COMPETITION AND MARKE INTEGRATION:
THE CASE OF CHINA'S AUTO INDUSTRY

TIAN XI

MPHIL

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COMPETITION AND MARKE INTEGRATION: THE CASE OF CHINA'S AUTO INDUSTRY

by

TIAN Xi

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ABSTRACT

Competition and Market Integration:

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The "special treatments" of automobile industry in China, especially in the forms of local protectionism, have been criticized as evidences of domestic market fragmentation for long. Whether these "special treatments" have stunted the integration of a national auto market in China remains a question.

This paper seeks to examine the degree of market integration in the automobile markets in China by using tests of cointegration between prices of spatial markets. Several econometric approaches for spatial price analysis, including the ADF unit root test, Maddala-Wu's Fisher type panel unit root test and more restrictive Dufour-Torres panel unit root test are applied to monthly average retail prices for the main models sold across 36 cities from 1994-2006. Besides the above conventional linear methods, the author also applies the newly developed nonlinear unit root method proposed by Kapetanios et al. (2003).

Test results indicate that the nonlinear test support convergence more often than the conventional linear unit root tests. Moreover, they also reveal that price convergence and hence market integration hold for majority of models and markets. The paper also investigates possible explanatory factors in price disparities of auto markets among cities. As the evidence shows, the geographic distance between markets, difference of per capital income, and the existence of local production play important roles in the absolute price differentials as well as the volatility of price differentials among cities.

Keywords: Auto market of China; Domestic market fragmentation; Panel unit root test; Nonlinear unit root test

DECLARATION

I declare that this is an original work based primarily on my own research, and I warrant that all citations of previous research, published or unpublished, have been duly acknowledged.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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Chapter 1 Introduction

1.1 Motivation of the Study

China's car market is replete with examples of protectionism not only at the national level but also at regional and firm levels. To boost local economic growth, provincial and municipal officials often favor regional manufacturers and at times levy discretionary license fees to boost the market share of locally made cars. Such protectionist measures have allowed many capital-inefficient makers to remain in business.

1.1.1 State Protectionism

China's car industry is indeed an infant industry. Before the mid 1980s, the majority of investment in the automobiles industry was by the central government. Since 1985, foreign multinationals have rushed into the automobile industry, and now most large automobile manufacturers are joint ventures. The total output of automobiles reached 1.5 million vehicles in 1995. The output (value-added) of the industry was about 1 percent of GDP in 1996. The automobile industry argued that since there were economies of scale in car manufacturing and the world car market was monopolized by a dozen or so companies in Japan, the United States and Europe, the only way in which China could emerge as a competitive automobile producer was via import substitution. Japan and Korea were citied as success models to follow. In particular, the industry argued that Japan and Korea have become two of the largest automobile producers in the world through high protection. So, it was argued, it is possible for China to build up its automobile industry behind high protection.

The government introduced the "Industrial Policy for the Automobile Industry in the 1990s" as response to the appeals. Under the policy, the industry has become China's 'pillar' industry, and car factories have flourished. By 1996, there had been established 120 factories producing complete vehicles, 600 factories rebuild vehicles and 2,400 factories producing components and spare parts. However, the national output of cars in 1996 was only 1.1 million vehicles, less than the annual output of a moderate scale company in an industrial country. In addition, the automobile industry had gained powerful influence in trade policy over the 1990s. The central government protected the automotive industry from outside competition by high tariff and import quota on both vehicles and parts. The tariff on cars was 160 percent in 1992, 100-120 percent in 1996 and 80-100 percent in 1997. This rate of tariff reduction was much slower than the average tariff level. In 1997, when tariffs were reduced by 35 percent on average, tariffs on cars were cut by only 25 percent. By also covering the tariff rate of auto-related industries such as machinery, iron and steel, rubber and electronics that stand at 10-20%, the effective rate of protection for the automotive industry is as high as 219%. The industry has formed a coalition which aims to keep overseas competitors out of the Chinese market. Ironically, most multinationals have successfully entered the Chinese market around the end of 1990s. Continuous protection merely allows these foreign multinationals and their Chinese partners to profit at the expense of Chinese consumers. For instance, in 1997 the cost, insurance and freights price of a Toyota Camry with cubic capacity 2.2 litres was US$ 14,850, whereas the domestic price was about 38,000 in US dollars. A Buick Century sold at US$20,000 in the United States is sold at RMB370, 000 in China in 1998 (equivalent to about US$40,000.) Besides the high-tariff protection, the import of automobile parts was restricted by non-tariff measures including quotas and license. China adopted a quota and license system for import of automobile products, which account for about 60% of the total in the catalogue of quota products. Besides these, The Chinese government continued to limit foreign ownership in joint ventures to 50 percent to give the Chinese partners more control and bargaining power.

