curve increased slightly and became flatter over the entire income range.[12] It is obvious, though, that there is still a strong relation between the household's income and its probability to own a refrigerator. Furthermore, ownership probabilities at mean income rose from 12% to 57% between 1989 and 2006.

With regard to interpretation, it can be said that the increase in ownership at mean income came largely from the growth of individual incomes (vertical distance between point A and B) than from the 'diffusion effects' (vertical distance between point B and C).[13] However, the effect of falling threshold income has been considerably smaller compared to that of colour TVs and the variance of threshold incomes has not risen similarly.[14] This means that refrigerator ownership is still segregated between different income groups in 2006 and increases in income have strong effects.[15]

[12] A likelihood-ratio test, with the H0 that the models of 1989 and 2006 are equal, is clearly rejected (X^2 = 511.18, Prob > X^2 = 0.000).
[13] Without the diffusion effect, the probability of ownership at the mean income would have increased from 12% to 38%.
[14] Following Bonus (1973), the variance of threshold incomes of refrigerators rose from 0.99 to 3.39, less than half as much as in the case of colour TVs.
[15] As an additional interpretation, the flattening of the Quasi-Engel curve could be due to the increase of income inequality in the population, with the Gini Coefficient increasing from 0.4 to 0.51. Recall from the theory section that higher equality of incomes yields steeper Quasi-Engel curves.

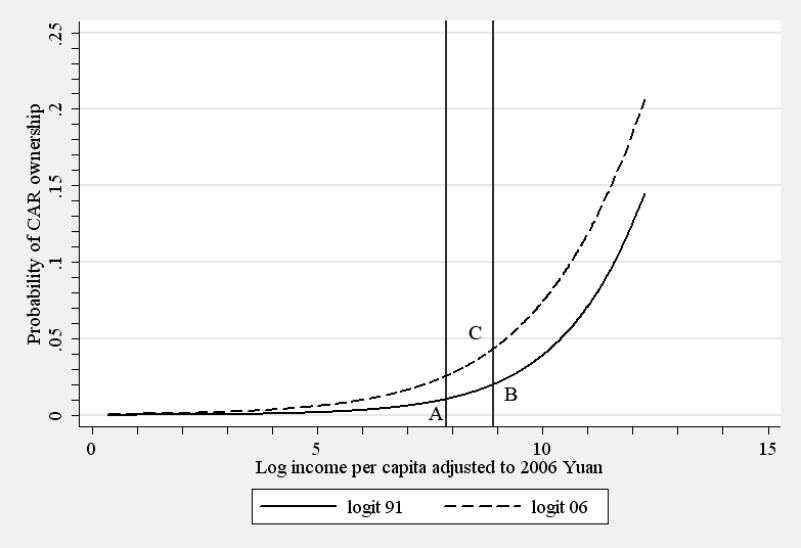
Figure 4.4 Probability of Refrigerator Ownership in Urban and Rural Areas 1989 and 2006



Looking at differences between urban and rural areas reveals two interesting observations (cf. Figure 4.4): First, it seems that the logit curves for both rural and urban areas showed a comparable shift from 1989 to 2006. However, ownership rates are still very low in rural areas, ending up only a little higher in 2006 compared to where urban areas started in 1989. Rong and Yao (2003) found rural ownership rates of refrigerators that are at comparable low levels. They point out that the use of refrigerators is quite limited in rural China since residents are able to get fresh food within very short distances and because they do not consume lots of dairy products at all. Therefore they do not have the same need to acquire a refrigerator to prevent the spoilage of food. Secondly, as in the case for colour TVs, it is interesting to stress that the *'diffusion effect'* has benefited rural areas more than urban areas. Although Quasi-Engel curves have shifted upwards by a seemingly similar degree, ownership at mean income was at very low levels of the sigmoid in 1989, so that the increase of the sigmoid had a much larger effect in these areas. (cf. points A, B and C for rural and urban areas in Figure 4.4).

4.1.3. Demand Patterns of Cars

Figure 4.5 Probability of Car Ownership in 1989 and 2006



Generally speaking, there are two new observations looking at the relationship between income and the probability of ownership in the case of cars: First, in Figure 4.5 the Quasi-Engel curve from 1989 has been omitted since the relationship was negative and not significant. In 1989, only 26 households out of 3960 were car owners. The relationship between income and car ownership starts being significant after 1991, which is plotted in Figure 4.5. Secondly, it is interesting that in 2006 even for the highest income groups the probability of ownership does not approach 1. This means that car ownership is far from saturation even in those groups. Although cross-country evidence suggests that car ownership rates do not approach any saturation line even at very high income levels, Chamon et al. (2008) report much higher probabilities of ownership (between 80% and 95%) for their highest income groups. Chamon et al. (2008) worked with similar techniques and an urban household survey panel of the NBS of the year 2005. This raises the conjecture that high-income groups are not properly represented in the CHNS survey [16] and the Quasi-Engel curve would reach higher ownership probabilities for these groups.

[16] One idea why the probability of car ownership is very low even for the highest income groups is that the highest income groups are not properly represented in the CHNS survey. According to Deaton (1997: 15 ff), it is quite common for household surveys that households that contribute a large amount to the mean – high income families – are overrepresented relative to lower income households, who contribute little. The overrepresentation ensures to get a clearer picture of those households at the upper tail of the income distribution. By taking too few of them, i.e. taking a proportion of them which is representative for the entire population, the chance is higher to accidentally get an imprecise picture of their wealth. This sampling method is called *"probability proportional to size"*. In order to get an average income representative for the entire population, overrepresented groups are weighted down and underrepresented groups weighted up. Since there are no income weights in the CHNS survey, this raises the conjecture that higher income groups are not represented properly in the sample population. .

On first sight, basic indicators from the Quasi-Engel-curve in 2006 are not so impressive: The probability of car ownership at the mean income is at a low 4.3% and a marginal increase of 1% of income at the mean would increase the probability of ownership about 2.1 percent points. However, it must be borne in mind that average income growth in China was 7.6% between 2004 and 2006 in the CHNS sample which would translate into a much higher increase of the ownership probability in one year. It will be shown later, though, that income elasticities derived from marginal effects must be interpreted with care for larger than marginal increases in income.

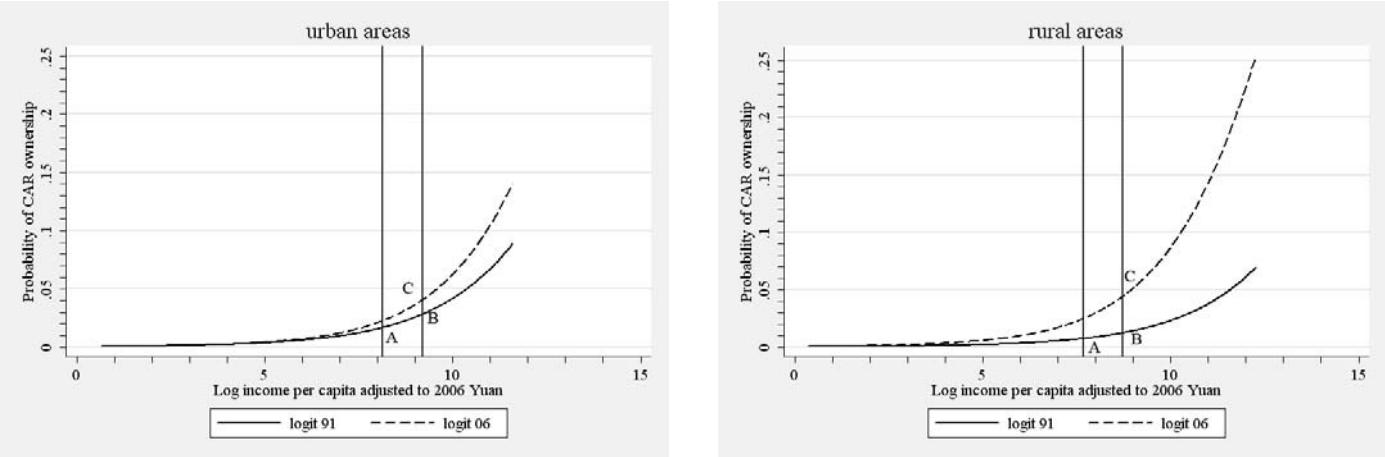
Given these observations, it is difficult to make clear-cut statements about the underlying diffusion process in car ownership; looking at the difference between 1991 and 2006[17] at mean income per capita reveals that a slightly larger share of the increase in ownership was due to the shift in the Quasi-Engel curves.[18] However, it would be tempting to compare the strength of diffusion and income effect from the small changes that have happened in car ownership patterns. As the comparison with estimates from Chamon et al. (2008) showed, ownership among the more affluent households is likely to be underestimated in the CHNS data. Yet, since this means that Quasi-Engel curves are likely to reach higher probabilities for these income groups, this is just another way to say that their threshold incomes are likely to be overestimated.

A look at differences between urban and rural areas (cf. Figure 4.6) reveals that the probability of ownership at the mean is slightly higher in rural areas (5.7%) than in urban areas (4%) in 2006. Furthermore, the responsiveness of ownership towards marginal changes in income is slightly higher for rural areas as well (an increase of 2.3 percent points vs. 2.2 percent points at its respective mean). These observations fall short of the expectation of more affluent urban households having higher ownership probabilities than rural ones. However, they might be explained by the same conjecture raised before.

[17] A likelihood ratio test proves that Quasi-Engel curves are significantly different in 1991 and 2006, X^2 =46.57, Prob> X^2 = 0.000.