China’s protection of its car industry had been a stumbling block in its negotiations for WTO accession. In November 1999, Chinese leaders endorsed an agreement with the United States under which the U.S. would support China’s entry into the World Trade Organization in the 2000. The WTO agreement included an explicit commitment by the Chinese government to substantially liberalize the restrictions it had imposed on automobile imports and on the operation of foreign manufacturers in

China.

During the negotiation, the automobile industry has succeeded in arguing for preferential treatment. China had resisted demands from industrial economies for substantial reductions in automobile tariffs and for the elimination of quantitative restrictions over a short period of time. China was permitted to gradually cut its auto tariff within five to six years to 25 percent on July 1, 2006. Thus by the middle of 2006, China had fully implemented its WTO commitments to tariff decreases in the automobile industry. Furthermore, some other trade barriers in the car industry, as well as an important license system, have been abolished.

Table 1.1 Tariff Rate Deduction Schedule

Product	**2002**	**2003**	**2004**	**2005**	**2006**	**7/2006**
Vehicles not exceeding 3000cc	43.8%	38.2%	34.2%	30%	28%	25%
Vehicles exceeding 3000cc	50.7%	43%	37.6%	30%	28%	25%

Source: Coudert Brothers LLP, Automotive Industry in China, China Auto Conference 2002

1.1.2 Local Protectionism

Conceptually, according to Mertha (2005), local protectionism refers to trade barriers that reduce the sale of goods between localities, thereby preventing the growth of significant scale economies. Local protectionism represents a barrier to the creation of an efficient, integrated national economy from a mosaic of balkanized local markets that establish unfair barriers to entry engage in illegal production and sales, or both.

In the internal market, the car industry in China has also been signed out for ‘special treatment’ by lower levels of government-provincial or municipal for many years. At provincial government level car industry singled out for special treatment falls in the catalogue of ‘infrastructure industries’ or ‘pillar industry’ just as what done as the central government. Special treatment has traditionally taken the form of favorable financing, for example, open ended, low or no interest loans, favorable regulations, assistance in restructuring and restrictions on “foreign” participation. The problems inherent in a special treatment approach are compounded by regional protectionism. Local protectionism is a highly visible issue in auto market during the 1990s.

According to the Provisions of the State Council on the Prevention of Regional Blockades in Market Economic Activities issued on April 21, 2001, generally there are seven kinds of activities that belong to regional blockades:

1. Prescribing, directly or in a disguised form, that the entities or individuals can only operate, purchase or use the local products or can only accept the services provided by local or appointed enterprise, economic organizations and individuals;
2. Setting up barriers to prevent outside products from entering local markets or preventing local products from being shipped outside;
3. Imposing discriminatory standards of charges and discriminatory prices on outside products or services;
4. Making different technical requirements and inspection standards for outside products or services of the same kind;
5. Carrying out discriminatory treatment in relation to outside products or services and preventing outside products or services from entering the local market by way of franchises, monopolization, examination and approval, and permission, etc.;
6. Restricting or excluding outside enterprises, other economic organizations or individuals from participating in the local bidding by providing discriminatory qualification requirements, examination standards or failing to disclose the relevant information according to law;
7. Treating outside enterprises, other economic organizations and individuals unequally and discriminatorily in terms of their investment and in the setting up of branches.

All the above forms of local protectionism are very common in the auto market. In some provinces, protective measures had been adopted to ban sales of cars and mini-vans manufactured in other regions, excessive fees and complicated vehicle purchase procedures had stifled individual interest in purchasing an automobile whilst manufacturers had often failed to meet the needs of individual consumers in terms of product line, price, and management, marketing and sales mechanisms and after sales services. Such policies will not be easily overcome as other factors are also at play. For example, in 1998, with deflation pushing prices down and consumer demand cooling off, the Shanghai municipal government effectively mandated that all taxicabs in the city must be locally produced Volkswagen Santana and then tried to block sales of the Xiali produced by Tianjin Automotive Industries and the Fukang produced by Dongfeng Citroen in Hubei by imposing extra taxes and fees totaling upward of RMB80000 per vehicle, almost doubling the costs of the Xiali and the Fukang. Authorities in Hubei retaliated by slapping a variety of taxes on the Santana, including a RMB70000 fee for the "relief of enterprises in extreme difficulty", which drives its retail price from RMB172000 to RMB326000. The Hubei government, however, offered to withdraw the fee if Shanghai cut its de facto tariff on the Fukang. Faced with the possibility of losing access to Hubei, where sales of the Santana amounted to 55 percent of total sales, Shanghai announced in December 1999 that it would eliminated the higher licensing fee for cars produced outside of the city. The following years, Hubei-based Sanjiang Renault had to halt sales of its vans in Jiangxi after the provincial authorities imposed fees that increased their price 15 percent and left them unable to compete with vans produced within the province. In the spring of 2000, the municipal government in Xi'an was reportedly using discriminatory taxes to block sales of "imported" taxis and ensure sales of locally produced automobiles.

Besides the above mentioned obvious market restrictions, many provinces took obscure or indirect measures to protect local auto market. A key feature of the 1994 automotive industry policy is its encouragement of the consumption of private economy vehicles that match the country's relative low purchasing power. However, many local governments were discouraging private citizens from buying cars by placing restrictions on the use of small, domestically produced cars. They imposed taxes and fees on car owners, banned traffic and restricted the number of parking places. Since the establishment of the automotive industry policy, the automobile sector has been expanding rapidly, which might be too fast compared with the development of roads. As a result, travel is slower, and traffic jams are a constant phenomenon in big cities. The urban traffic management authorities tried to cut traffic volume by restricted private economy cars. For example, Beijing's municipal traffic authorities issued a dec ree limiting urban road-riding of Jeeps, light buses and sedans with engines smaller than 1.0 litres to every other day, according to license plate numbers. Most vehicles were domestically made economy cars. For economy-car producers, such restrictions were pretexts for local protectionism. For example, in Beijing, locally made Cherokee Jeeps were not restricted. In Shanghai, authorities stipulated that cars with an engine capacity of more than 1.6 litres could be used as taxis, thereby squeezing out small domestic cars, mainly the Xiali cars manufactured in Tianjin. Dalian followed the same policy of Shanghai; Tianjin restricted the use of mini-vans in some districts. In Wuhan, buyers of the local Citroen ZX (Fukang) enjoyed significant fee reductions not available to owners of other brands. Dalian, Guangzhou, Ningbo and many other cities has similar policies. It is no coincidence that the Guangzhou's largest taxpayer is Guangzhou Automobile Group’s Honda Accord and Toyota Camry, Beijing is Beijing Hyundai, Shanghai is Shanghai Volkswagen and GM, and Wuhan is Citroen. Quite likely, such measures were meant to boost the local automotive industry's growth. But when obsessed with their own vested interests, they might fail to see the whole picture, crippling the automotive industry.

Under such circumstances, it is only right that the central government steps in to resolve the problems. Its intervention would prevent freewheeling local authorities from fragmenting the market and freezing the industry's development. The increasing tension of regional protectionism caused tremendous concern from the central government while the tariffs began to de-escalate. The issue of a package of laws and regulations in recent years has put an end to many means used to block the market[1].