[18] If the curves had remained stable between 1991 and 2006, ownership would have increased from 1% to only 2%, whereas the shift of the curves led to an increase to 4.3% in 2006.

Figure 4.6 Probability of Car Ownership in Urban and Rural Areas in 1989 and 2006



4.1.4. Summary of Findings from the Demand Analysis

To sum up, there are several observations worth emphasising from the demand analysis: First, it can be stated that the three different goods are, on the one hand, on very different stages of their diffusion process and, on the other hand, reveal some interesting differences in their diffusion patterns. Whereas ownership of colour TVs is about to reach saturation, refrigerators are in the stage where the strongest increase in possession is about to happen and cars are close to enter the first phase of this stage as well. In terms of the driving process behind diffusion of ownership, it is interesting to note that the relative effect of income growth was strongest for refrigerators, whereas falling threshold incomes have been more important for the spread of colour TVs. In the case of cars, the patterns are not clear-cut. Secondly, falling threshold changed the public perception of colour TVs from being seen as a luxury good in 1989 into a clear necessity in 2006. This trend was not as strong in the case of refrigerators and cars did not lose their luxury status at all. Thirdly, looking at geographical differences, it can be noted that rural areas, generally speaking, lag behind in terms of ownership. Yet, households in these areas demonstrate a considerably stronger sensitivity of ownership towards changes in income in 2006 than their urban counterparts. Furthermore, because of their low position in overall ownership patterns, households in rural areas benefited more from falling thresholds than in urban areas. Fourthly, a closer look at car ownership patterns and a comparison with the literature reveals a potential underestimation of the probability of ownership for households on the upper tail of the income distribution and an overestimation of their threshold incomes towards car ownership.

4.2. Analysis of Further Influence Factors – Drivers of Threshold Incomes

Having observed the broad patterns of changing ownership of colour TVs, refrigerators and cars by comparing the first (1989) and last (2006) survey year, the question remains as to which factors are behind the shifts in the relationship between the ownership and income, i.e. the discovered changes of threshold incomes. The purpose of this section is to shed more light on this issue. As shown above, individual threshold incomes of individuals are either influenced 'autonomously' through changes in preferences or may be altered, on the other hand, through changing goods prices. Econometrically, the analysis will move from the single cross-section estimations in the last section to a panel estimation on all survey years (pooled estimation) which increases the availability of observations and allows exploiting the time-series information.[19]

As was shown in the last section, changing threshold incomes led Quasi-Engel curves to be unstable, i.e. to change intercepts and slopes over the survey period. In order to capture such changes over time in a panel regression, the econometric analysis follows two different approaches of Chamon et al. (2008): On the one hand, the trend in the relationship between income and ownership is accounted for by including a time trend into the estimation equation. This will be the baseline approach. However, including a time trend is, as Chamon et al. (2008) put it, economically speaking an *"agnostic approach"* to capture effects triggered through other factors that change over time than simply time itself. This is why an alternative approach has been adopted in a second step: This approach assumes that the time trend in slopes and intercepts is, at least in part, influenced by changes on the supply side, e.g. changing prices of durable goods.

As outlined in the data chapter, variables of household characteristics and living conditions were included into the analysis in order to control for other factors apart from the trend variables and income.

4.2.1. The 'Time Trend' Approach

The time-trends in intercepts and slopes of the relationship between income and ownership are econometrically accounted for as follows: On the one hand, time dummies for each survey year[20] *(variables yr91 to yr06)* control for intercept changes of Quasi-Engel curves. On the other hand, interaction terms of the logarithm of income with these year dummies *(variables income91 to income06)* allow the income elasticities to vary over the survey period, i.e. the slopes of Quasi-Engel

[19] In accordance with Cameron and Trivedi (2008: 706) panel robust standard errors were estimated in order to account for serial correlation and heteroscedasticity in the error term. The cluster variable in this case was the household identity variable.
[20] In which the first survey year is taken as the reference.

curves. Table 4.1 presents the income elasticities[21] and the marginal effects of the time dummies for all survey years. The estimations basically give the same information already learnt in the previous part; In the case of colour TVs and refrigerators, the responsiveness of the probability of ownership towards changes in income decreased over the survey period as the Quasi-Engel curves became flatter and people moved upward in less steep regions of the sigmoid. Meanwhile, the rising marginal effect of the year dummies show that the probability of ownership has risen even when all other explanatory variables are excluded. Additionally, it can also be recognised that the differences between the year dummies as well as the income elasticities become less pronounced in the latest years of the survey period. It could be argued, therefore, that there is a certain stabilisation in the relationship between the income and the probability of ownership, hence Quasi-Engel curves becoming more and more stable. As mentioned in the theory chapter, Bonus (1975: 44) points out that this phenomenon occurs in mature diffusion processes when tastes of household do not change much.

The case of cars is shown in column 3 of Table 4.1. The first survey year has been excluded from the pooled regression since, as shown before, there was no significant relationship between income and car ownership.[22] It can be seen immediately from the insignificant income elasticities of the years after 1991 and the insignificant year dummies that there is no clear change in the relationship between ownership probability and income. A Chow-test for structural change reveals, however, that the hypothesis of no change in income elasticities over the entire survey period must be rejected (Wooldridge, 2003: 431).[23] The findings in the previous section showed that the Quasi-Engel curves in 1991 and 2006 proved to be significantly different but the differences were not large. However, it could be argued from a theoretical perspective and the findings so far that the income elasticity at the mean is likely to increase when average income grows and the mean moves upward into steeper parts of the sigmoid. This could be altered (reinforced or counterbalanced), though, with the expectation of the Quasi-Engel curve bending more upwardly.

[21] The income elasticity of the basis year, 1989, is given as the marginal effect of *ln_pcinc_ad06*. The income elasticities of the subsequent survey years can be calculated from the sum of the marginal effect of the basis year with the marginal effect of the interaction term of income with the survey year in question. For instance, the income elasticity of colour TV ownership in 2006 is given as 0.12 (= 0.253 – 0.133). This means that a change of 1% in income results in a 12% point increase in the probability of ownership.

[22] This means that 1991 is used as the reference year in the case of cars.

[23] The test for joint significance of all year-income interaction terms cannot be rejected at all conventional levels, $X^2 = 17.77$, Prob > $X^2 = 0.000$.

Table 4.1 Logit Regression with Time Dummies and Time-Income Interaction Terms

	Colour TV	Refrigerator	Car
ln_pcinc_ad06	0.253	0.269	0.0122
	[0.0193]***	[0.0157]***	[0.00628]*
income91	0.114	0.0466	
	[0.0240]***	[0.0212]**	
income93	-0.00152	-0.0384	0.00522
	[0.0236]	[0.0203]*	[0.00849]
income97	-0.0607	-0.0845	0.0099
	[0.0234]***	[0.0199]***	[0.00744]
income00	-0.0917	-0.101	-0.00659
	[0.0218]***	[0.0187]***	[0.00667]
income04	-0.132	-0.114	-0.00399
	[0.0213]***	[0.0181]***	[0.00680]
income06	-0.133	-0.13	-0.00213
	[0.0216]***	[0.0179]***	[0.00668]
yr91	-0.595	-0.216	
	[0.0659]***	[0.0816]***	
yr93	0.167	0.479	-0.0218
	[0.161]	[0.179]***	[0.0252]
yr97	0.502	0.784	-0.0336
	[0.0549]***	[0.0560]***	[0.0189]*
yr00	0.615	0.839	0.265
	[0.0341]***	[0.0345]***	[0.454]
yr04	0.699	0.862	0.125
	[0.0255]***	[0.0256]***	[0.280]
yr06	0.722	0.886	0.0645
	[0.0245]***	[0.0179]***	[0.170]
Observations	27099	27183	23367
Pseudo R-squared	0.286	-14129	0.0474
Loglikelihood	-13314	0.163	-2650

Clustered and robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Household Characteristics

In column one of Tables 4.2, 4.3 and 4.4, regression models with household characteristics are presented for colour TVs, refrigerators and cars.[24] In general, it can be seen that their influence is less strong relative to income apart from the geography indicators, which converges with the findings of Chamon et al. (2008) who also found less strong effects of population characteristic controls. A closer look reveals some more interesting facts:

It can be seen that there is a positive relationship between family size *(hhsize)* and the ownership of all three durables. According to Rong and Yao (2003), more family members reduce the

[24] Note that the year and province dummies have been omitted from the tables for the sake of clarity.

cost of a durable for each usage and raises, thereby, the household's willingness to purchase it. This makes sense on the household level. On the aggregate level, though, Chamon et al. (2008) found a negative relationship of household size to car ownership. This can be explained by the fact that household size has generally decreased over time, among others through urbanisation, which yielded more and smaller households that are in need to furnish their homes.

The positive relationship between colour TV and refrigerator ownership and the age of the household head *(hhhage)* differs from the findings of Rong and Yao (2003) and Chamon and Prasad (2007) who report a negative correlation that indicates that it is rather the young who acquire new modern durables. An interesting observation, though, is that age starts to be negatively associated with colour TV ownership after 2000 once one allows for differences in years. This can be done the same way as with income, through interaction terms of age with the year dummies (cf. Table 7.6 in the appendix). Both observations together mean that over the entire survey period colour TV ownership is positively associated with age but, after 2000, the trend reverses and ownership and age are negatively correlated.[25] For cars, the relationship with age is negative too; on average, car owners are three years younger than non-owners over the entire survey period. Thus, there is some tendency towards young consumerism. This points into the same direction as the findings of MGI (2006), who describe that the relative youth of the new middle class with considerable spending power in China is an important feature. Unlike in the developed countries, young Chinese adults will be wealthier than their parents. According to MGI (2006), this is largely because they are better educated and possess the skills demanded by future labour markets. Therefore they will be disproportionally able to benefit from economic growth.

Lastly, the sign of the education variable *(hhh_edu)* is positive as expected but not significant in the case of car ownership. Education can have various interpretations: On the one hand, it can be used as a proxy for income, indicating that a household with higher education might also expect higher income. On the other hand, education can be interpreted as an indicator for the openness towards western living styles, as an indicator for the ability to adapt with modern technology all of which increases the household's likeliness of ownership (Rong & Yao, 2003).

The geography indicators of whether a household lives in an urban area *(urban)* and in a coastal province *(coastal)* show the expected tendencies for colour TVs and refrigerators: In both areas the probability of ownership is significantly higher than in rural areas or landlocked provinces. In the case of cars, again, the low number of owners does not produce ownership rates that significantly differ between geographical areas.

[25] In fact, owners and non-owners (of colour TVs) have about the same age in 1989 (44), whereas the average owner age in 2006 is 54 and 61 for a non-owner. This difference is significant; cf. also Table 7.6 in the appendix.

Table 4.2 Logit Regression for Colour TV Ownership

Colour TV	(1)	(2)	(3)	(4)	(5)
ln_pcinc_ad06	0.191	0.146	0.189	0.199	0.123
	[0.0197]***	[0.0227]***	[0.0118]***	[0.0137]***	[0.0117]***
income91	0.112	0.125			
	[0.0251]***	[0.0282]***			
income93	0.000821	0.023			
	[0.0243]	[0.0273]			
income97	-0.0447	-0.0207		-0.176	
	[0.0237]*	[0.0265]		[0.0337]***	
income00	-0.0621	-0.0284		-0.213	
	[0.0222]***	[0.0250]		[0.0371]***	
income04	-0.0899	-0.0476		-0.311	
	[0.0224]***	[0.0250]*		[0.0532]***	
income06	-0.0922	-0.0461		-0.331	
	[0.0227]***	[0.0254]*		[0.0591]***	
urban	0.318	0.561			0.448
	[0.0119]***	[0.0772]***			[0.0788]***
coastal	0.0305	0.316			0.242
	[0.0219]	[0.0204]***			[0.0154]***
hhsize	0.0557	0.068			0.0549
	[0.00421]***	[0.00433]***			[0.00360]***
hhhage	0.00291	0.00145			0.00143
	[0.000523]***	[0.000526]***			[0.000428]***
hhhyredu	0.0306	0.026			0.0197
	[0.00154]***	[0.00155]***			[0.00127]***
tapwater		0.288			0.208
		[0.0130]***			[0.0111]***
tapwater_urb		0.027			0.0476
		[0.0246]			[0.0218]**
hrs_el		0.0153			0.0174
		[0.00199]***			[0.00207]***
hrs_el_urb		-0.00793			-0.00478
		[0.00301]***			[0.00330]
el_light		0.335			0.413
		[0.0635]***			[0.0772]***
el_light_urb		-0.278			-0.414
		[0.119]**			[0.125]***
ln_relcpidur			-2.175	0.843	-1.548
			[0.193]***	[0.814]	[0.203]***
ln_pcinc_cpidur			0.154	-0.368	0.077
			[0.0234]***	[0.0971]***	[0.0247]***
Observations	25806	24851	19885	19885	18152
Pseudo R-squared	0.381	0.417	0.218	0.239	0.342
Loglikelihood	-11019	-9993	-9891	-9619	-7634

Clustered and robust standard errors in brackets, year and province dummies omitted from table for specification (1), (2) respectively (1), (2) and (5) for the sake of clarity.
*** p<0.01, ** p<0.05, * p<0.1

Table 4.3 Logit Regression for Refrigerator Ownership

Refrigerator	(1)	(2)	(3)	(4)	(5)
ln_pcinc_ad06	0.187	0.151	0.223	0.274	0.16
	[0.0149]***	[0.0175]***	[0.0124]***	[0.0162]***	[0.0131]***
income91	0.0295	0.0236			
	[0.0209]	[0.0230]			
income93	-0.0402	-0.0317			
	[0.0196]**	[0.0218]			
income97	-0.069	-0.0571		-0.104	
	[0.0185]***	[0.0205]***		[0.0370]***	
income00	-0.0754	-0.0615		-0.136	
	[0.0176]***	[0.0197]***		[0.0415]***	
income04	-0.092	-0.0722		-0.174	
	[0.0175]***	[0.0194]***		[0.0607]***	
income06	-0.105	-0.0798		-0.193	
	[0.0172]***	[0.0193]***		[0.0668]***	
urban	0.311	0.661			0.642
	[0.0117]***	[0.0947]***			[0.123]***
coastal	0.144	0.115			0.133
	[0.0184]***	[0.0185]***			[0.0236]***
hhsize	0.0189	0.0248			0.0354
	[0.00303]***	[0.00280]***			[0.00390]***
hhhage	0.00288	0.00172			0.00288
	[0.000393]***	[0.000360]***			[0.000498]***
hhhyredu	0.0269	0.0215			0.0302
	[0.00117]***	[0.00107]***			[0.00147]***
tapwater		0.222			0.277
		[0.00999]***			[0.0123]***
tapwater_urb		0.0111			0.0168
		[0.0166]			[0.0238]
hrs_el		0.0166			0.0228
		[0.00175]***			[0.00303]***
hrs_el_urb		-0.0159			-0.0176
		[0.00222]***			[0.00399]***
el_light		0.114			0.124
		[0.0324]***			[0.0633]*
el_light_urb		-0.0065			-0.0385
		[0.0889]			[0.142]
ln_relcpidur			-1.163	-1.465	-1.084
			[0.212]***	[0.889]*	[0.222]***
ln_pcinc_cpidur			0.0908	-0.0964	0.0974
			[0.0255]***	[0.104]	[0.0269]***
Observations	25892	24848	19869	19869	18144
Loglikelihood	-11304	-10186	-11376	-10919	-8384
Pseudo R-squared	0.298	0.342	0.134	0.169	0.302

Clustered and robust standard errors in brackets, year and province dummies omitted from table for specification (1), (2) respectively (1), (2) and (5) for the sake of clarity.
*** p<0.01, ** p<0.05, * p<0.1

Table 4.4 Logit Regression for Car Ownership

Car	(1)	(2)	(3)	(4)	(5)
ln_pcinc_ad06	0.0122	0.0117	0.0216	0.02	0.0172
	[0.00470]***	[0.00465]**	[0.00548]***	[0.00634]***	[0.00399]***
income93	0.00315	0.0033			
	[0.00612]	[0.00604]			
income97	0.00541	0.00702		-0.0416	
	[0.00550]	[0.00556]		[0.0290]	
income00	-0.00575	-0.00567		-0.0713	
	[0.00502]	[0.00497]		[0.0348]**	
income04	-0.00323	-0.003		-0.0843	
	[0.00509]	[0.00503]		[0.0438]*	
income06	-0.000536	-0.000382		-0.0839	
	[0.00498]	[0.00492]		[0.0447]*	
urban	0.000306	0.00359			0.00313
	[0.00175]	[0.00313]			[0.00379]
coastal	0.0051	0.000184			0.00783
	[0.00312]	[0.00300]			[0.00394]**
hhsize	0.00637	0.00624			0.00739
	[0.000548]***	[0.000551]***			[0.000651]***
hhhage	-0.000534	-0.000527			-0.000621
	[7.21e-05]***	[7.18e-05]***			[8.62e-05]***
hhhyredu	-0.00015	-0.00017			-0.00024
	[0.000176]	[0.000174]			[0.000215]
bus		0.00314			0.00443
		[0.00170]*			[0.00202]**
bus_urb		-0.00337			-0.00441
		[0.00264]			[0.00332]
train		0.00304			0.00274
		[0.00234]			[0.00271]
train_urb		-0.0027			-0.00272
		[0.00272]			[0.00344]
ln_relcpitrans			-0.183	1.238	-0.103
			[0.0947]*	[0.686]*	[0.0688]
ln_pcinc_cpitrans			0.0197	-0.135	0.00926
			[0.0114]*	[0.0796]*	[0.00840]
Observations	22169	21677	19803	19803	18154
Pseudo R-squared	0.121	0.124	0.0361	0.041	0.114
Loglikelihood	-2303	-2239	-2467	-2454	-2069

Clustered and robust standard errors in brackets, year and province dummies omitted from table for specification (1), (2) respectively (1), (2) and (5) for the sake of clarity.
*** p<0.01, ** p<0.05, * p<0.1

Public Infrastructure and Living Conditions

In column two in Tables 4.2, 4.3 and 4.4, the idea of provision of public goods from Rong and Yao (2003) has been taken into consideration by controlling for some public infrastructure and livelihood indicators. Generally, the provision of public services has improved considerably over the survey period although there are still deficiencies and rural areas generally lag behind (cf. Table 7.7 in appendix). To account for this observation, the indicator variables were interacted with the dummy variable for urban areas *(suffix urb)*. This allows the marginal effects to differ between urban and rural areas.