[1] “Law on Unjust Competition” approved in 1993, and the State Council No. 303 Order, “Stipulation of the State Council to Forbid Regional Blockade in Market Economic Activities”, issued in 2001. In 2003, State Development

In December 2005, six central government ministries further issued a joint notice eliminating all local government restrictions on small cars - defined as those with fuel capacity of less than 1.6 litres - starting on March 31, 2006. However, uncertainty remains about the effectiveness of the Chinese government's directives because they didn’t clarify penalties for local governments, and lack a deadline. Certainly the automobile industry has a long way to go. There are still many important issues required for academic study. An important question is that whether China’s car market is integration. Or in other words, whether the existing of various local protectionism has blocked the process of market integration?

After checking the car retail price data provided by the China Price Information Center (CPIC), I do find significant price differences for cars among cities in China. For some car models, the maximum price difference can exceed 10% or even more at the same time. In general, for the same model, as time goes by the price differences among cities do diminish, in particular, for the newer introduced models after China’s WTO accession.

In the context of this study, I will investigate the auto market performance by studying the impact of deregulation on market prices, prices spreads and market volatility in the domestic car market in China. A review of the literature showed that no study has been specifically conducted to measure the extent of market integration and price transmission in the China market.

1.2 Compare with Previous Study within EU

During the past two decades, car prices in Europe Union member countries were characterized by large and persistent difference despite the development of a single market there; therefore research on car price dispersion becomes an interesting issue

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and Reform Commission together with other eight ministries jointed issued the “Notice on Campaign to Rectify Auto Market” to examine and abolish discriminative local provisions or policies that favor market monopoly by local auto manufacturers.

to study on the European car market. These price differences had been the focus of intense public debate in Europe at the beginning. Consumer organizations and automakers gave their explanations from the role of geographical segmentation to exchange rate fluctuations.

The automobile industry also provides an opportunity for studying price convergence within both EU and EMU countries. A considerable number of studies aimed to assess the presence and importance of international price differentials, using different measurement methodologies. At the same time, efforts have been made to explain the causes of the observed price differentials.

To date, there has been little research on market segmentation of auto market other than the Europe Unions. The lack of study on this issue in the intranational context is probably because the following three reasons.

First, in contrast with other goods such as corns or gasoline in market, cars demonstrated great or unbounded specification differences among markets and models. The variability does make it often to confuse whether cars with the same name are identical goods among markets or regions. For instance, in United Kingdom, carmakers often provide more luxury equipments for the same model than in other EU members. That’s why most of studies focusing on European market applied hedonic price methods.

Second, in many countries, such as the United States, interregional trade barriers are prohibited by law or the central government effectively. That is why though there exists a lot of research on car price in the United States, most of which are concentrated on industrial organization theory.

Third, transportation cost has been identified to play important roles in many studies focusing on the law of one price. There are very few countries or single economies can display vast geographical disparities among regions in the sectoral distribution of economic activity, living standards and governmental administration.

The case of China is different as it provides us with a unique opportunity to study market segment theory.

First, comparing with the Europe Union, China is a single uniform country with a powerful central authority[2]. In this case, border effects and exchange rates cannot play the same roles in the possible interregional price dispersion as they did in the European car markets. Furthermore, we do not need to consider the hedonic price method to take into account the difference of specification for the same model sold in different regions.

Second, the automotive market in China represents an even more extraordinary case of development than other industry sectors. The whole automotive industry, which had more than 120 plants, only produced about 0.25 million unit cars in 1994. By the end of 2006 the production of cars had reached more than 3.87 million units and it is expected to grow even more quickly in the 2007 according to recently XINHUA Report. The number of private owned cars in China has increased to 13.83 million in 2005 from 0.78 million in 1994. In 2006, private customers accounted for a more than 53% of total sales nationwide.