Similar results were found for colour TVs and refrigerators in the case of the most common energy usage of households *(el_light)* and of the number of hours electricity is supplied per day *(hrs_el)* in their communities; their marginal effects are all significant and positive and the effect is stronger in urban areas than in rural areas.[26]

Interestingly, the availability of running water (*tapwater*) has a stronger effect in urban areas than in rural areas (positive sign of *tapwater_urb*). This is somehow surprising, since it is expected that running water is less often supplied in rural areas and hence improvement would advance their living conditions more strongly than in urban areas. The general baseline of this observation can be confirmed; in urban areas less than 20% of all households have lacked running water since 2004, whereas in rural areas over a half of them do so (cf. again Table 7.7 in appendix). However, the households without running water in urban areas are mainly those with low income levels. Their average income is 40% below the urban mean income. In rural areas, the incomes of these households are 'only' about 15% lower. Furthermore, the difference in the ownership rate between urban households with and such without tap water is larger than in rural areas. Therefore, the lack of running water in urban areas could be interpreted as an indicator for urban poverty. Since mean income is still higher for urban households without tap water than for those in rural areas, the effect of an improvement of water supply (going from zero to one in the dummy variable) or public infrastructure in general for poor neighbourhoods in urban areas is larger.

Generally it can be stated that public infrastructure reveals to have strong effects towards ownership also relative to the influence of income. This parallels the findings of Rong and Yao (2003) who found that the improvement of public infrastructure has even stronger effects in Chinese rural areas than income growth. According to them, providing public services in rural areas would not only boost the rural demand for electric appliances but would also bring other complementary

[26] As explained in conjunction with the interpretation of other interaction terms, the effect in urban areas must be calculated by adding the coefficients. E.g. the marginal effect of an additional hour of electricity supply on colour TV ownership is 1.5% in rural areas and 0.7% (= 1.5% - 0.79%) in urban areas.

improvements to rural life. For example, introducing tap water would not only allow them to buy flush toilets or washing machines but also improve sanitary conditions.

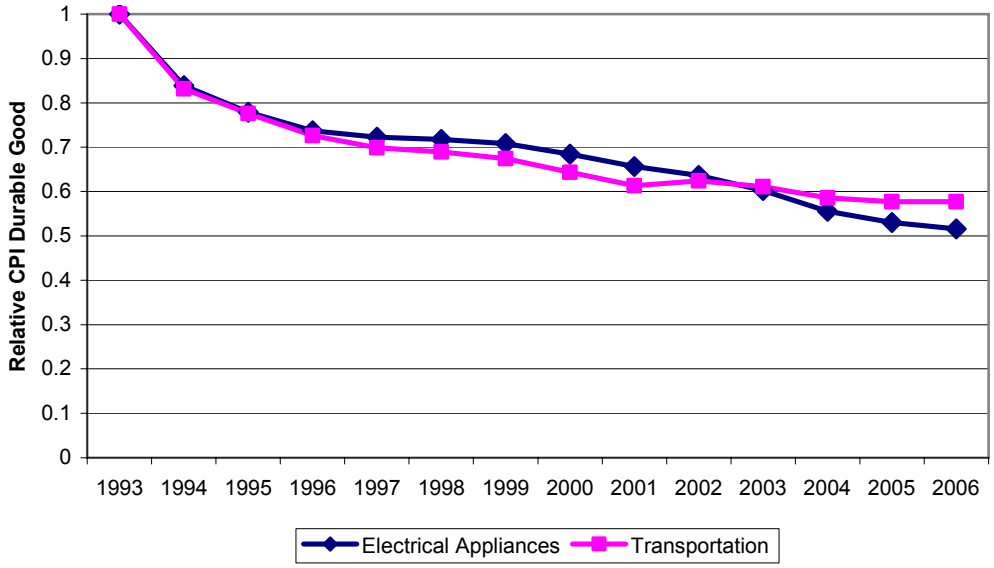
Following the Asian Development Bank (2007) which emphasised the importance of public transport services that shapes the households' decisions about private transportation, variables for the availability of public transport were included into the regression model rather than the household's living conditions. As column two of Table 4.4 shows, both variables on public transport services, busses as well as trains *(bus, train)*, are not significantly associated with car ownership.

4.2.2. The Supply Side Approach - Influence of Durable Prices

As outlined above, it is a reasonable guess that time trends in the relationship between income and ownership are, at least in part, driven by a trend decline in the relative price of durable goods (Chamon, 2008). As Figure 4.7 shows, the relative price of durable goods (measured as the CPI for durables divided by the overall CPI) declined by about 50% depending on the respective measures used for the three different goods. In order to control for this trend in durable prices, the logarithm[27] of the relative price of durables *(ln_relcpidur, ln_relcpitrans)* and an interaction term of income with the durables price trend *(ln_pcinc_cpidur, ln_pcinc_cpitrans)* has been included into the model. Their interpretation follows the same way as it was the case with the time dummies and the time-income interaction terms and it is expected that they yield comparable results that have already been encountered before.[28]

[27] Recall that taking the logarithm allows interpreting the marginal effect as price elasticities: e.g. the effect of a 1% decrease in the relative price of durables on the probability of ownership.
[28] Note also that the correlation between the time variable and the respective measures of the relative CPI are all higher than 90%.

Figure 4.7 Development of Relative Durable Goods Prices from 1993 to 2006



Source: Chinese National Bureau of Statistics (2008)

Columns three of the Tables 4.2, 4.3 and 4.4 shows the results for colour TVs, refrigerators and cars respectively. It can be observed that the relative price of durables has a strong and positive marginal effect on the probability of ownership.[29] Since relative durable prices decline over the survey period, this effect becomes stronger in the latest survey years. Furthermore, the marginal effects of the interaction terms reveal that the income elasticity also decreases when relative durable prices fall throughout the survey period (positive sign of the interaction term).[30] Interestingly, both effects are larger[31] for colour TVs than for refrigerators or cars where the effect is only significant at the 10% level. This observation coincides with the impression gathered from the demand analysis where it was discovered that effects other than income had the strongest influence in the diffusion process of colour TVs compared to the other two goods.

[29] Since the logarithm turns all values of the relative durables price negative, logarithms of relative durable goods prices become more and more negative. Thus, the negative sign of the price trend means that as prices of durable goods decline, the probability of ownership increases. This converges with findings from the time dummies with their marginal effects growing from the first to the latest survey year.

[30] The interpretation of interaction term between income and the relative durables price can be straightforwardly deduced from the previous part. Unlike above, where the income elasticity depended on an interaction term with a year dummy, its value now depends on the magnitude of yet another variable: the relative price of durables (Wooldridge, 2003: 194). Thus, the income elasticity is now calculated as the sum of the elasticity of the base year (marginal effect of ln_pcinc_ad06) and the marginal effect of the interaction term times the value of the relative durable price of the survey year in question. E.g. the income elasticity for colour TV ownership is 18% in 1989 and 8% (= 0.18 + 0.154*ln(0.51)) in 2006.

[31] Income elasticities, for instance, decrease for colour TVs from 18% in 1989 to 8% in 2006, whereas the income elasticity towards refrigerator ownership decreases only from 22% to 16%.

Also inspired from the demand analysis where it was found that thresholds seemed to have fallen by a larger extent in rural areas (for colour TVs and refrigerators), it was investigated whether there was a geographical difference of the price trend. Therefore, the price trend variable (*ln_relcpidur, ln_relcpitrans*) was interacted with the dummy variable for urban areas (*suffix urb*). The results are shown in Table 7.8: In fact, the effect of the decline in the relative durable goods prices had a significantly larger effect on the probability of ownership in rural areas for colour TVs and refrigerators. For cars, this difference between urban and rural areas was not significant.

In sum, column three in said tables shows that indeed declining relative durable prices have played a significant role determining ownership and probably make up for much of the explanatory power embedded in the time trend of income encountered before. However, It does not make sense to include both the time and price trends and their interaction terms with income in one single regression. The strong collinearity between time and the relative price of durables produces results that cannot be interpreted (cf. column four Tables 4.2, 4.3 and 4.4).

4.2.3. Model Discussion

With an eye on the intention to project ownership patterns in the next step, the question remains as to which model describes the underlying changes best. It could be argued that instead of using an agnostic time trend, changing durable prices is more adequate in describing changing ownership patterns. For this purpose, column five in the Tables 4.2, 4.3 and 4.4 presents a model specification with the price trend, its interaction term with income and the same controls as the model specification in column two. However, a comparison of both pseudo R-squared reveals that the model specification in column two has a stronger explanatory power towards ownership than the one with the price trend. Although this difference is more clear-cut for colour TVs and refrigerators than for cars, the model specification in column two will be taken as the baseline model for projections later on.
Since many of the households took part in more than in one survey year in the CHNS survey, it would be possible to account for household fixed effects that are probably not fully captured in the baseline model through the control variables, e.g. unobserved household characteristics that remain constant over the survey period and have an effect on ownership. This is why the baseline model was also estimated with household fixed effects for all goods. The coefficients[32] of these estimations are

[32] Coefficients rather than marginal effects were reported since Cameron and Trivedi (2009: 613) highlight that the calculation of marginal effects for fixed effect regression depends crucially on assumptions about the fixed effect parameter, e.g. often the fixed effect parameter is set to zero. Hence, the coefficients are given in order to provide the full information about the fixed effect logit regression.
Recall that the coefficients of a logit model have generally the same sign and standard error as their marginal effects. Thus, an interpretation is still possible. As a rule of thumb, a multiplication with the factor 0.25 translates

reported in Table 7.9 in the appendix. Unfortunately, fixed effect estimation turned most variables insignificant, particularly in the case of colour TVs and cars. Additionally, it can be observed that the number of observations considered for the fixed effect estimation is significantly lower to the other estimation models. This is due to the fact that fixed effect estimation considers only observations with change in the dependent variable, e.g. in ownership patterns (Cameron & Trivedi: 2005: 781). Household who stay owners or non-owners over the entire survey period have been omitted automatically from the regression. Because of these drawbacks, the fixed effect estimation was not taken as the baseline approach.

4.2.4. Summary of Findings of Analysis of Further Influence Factors

To review the main points, apart from income there are a few influence factors that likely shaped the threshold incomes of households and through this their ownership decisions: First and foremost, a strong decline of relative durables prices (for both household appliances and cars) was observed that showed significant influence on ownership, directly and indirectly through interaction with income. The analysis showed that this trend, at least in part, makes up for the changes of the Quasi-Engel curves over time. Furthermore, this effect was found to be significantly stronger associated with ownership in rural areas than urban areas. Secondly, it was shown that there is a positive relationship of ownership with the improvement of living conditions through public services. Although advances in public infrastructure have, generally speaking, stronger effects in rural areas, one indicator pointed out that improvements for poor urban households are likely to have even stronger effects. Third, household characteristics generally proved to have relatively small effects on ownership compared to income. An exception is the location where a household is situated: Households in urban and coastal areas have a higher probability of ownership. Fourthly, an analysis on the time trend of income elasticities revealed that Quasi-Engel curves are likely to become stable in the case of refrigerators and colour TVs. For cars, there is no clear-cut trend, but theoretical reasoning raises expectation of further changes in the relationship between income and car ownership.

logit coefficients roughly into OLS coefficients which are interpreted the same way as marginal effects (Cameron & Trivedi, 2005: 473).

4.3. Projection of Ownership Patterns

Having analysed the different factors that shape the patterns of durable ownership, this section makes a first, explorative attempt with CHNS data[33] to sketch how these patterns are going to evolve until 2030 by extrapolating the observed relationship between ownership and its influence factors from the baseline model. Thereby, projections will rely on forecasted GDP growth for China from the literature: Following Chamon et al. (2008), a growth rate of 5.3% is assumed per year for GDP per capita.[34] By relying on GDP forecasts, the implicit assumption is made that the household's disposable income is growing at the same rate during this period.[35] Meanwhile, by shifting the entire income distribution by the same amount, it is implicitly assumed that only mean income will change over time. Needless to say, projecting ownership patterns over such a long time horizon involves a great deal of uncertainty, particularly with respect to economic growth projections. However, the main objective of this section is to get an idea of how given levels of income affect the demand for durables which might be interesting to study despite all these limitations.

The projection of future ownership patterns are based on an estimation of the model in column two of the Tables 4.2, 4.3 and 4.4 on the last survey year, 2006. This model had the highest explanatory power towards ownership. The trend towards stabilisation of Quasi-Engel curves, at least in the case of colour TVs and refrigerators, allows considering the projections based on an estimated model of only the last survey year. This seems more promising then relying on either a time trend or a trend of relative durable prices with little guidance on how they are going to evolve in the future. Although Quasi-Engel curves are expected to change for cars, little or no observed changes in income elasticities across survey years make estimations based on the latest information from 2006 a best guess for later years. It must be borne in mind that relying only on income forecasts for ownership projections, all other influence factors are held constant. Because improvements of public services and prices proved to have strong positive effects on ownership, these projections must be seen as a lower bound.

Table 4.5 presents the marginal effects for colour TVs, refrigerators and cars.[36] Usually, the first step in projecting changes of a regression variable, here household income, is to analyse its marginal effect. It is only reasonable, though, to interpret marginal effects for small changes, i.e. a 1%

[33] To the best knowledge of the author CHNS data have not been used for such projections.
[34] The GDP projections Chamon et al. (2008) relies on can be seen as a lower bound up to 2020; MGI (2006), for instance, expects GDP to grow with an annual rate of 6.5%, whereas Zhou et al. (2008) expect an annual rate of 7.5% until 2020.
[35] Chamon et al. (2008) note that it could be argued that growth in household disposable income is larger since the share of households' GDP should be expected to increase over time with the share of investment not expected to remain at 40% of GDP until 2030.
[36] No interaction terms of variables of public good provision with the urban dummy were included into the analysis because of interference with other explanatory variables (collinearity).

increase in income.[37] Assuming a single one-year-increase of 5.3% in disposable income yields massive increases of 8.1 percent points, 60.95 percent points and 12.72 percent points of the probability at mean income for colour TVs, refrigerators and cars, respectively. It is clear that these figures can not be reasonable.

Table 4.5 Forecast Logit Model Based on Survey Year 2006

	Colour TV	Refrigerator	Car
ln_pcinc_ad06	0.016	0.115	0.024
	[0.00193]***	[0.0127]***	[0.00437]***
urban	0.0321	0.197	-0.00959
	[0.00539]***	[0.0204]***	[0.00532]*
coastal	0.00138	0.124	-0.0149
	[0.00804]	[0.0382]***	[0.00843]*
hhsize	0.0194	0.0414	0.0137
	[0.00196]***	[0.00702]***	[0.00176]***
hhhage	-0.000632	0.00383	-0.00124
	[0.000203]***	[0.000884]***	[0.000210]***
hhhyredu	0.00277	0.0353	-0.000743
	[0.000567]***	[0.00258]***	[0.000651]
tapwater	0.0437	0.318	0.00739
	[0.00719]***	[0.0207]***	[0.00535]
hrs_el	0.00104	0.00301	
	[0.00189]	[0.0105]	
el_light	0.12	0.251	
	[0.0771]	[0.112]**	
bus			0.0125
			[0.00526]**
train			0.0031
			[0.00601]
Observations	3819	3819	3861
Pseudo R-squared	0.256	0.254	0.149
Loglikelihood	-912.1	-1974	-526.2

Robust standard errors in brackets, province dummies omitted from table for the sake of clarity.
*** p<0.01, ** p<0.05, * p<0.1

Another approach is to calculate the probability of ownership from the estimated model separately for every household with its projected future income level.[38] Intuitively, this method checks for each household where on the Quasi-Engel curve it will be found after his or her income has increased. This leaves aside the problem associated with the marginal effect. Then, in a second step, the average probability of ownership is taken from all households in order to get an approximation of the aggregate ownership rate. The results of the baseline model are presented in column one of Table 4.6. According to this model, colour TV ownership will grow from 90% in 2006 to 93% in 2030, refrigerator ownership from roughly 50% to 60% and car ownership from 3.7% to roughly 10%.

[37] It is important to be aware of the fact that the magnitude of a marginal effect depends on the level of its regressor variable. Thus, the interpretation of marginal effects is only reasonable for small changes of the regressor variable (Cameron & Trivedi, 2005: 122)
[38] According to the formula (3.3)

Bearing in mind the observations from the last sections, the relative magnitude of the increase projected by these models make good sense; refrigerator ownership, where households are in a very steep part of the Quasi-Engel curve, increases by the largest amount, followed by cars where households are expected to move into a part of the Quasi-Engel curve where elasticities of ownership towards income changes become more sensitive and finally colour TVs where consumers are already well saturated.

Table 4.6 Projected Probabilities of Ownership and Comparison with Literature

		(1)	(2)	(3)	(4)	literature
Colour TV						
2006	total	0.90	0.90	0.90		
	urban	0.96	0.96	0.91	0.96	
	rural	0.87	0.87	0.91		
2020	total	0.92	0.92	0.93		
	urban	0.97	0.97	0.94		
	rural	0.90	0.90	0.92		
2030	total	0.93	0.94	0.94		
	urban	0.97	0.98	0.95	0.98	
	rural	0.91	0.92	0.94		
Refrigerator						
2006	total	0.50	0.49	0.49		
	urban	0.71	0.71	0.55	0.71	0.85 (a)
	rural	0.38	0.38	0.46		0.2 (b)
2020	total	0.56	0.57	0.60		
	urban	0.76	0.78	0.66		0.92 (b)
	rural	0.45	0.47	0.57		0.37 (b)
2030	total	0.60	0.64	0.68		
	urban	0.80	0.83	0.73	0.83	
	rural	0.49	0.54	0.65		
Car						
2006	total	0.04	0.03	0.03		
	urban	0.04	0.03	0.05	0.03	0.04 (a)
	rural	0.04	0.03	0.03		
2020	total	0.07	0.05	0.05		
	urban	0.06	0.06	0.06		
	rural	0.07	0.05	0.05		
2030	total	0.10	0.08	0.07		
	urban	0.09	0.08	0.08	0.06	0.25 (a)
	rural	0.10	0.07	0.06		

Note: Figures from the literature are taken from (a) Chamon et al. (2008) and (b) Zhou (2008).

4.3.1. Robustness Checks

How *robust* are these results to changes in model specification? Columns two to four in Table 4.5 present the results of some alternative regressions on data of the last survey year. In the model of

column two only time-invariant geographical factors were included as controls apart from income and column three used income alone. In both models, variables on household characteristic and on public services are left out. As can be seen directly, projected outcomes do not change much; ownership rates are slightly smaller (7.5% or 6.7%) in the case of cars and somewhat higher (64%) for refrigerators, particularly in the model with income alone (68%). The third alternative model (column four) draws on expected relative population shares[39] in urban areas of people classified as rich, middle-class and poor by MGI (2006) instead of income forecasts using the same controls as the baseline model.[40] Thereby, ownership probabilities are predicted for each class and averaged over the population using the group shares as weights. Since the relative group shares are also projected according to expected future income growth (MGI, 2006), it is not astonishing that projected ownership rates differ little from the other estimated outcomes. Yet, one interesting point can be highlighted with regard to the case of car ownership: The model in column four predicts the probability of car ownership for the richest class (1% of the population) in 2006 to be 23%.[41] This said, it becomes clear that car ownership could never exceed 23% in the population even if all households became rich according to estimations based on 2006 data.