[Insert Figure 1.1 here]

Third and most important, domestic competition is a very controversial issue in China. We often see some phenomena being criticized as anecdotal evidence for local protectionism in China, especially in auto market. Academically, some scholars describe China's economy as deeply segmented, with local protectionism imposing stringent limits on domestic trade. However, there are also some recent studies which

[2] However, china's transition to markets has long been associated with the devolution of authority from the central to local governments. See Montinola, Qian and Weingast (1995), Chang and Wang (1998), Xu and Zhuang (1998)).

show that intra-provincial trade barriers have decline.[3]

1.3 Outline of the Study

Chapter 2 provides a general overview of the theoretical background of market integration analysis of spatially separated markets. Chapter 3 provides an industry overview that uses the structure, conduct and performance method. In chapter 4 reviews recent literature one auto market convergence within EU, Law of one price in general commodities, and previous studies about China's economy segmentations. Chapter 5 presents the empirical method used in this study is discussed, while Chapter 6 considers various specifications of unit root tests, and reports my findings. To summarize my results, I find evidence in favor of market convergence for majority of car models in China's auto market when apply panel unit root test and nonlinear unit root tests support convergence more often than linear unit tests. In Chapter 6 conclusions and limitations of this study are provided.

[3] See Li Shantong et al.(2004) for comprehensive survey on Chinese domestic regional protectionism
See also C. Simon Fan and Xiangdong Wei (2006)

Chapter 2 the Theories of the Law of One Price

2.1 General Theory

The intranational law of one price (henceforth LOOP), as the basis of intranational "purchasing power parity" (PPP) for individual goods is an empirical proposition that in competitive markets, free of transportation costs and public barriers to trade (such as tariffs), identical goods sold in different locations must sell for the same price when their price are expressed in terms of the same currency (Krugman and Obstfeld (2006), p.395).

There is an important distinction between the LOOP and the more familiar Purchasing Power Parity (PPP) condition. The key aspect distinguishing LOOP from the more familiar Purchasing Power Parity (PPP) is the use of a large data set on the prices of individuals traded goods instead of aggregated indexes. Wile the LOOP arbitrage relation is postulated to hold for the prices of individual commodities, PPP is said to hold if the postulated holds for all products within country or among countries. If LOOP holds true for every commodity PPP must hold automatically. On the other hand, validity of PPP does not require the law of one price to hold exactly. Therefore, the LOOP is more restrictive than PPP. This has several advantages over aggregate data. First the absolute version of the LOOP can be tested. Second, potential biased due to index weights, varying based periods and no-traded goods do not distort the analysis. Third, the identical goods assumption can be examined and the price data adjusted accordingly. Fourth, price differences have a direct interpretation and allow attaching a value to potential arbitrage gains. Fifth, the effect of arbitrage barriers on price differences can be assessed directly.

The reason why LOOP must hold is arbitrage, which means that if in region A there is a demand shock for some good that causes the price of the good in location A to rise, there will be a possibility to buy the good at a lower price in another location, such as region B and sell it for a higher price in region A; Therefore, the effect of higher demand will be eliminated by additional supply. In a perfectly integrated economy, were there are no obstacles for the movement of goods among different regions and all markets are competitive, arbitrage is costless (means no transportation costs), and the supply of goods will be perfectly elastic in each regions. This is because any increase in demand of some product in region A will be satisfied by an instant inflow of the product from other regions.

While the idea is strongly rooted in appealing economic intuition, empirical analysis notoriously fail to establish support for it in the data; price differentials tend to remain persistent over time. This failure to detect price convergence among different countries undermined confidence in a wide range of open macro models that assumed some version of the law of one price. “The difficulties researchers had in rejecting a random walk model for PPP deviations on modern floating rate data was something of an embarrassment. Every reasonable theoretical model suggests that there should be at least some temporary component to PPP deviations.” (Rogoff, 1996, p.655) Therefore, there is great interest in determining factors that cause persistent deviations from the LOOP, which exactly is one of the aims of this paper.

The theory described in following part builds upon the framework of Gluschenko (2002). Let’s consider a perfectly integrated economy; by such is meant an economy in which there are not any economic, physical, and administrative obstacles to the movement of goods among regions. The absence of economic obstacles implies, among other things, that arbitrage is costless. The usual assumption of instantaneous arbitrage applies well. Clearly, in such an ideal economy, the LOOP holds at every point since any small deviation from the equilibrium will be instantly eliminated by perfect arbitrage. Therefore the perfectly integrated economy may be considered as an economy in which the LOOP holds.