4.3.2. Comparison with the Literature

Column five in Table 4.6 presents some projected ownership rates of the *literature for the sake of comparison*. Generally, it is tempting to compare projected ownership rates since figures in the literature most often present durable stocks (number of durables per 100 households), which accounts for households that have more than one car, for instance, rather than simple ownership rates.[42] This is why figures for colour TVs were omitted from the table. However, refrigerator stocks are presented in the table since it is a reasonable guess to assume for refrigerator ownership not to exceed 100%.[43] As can be seen, projections based on CHNS data are generally higher for rural areas and lower for urban areas compared to the figures of Zhou et al. (2008). In the case of car ownership, the projections of Chamon et al. (2008) show ownership rates deduced from household level data with similar estimation techniques and can directly be compared. They present clearly higher ownership figures than projections based on CHNS data. Two remarks must be made to explain these differences to some degree: On the one hand, future ownership projections obviously depend strongly on the choice of the

[39] According to projections of MGI (2006), the share of the urban middle-class and the rich is expected increase from 43% in 2005 to about 77% in 2030 and from 1% to 7% respectively, whereas the share of people classified as poor is shrinking from 57% to roughly 16%.
[40] For this purpose, ownership probabilities were predicted for each class. Then, the average probability in the population was calculated by weighing the class probabilities with respect to their (projected) class proportion.
[41] In contrast, Chamon's (2008) estimations on urban households show probability levels on more than 80% for corresponding rich households.
[42] Furthermore, one must be aware of differences in model assumptions, income growth assumptions, data sets etc.
[43] This assumption is backed by long-term projections of Zhou et al. (2008), who reckon refrigerator stocks will not to exceed 100% and approach this mark very slowly despite expected high income growth.

data set. Therefore, with similar estimation models based on household level data, the CHNS data from the survey year 2006 do not suggest the same steep increase in ownership rates as found in the literature. As was already demonstrated in the data chapter with descriptive statistics, ownership rates of different data bases (there from the CHNS and the NBS) diverged also in past years; Recall, for instance, that ownership patterns of the CHNS were generally higher in rural areas and sometimes lower in urban areas than NBS figures. Both Chamon et al. (2008) and Zhou et al. (2008) draw on NBS data. On the other hand, sampling issues of the CHNS data discussed earlier point into the same direction to explain the low projections of car ownership.

There must be a clear notion that projections based on 2006 CHNS data reflect patterns of ownership versus non-ownership and not durable stocks in the population.[44] Recall that the intention of the preceding analysis was to study the newly arising demand in a society of non-owners with rapid economic and social change. Thus, the main message gained from the projections is that even as massive income growth is expected, there will be some households excluded from ownership in 2030. As the figures in Table 4.5 show, these non-owners will be found particularly in rural areas, whereas in urban areas, living conditions in terms of ownership rates of colour TVs and refrigerators, approach saturation.

4.3.3. Summary to Projections

First, projecting ownership patterns until 2030 reaffirms the observations made in previous parts: the relative increase of ownership will be strongest in the case of refrigerators and cars and less pronounced in the case of colour TVs, where households are already well saturated. Furthermore, it is shown that the advances in ownerships will be driven by larger shares from increases in rural areas. Secondly, these projections reflect the patterns of ownership rather than the level of durable stocks in the populations. Through this, it is shown that non-owners will still be prominently represented in the population, particularly in rural areas, despite massive expected income growth. Thirdly, a comparison with the literature demonstrates that projections are to some degree sensitive to the choice of the data set. This is especially pronounced in the case of car ownership projections. Fourthly, it is shown that the ownership projections of this analysis must be seen as a lower bound, particularly because durable prices and the provision of public services were assumed to be stable.

[44] If the focus is more on the number of durables in the society, e.g. in order to project future durable stocks and energy consumption, it will be necessary to account for multi-ownership. For this purpose, other scholars (Zhou (2008), Fridley (2007), ADB (2006)) draw on experiences made by more advanced countries at similar income levels in order to project future durable stocks.

4.4. Policy Implications and Outlook

Given the strong projections of demand patterns for durable goods, whichever data set ever is taken into consideration, the questions arises about its implications for China. As outlined in the introduction, the newly arising demand in emerging economies, and China in particular because of its population weight and the speed of its economic growth, have been brought into the field of environmental concerns. Prospects are in fact dizzying; as the Chinese economy becomes more and more consumption driven, the International Energy Agency (2007) reckons that an increasing share of energy demand will come from both the transportation and the residential sector.[45]

The question is, apparently, whether growth rates of durables ownership will translate into a similar rise of energy and related greenhouse gas emissions. Along with China's goal to reduce energy intensity of the economy by 20% until 2020 (IEA, 2007), various scholars point out that it is likely that efficiency gains on the supply side might mitigate emissions to some extent. Fridley et al. (2007), for instance, highlights that the adoption of a standards and labelling program for electrical appliances is expected to save 9% of the projected consumption of electricity towards 2020. Also in the transport sector, vehicle fuel efficiency standards have been put in place for new cars that are already tighter than in the United States.[46]

In the case of China, the challenge will be to bridge the gap between development and reducing the environmental impact. As Chamon et al. (2008) point out, these need not be contradictions. They found, for instance, that taxing and setting standards might not necessarily reduce people's welfare. Based on low statistical correlation between fuel prices and car ownership, they suggest that adjustment might rather take place on the 'intensive margin' with households having smaller and less gas-guzzling cars than on the 'extensive margin' with households being prevented from acquiring cars at all. Furthermore, a study by The Climate Group (2008) suggests that China is already well underway to a lower carbon economy; with ambitious government target being set but also with the promotion of innovation in the industry[47]. Chamon et al. (2008) thus conclude that the increase in greenhouse gases that would result from the projected ownership is likely to be smaller than those that would result from a simple multiplication of current emissions by projected growth in ownership rates.

[45] Whereas the share of the transpiration sectors on total energy demand is expected to increase from 13% in 2005 to 21% in 2003, that share of the residential sector will increase from 17% to 20%. In the residential sector heating, cooling and appliances will bear the lion's share of energy end use. With the expected growth in its car fleet, China will overtake the United States as the country with the largest car fleet in the world in 2030.

[46] Cf. ADB (2007), IEA (2007)

[47] The Climate Group (2008) found that China is already leading in the field of environmental technologies, such as the production of electricity-driven bicycles and wind technology.

5. Conclusions

The spread and availability of durable goods is commonly seen as a 'defining gauge' of a country's stage of development. Since the introduction of its economic reforms about three decades ago, China has experienced unprecedented economic growth creating a new class of consumers with steadily increasing spending power. This makes China a prime example for investigations of durable goods diffusion. The goal of this paper is to model empirically the changing demand for consumer durables in a developing country with rapid income growth such as China. Furthermore, the analysis aims to disentangle different factors of influence that played an important role in determining diffusion patterns of ownership and to project how ownership patterns are evolving once economic growth brings more and more spending power to Chinese consumers. Throughout the entire analysis a special focus is laid on differences between developments in urban and rural areas.

In order to model the diffusion of durable goods ownership, the analysis draws on a theoretical framework originally put forward by Farrell (1954) and developed further by Bonus (1973, 1975). In their discrete choice model of durable goods ownership, households acquire the ownership of a durable good if their actual income exceeds their threshold income. Threshold incomes, in turn, are influenced by individual preferences towards ownership and by price and quality characteristics of the durable good. This concept allows disentangling influence factors behind the diffusion of durables ownership. On the one hand, growth of disposable income lifts more and more people above their individual thresholds inducing acquisition of durables. On the other hand, the spread of ownership could be driven by decreasing threshold incomes; then households acquire the durable good even when their disposable incomes remain stable as their preferences strengthen or price or quality patterns of the durable good adjust. As Bonus (1975) states, a 'typical' diffusion process incorporates all of these forces. Graphically, the relationship between ownership and income is illustrated through a sigmoid curve, the Quasi-Engel curve, which allocates the probability of ownership to each level of income.

Econometrically, a logit model estimates the probability of ownership for each level of income. Following Deaton and Muellbauer (1980) and Chamon et al. (2008), variables about socio-economic characteristics of households, their living conditions and durable goods prices are incorporated into the econometric model in order to control for other influence factors and to give the model more sharpness in the analysis of processes behind threshold income changes.

Data about household ownership, income and most of the control variables employed in the econometric analysis are taken from a micro-data panel of the China Health and Nutrition Survey

(CHNS) with seven waves carried out between 1989 and 2006. Additionally, a measure for relative durable goods prices was constructed drawing on the Statistical Yearbooks of the Chinese National Bureau of Statistics. The analysis was restricted to three different durable goods (colour TVs, refrigerators and cars), which were found to differ considerably in their overall diffusion patterns over the survey period.

With respect to the results, a primary analysis of the demand side showed how the patterns between the disposable income and the ownership of durables of households changed in the survey period. Several observations are worth emphasising: The three different durable goods are all in very different stages of their diffusion: Whereas colour TV ownership is about to approach saturation, refrigerators are in a development stage, where the strongest increases of ownership can be expected with further income growth, and cars are about to reach this stage. Furthermore, it has turned out that income growth[91] had a larger role in the diffusion of refrigerator ownership, whereas the diffusion of colour TVs was more driven by decreasing threshold incomes. In the case of cars this issue was not clear-cut. Furthermore, the strong fall in threshold incomes in the case of colour TVs points out that colour TVs became a necessity in the sampling population throughout the survey period, whereas cars clearly kept their luxury status. Refrigerators are also less concentrated in higher income groups as in 1989, but ownership still depends heavily on the level of income. With respect to geographical differences it was shown that rural areas generally lag behind in terms of ownership. Yet, it was found that households in rural areas have benefited more from the fall of threshold incomes and that they showed a higher responsiveness in 2006 towards further income growth.

A second step shed more light on factors other than income that drove the diffusion of these durables goods. First, it was found that there was a strong effect of falling durables prices on ownership. This effect was found to be stronger in rural areas. This could mean that the overall fall in durable goods prices benefited households in rural areas more than urban ones, counterbalancing to some degree the prevailing backwardness in economic performance of those areas. Secondly, public service provision proved to be strongly and significantly associated with ownership apart from durable prices and income growth. Whereas this effect was discovered to be generally stronger in rural areas, one indicator pointed out influence could also be strong for poor urban households. Along with Rong and Yao (2003), these findings point out that the improvement of public services may foster durable goods demand and might be one way to foster domestic consumption in China.

Projecting ownership patterns for colour TVs, refrigerators and cars until 2030 first and foremost reaffirmed previous findings: The increase in ownership can be expected to be strongest for refrigerators and, to some smaller extent, for cars for which households already show high sensitivity towards further growth in income. Since households are already well saturated, particularly in urban areas, colour TV ownership is not expected to grow by a similar extent. Generally, the increase in

[91] For a representative household with mean income.

ownership is expected to be stronger in rural areas where people prove to have higher elasticities of income. A comparison with projected figures in the literature reveals that demand projections of durable goods crucially depend on the choice of the data set. As also demonstrated likewise for previous years, ownership figures from the CHNS are generally higher for rural areas than figures from the official statistics (NBS) and lower for urban areas. This could explain why similar patterns were found in the projections. Differences in projections were particularly pronounced in the case of cars. Apart from the analysis of an econometric model for the description and disentangling of different driving forces behind durable goods diffusion, the findings of this paper deliver further insights into the understanding of diffusion processes and build a reference for the projections in the literature.

With respect to further investigations, one has to be aware that in the models applied for these projections all influence factors, apart form increasing income, have been held constant. As it has been demonstrated in previous parts of the paper, there are strong links between ownership and declining durable prices and also some other tendencies, e.g. the improvement of public goods. Particularly in the case of cars, the introduction of (extremely) cheap motoring in developing countries, like the new Tata Nano in India, poses a considerable scope for upward corrections of ownership projections. Another idea is to trace the effect of changing inequality patterns and class structures on ownership with more detail and to internalise it into a model.

With regard to the projections, there are also some remarks from the econometric side: On the one hand, it must be noted that even the baseline model with the highest explanatory power explains a minor share of total variance in the subsample of 2006.[92] This means that there is clear scope for improvement of forecast models. On the other hand, experience from Chamon et al. (2008) show that ownership models could be improved by exploiting the panel information in the data, i.e. not restricting to forecast models to the last survey year. This particularly makes sense in the case of car ownership, where Quasi-Engel curves are expected to change slopes and intercepts with specifically the affluent people being more likely to own a car.

In the case of cars, however, it could be fruitful to apply the econometric analysis also to other household level data and compare it to the findings with the CHNS data. As mentioned earlier, Chamon et al. (2008), for instance, use urban household data from the China's National Bureau of Statistics and find ownership probabilities that are considerably higher than the ones found with the CHNS.

[92] In fact the total variance explained is 26%, 25% and 14% in the case of colour TVs and refrigerators and cars respectively.

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http://www.stats.gov.cn/enGliSH/ (access 21.1.2009)
http://www.chinadataonline.org/ (access 21.1.2009, provides a NBS data with a longer time horizon than the actual homepage of the NBS)

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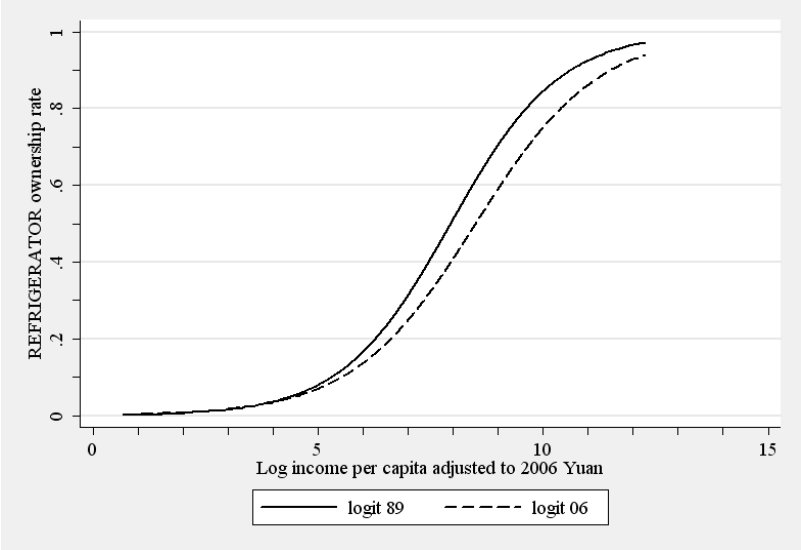
7. Appendix

7.1. Figures

Figure 7.1 Quasi-Engel Curves for Income Distributions with Different Inequality

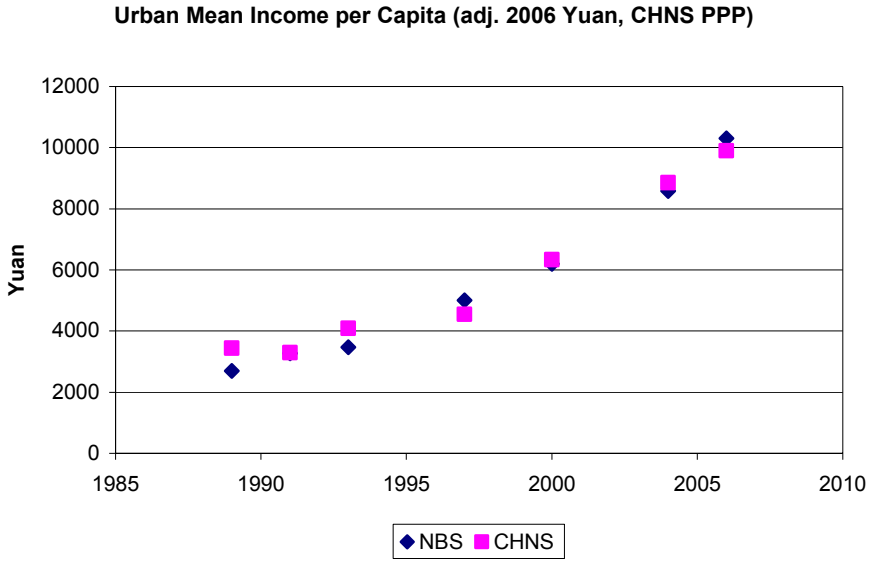


Note: The Quasi-Engel curves derived from CHNS data show the rate of ownership* of refrigerators in various income groups (household income per capita is given in logarithms). The first and last survey years with the same ownership patterns and similar mean incomes are illustrated, with the mean of 1989 rescaled to mean 2006. The increase in inequality over the survey period from 1989 to 2006 with the Gini-Coefficient rising from 0.40 in 1989 to 0.51 in 2006 also becomes apparent in a less steep Quasi-Engel curve in 2006. (* The ownership rate is given as the probability of ownership, cf. later.)

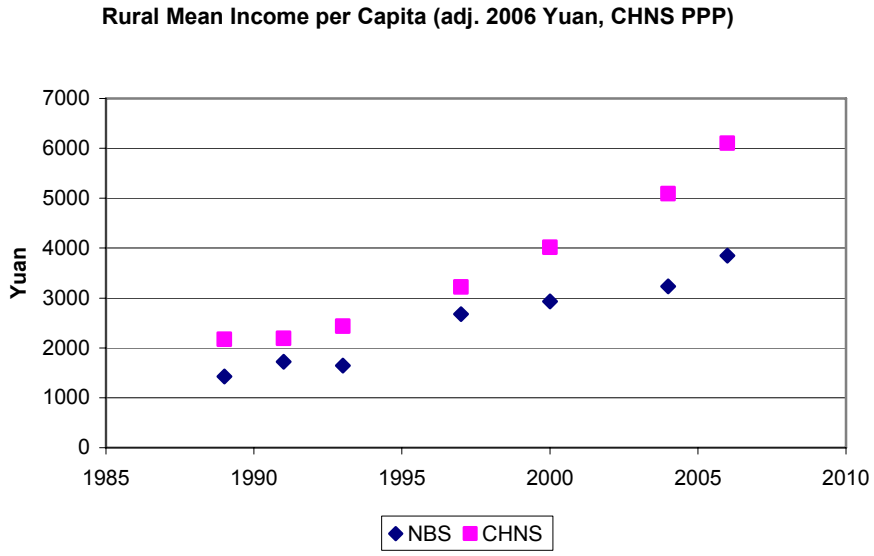
Figure 7.2 Survey Provinces

Source: CHNS homepage: http://www.cpc.unc.edu/projects/china (access: 20.1.2009)

Figure 7.3 Income Levels in CHNS and NBS Household Surveys



Implied annual urban growth rate:
CHNS: 6.42%
NBS: 8.2%



Implied annual rural growth rate:
CHNS: 6.27%
NBS: 6%

Note: Both figures of disposable income (CHNS and NBS) were deflated to 2006 Yuan using the CHNS deflator.
Source: NBS (2008).

7.2. Tables

Table 7.1 Durable Goods Ownership Throughout the Survey Period

CHNS - total	1989	1991	1993	1997	2000	2004	2006
Colour TV	18.99	24.94	32.3	50.15	67.71	83.29	89.87
Refrigerator	12.44	16.63	20.42	30.83	38.45	43.21	48.58
Washing Machine	33.86	36.42	37.91	47	52.79	57.37	62.92
Air Conditioner	0.37	0.25	1.31	5.1	8.71	16.58	20.01
Motorcycle	0.7	0.97	1.43	2.35	2.82	3.43	3.89
Car	2.09	2.39	3.9	12.41	18.92	25.63	28.2

CHNS -urban	1989	1991	1993	1997	2000	2004	2006
Colour TV	36.31	46.56	58.96	72.26	85.72	92.96	95.88
Refrigerator	30.27	38.51	44.74	55.95	64.47	66.48	70.44
Washing Machine	58.97	60.45	61.52	66.64	71.88	73.6	78.12
Air Conditioner	0.48	0.44	3.22	11.61	19.96	33.06	37.45
Motorcycle	2.51	3.06	4.93	15.02	20.83	20.72	19.64
Car	0.67	1.57	1.52	2.65	2.4	3.94	3.71

CHNS -rural	1989	1991	1993	1997	2000	2004	2006
Colour TV	10.69	14.82	20.49	39.07	58.83	78.51	86.94
Refrigerator	3.8	6.35	9.66	18.23	25.58	31.69	37.94
Washing Machine	21.69	25.14	27.46	37.17	43.37	49.33	55.51
Air Conditioner	0.31	0.16	0.46	1.83	3.15	8.42	11.52
Motorcycle	1.88	2.08	3.45	11.11	17.99	28.06	32.36
Car	0.72	0.69	1.39	2.2	3.03	3.18	3.98

Table 7.2 Durable Goods per 100 households in 2006

2006	Urban		Rural	
	CHNS	NBS	CHNS	NBS
Colour TV	127.3	137.4	101.7	89.4
Refrigerator	74.3	91.8	38.8	22.5
Washing Machine	81.4	96.8	56.9	43.0
Air Conditioner	55.8	87.8	15.5	7.3
Motorcycle	21.3	25.3	36.7	44.6
Car	4.6	4.3	4.5	

Source: Chinese National Bureau of Statistics, CHNS

Table 7.3 Logit Regressions for Colour TV Ownership 1989 and 2006

	Colour TV	
	1989	2006
ln_pcinc_ad06	1.028	0.487
	[0.0776]***	[0.0410]***
Constant	-9.414	-1.773
	[0.613]***	[0.337]***
Observations	3643	4297
Loglikelihood	0.0809	0.0501
Pseudo R-squared	-1638	-1330

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 7.4 Logit Regressions for Refrigerator Ownership 1989 and 2006

	Refrigerator	
	1989	2006
ln_pcinc_ad06	1.418	0.736
	[0.0844]***	[0.0453]***
Constant	-13.07	-6.258
	[0.671]***	[0.389]***
Observations	3739	4297
Loglikelihood	0.122	0.0903
Pseudo R-squared	-1244	-2708

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 7.5 Logit Regressions for Car Ownership 1989 and 2006

	Car		
	1989	1991	2006
ln_pcinc_ad06	-0.0783	0.629	0.52
	[0.281]	[0.329]*	[0.0980]***
Constant	-4.383	-9.493	-7.726
	[2.122]**	[2.609]***	[0.876]***
Observations	3637	3564	4294
Loglikelihood	0.000393	0.0177	0.0306
Pseudo R-squared	-149.4	-193.2	-678.1

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 7.6 Logit Regressions with Changing Age Effects

	Colour TV	Refrigerator	Car
ln_pcinc_ad06	0.19	0.187	0.0121
	[0.0196]***	[0.0149]***	[0.00465]***
income91	0.108	0.0313	
	[0.0250]***	[0.0209]	
income93	-0.000697	-0.0399	0.00319
	[0.0241]	[0.0196]**	[0.00604]
income97	-0.0429	-0.0677	0.00531
	[0.0235]*	[0.0185]***	[0.00542]
income00	-0.0614	-0.0749	-0.00567
	[0.0221]***	[0.0176]***	[0.00497]
income04	-0.0903	-0.0919	-0.00315
	[0.0223]***	[0.0175]***	[0.00503]
income06	-0.101	-0.105	-0.000563
	[0.0228]***	[0.0173]***	[0.00493]
urban	0.314	0.311	0.000323
	[0.0118]***	[0.0117]***	[0.00173]
coastal	0.338	0.144	0.00498
	[0.0199]***	[0.0180]***	[0.00308]
hhsize	0.0527	0.0189	0.00631
	[0.00414]***	[0.00304]***	[0.000545]***
hhhyredu	0.0304	0.0269	-0.00016
	[0.00153]***	[0.00117]***	[0.000173]
hhhage	0.00308	0.00333	-0.000549
	[0.000899]***	[0.000760]***	[0.000192]***
hhhage91	0.00234	-0.00128	
	[0.000838]***	[0.000734]*	
hhhage93	0.0022	-0.000261	-0.000236
	[0.000972]**	[0.000810]	[0.000237]
hhhage97	0.00138	0.000281	7.21E-05
	[0.00107]	[0.000884]	[0.000237]
hhhage00	-4.92E-05	-0.000254	-5.18E-05
	[0.00108]	[0.000886]	[0.000227]
hhhage04	-0.00382	-0.00127	0.000151
	[0.00120]***	[0.000896]	[0.000221]
hhhage06	-0.00747	-0.000286	1.66E-06
	[0.00137]***	[0.000904]	[0.000224]
Observations	25806	25892	22169
Pseudo R-squared	0.383	0.298	0.122
Loglikelihood	-10976	-11301	-2301

Clustered and robust standard errors in brackets, year and province dummies omitted from table for the sake of clarity.
*** p<0.01, ** p<0.05, * p<0.1

Table 7.7 Public Service Provision in Urban and Rural Areas

		1989	1991	1993	1997	2000	2004	2006
hrs_el	urban	21.00	23.38	23.76	23.70	23.12	24.00	24.00
	rural	16.77	20.07	21.99	22.84	23.55	23.90	23.81
SHARE OF HOUSEHOLDS WITH…								
tapwater	urban	61.02	59.48	64.77	76.27	78.14	82.69	86.07
	rural	23.50	27.72	33.12	36.89	41.91	47.05	49.60
el_light	urban	98.33	99.74	99.72	99.76	99.58	99.72	99.79
	rural	89.80	94.23	97.99	99.09	98.90	99.66	99.63
bus	urban	56.32	65.88	61.42	72.65	87.07	72.17	76.56
	rural	34.99	48.68	50.73	59.94	64.45	59.97	56.03
train	urban	5.56	25.68	31.45	23.41	23.91	29.02	23.92
	rural	5.66	15.16	13.94	18.39	17.12	20.32	17.18

Note: Shares are given in percent.

Table 7.8 Geographical Differences of the Price Trend

	Colour TV	Refrigerator	Car
ln_pcinc_ad06	0.109	0.142	0.0172
	[0.0119]***	[0.0136]***	[0.00420]***
ln_relcpidur	-1.47	-0.979	
	[0.200]***	[0.226]***	
ln_relcpidur_urb	0.503	0.342	
	[0.0439]***	[0.0423]***	
ln_pcinc_cpidur	0.039	0.0618	
	[0.0247]	[0.0279]**	
ln_relcpitrans			-0.104
			[0.0716]
ln_relcpitrans_urb			-0.000628
			[0.0108]
ln_pcinc_cpitrans			0.00935
			[0.00888]
Observations	18152	18144	18154
Pseudo R-squared	0.348	0.305	0.114
Loglikelihood	-7564	-8350	-2069

Clustered and robust standard errors in brackets, province dummies and household control variables on geography, household characteristics and public services are omitted from the table for the sake of clarity

*** p<0.01, ** p<0.05, * p<0.1

Table 7.9 Fixed Effect Estimation

	Colour TV	Refrigerator	Car
ln_pcinc_ad06	-0.227	0.512	0.523
	[0.169]	[0.230]**	[0.323]
income91	0.527	-0.133	
	[0.228]**	[0.278]	
income93	0.366	-0.217	-0.385
	[0.201]*	[0.255]	[0.393]
income97	0.423	-0.335	0.115
	[0.197]**	[0.250]	[0.400]
income00	0.48	-0.372	-0.328
	[0.188]**	[0.243]	[0.349]
income04	0.462	-0.51	-0.074
	[0.193]**	[0.240]**	[0.344]
income06	0.587	-0.276	0.0709
	[0.202]***	[0.240]	[0.346]
hhsize	0.565	0.404	0.46
	[0.0397]***	[0.0331]***	[0.0722]***
hhhage	-0.016	-0.0177	0.000186
	[0.0101]	[0.00857]**	[0.0178]
hhhyredu	0.0205	0.0287	-0.0336
	[0.0216]	[0.0180]	[0.0351]
tapwater	0.212	0.49	
	[0.131]	[0.118]***	
tapwater_urb	-0.0696	-0.343	
	[0.241]	[0.198]*	
hrs_el	-0.00626	-0.00448	
	[0.0139]	[0.0177]	
hrs_el_urb	0.0828	-0.0402	
	[0.0366]**	[0.0285]	
el_light	0.353	-0.108	
	[0.517]	[0.714]	
el_light_urb	-1.776	0.435	
	[1.883]	[1.176]	
bus			-0.163
			[0.208]
bus_urb			0.122
			[0.383]
train			0.062
			[0.236]
train_urb			0.467
			[0.419]
Observations	14683	9107	1457
Number of hhid	2695	1808	327
Pseudo R-squared	0.748	0.459	0.172
Loglikelihood	-1523	-1923	-440

*** p<0.01, ** p<0.05, * p<0.1