For the convenience of subsequent formalization, let us simplify the country further.

Let it consist of only two regions, j and k, and there is only one product i. The prices of which in these locations are denoted as P_j and P_k. Both the two markets are perfectly competitive. It is also assumed that j is a relative small region of the country, and k is the rest of the country, which means any possible supply provided by local producers is negligibly smaller in region j than those quantities in region k. Arbitrage transaction costs per unit of good (marginal costs of arbitrage) are denoted as C; since arbitrage is perfect, $C = 0$. Income per capital, I_j, will be considered as the only factor, besides price, determining demand in region j, so that $Q_j = D(P_j, I_j)$. $D(P_j, I_j)$ monotonically decreases in price, and monotonically increases in income.

With these assumptions, supply in j will be absolutely elastic as any increase in demand in j will be opposed by an instant flow of good from k, and a decrease will cause an instant outflow to k; thus P_j is permanently maintained to be on the level $P_j = P_k$. Figure 2.1 illustrate illustrates different equilibria in a perfectly integrated market. (S labeling the supply curve)

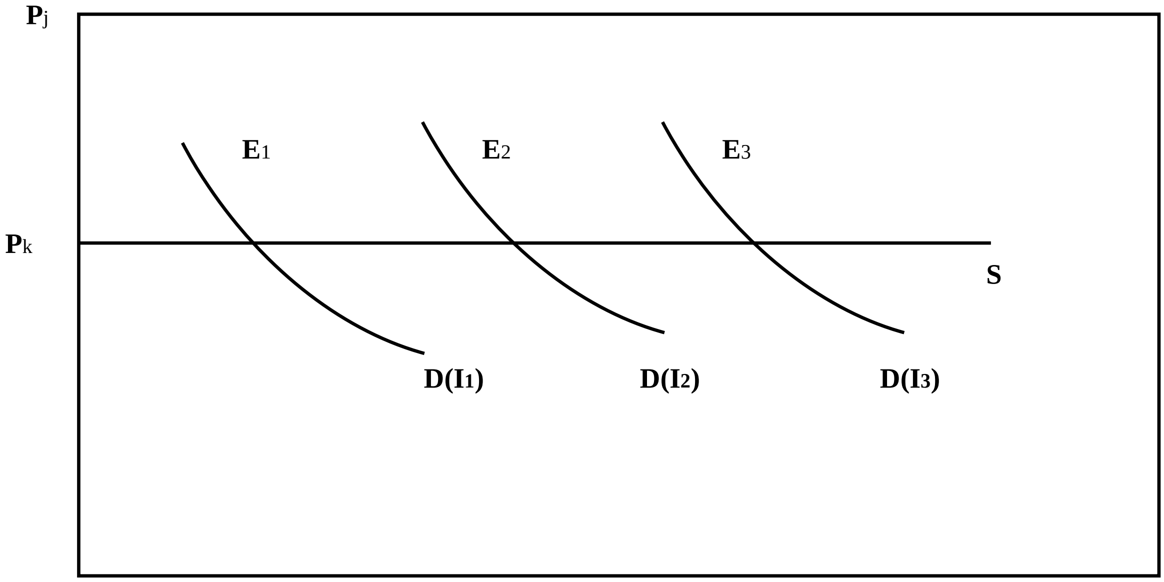


Figure 2.1 Market Equilibrium in a Local Market with Perfect Arbitrage

As the figure clearly demonstrates, with perfect arbitrage the same price P_k corresponds to each demand in region j (hence, to income I_j). Thus, the absence of the dependence of local price on local demand is a necessary condition for the LOOP to hold. Hence, any relationship between the relative price and demand in region j points to a violation of the LOOP, so indicating that there are some barriers in the way of commodity flows between j and k, and thus the economy is not integrated.

At this point, let us allow for such barriers. Barriers are considered as fully characterized by arbitrage transaction costs $C > 0$ (with a broader definition of transaction costs, these may also involve barriers of non-economic nature, e.g., administrative ones). In such an economy, arbitrage is no longer able to equalize prices in j and k as arbitrage occurs only if the price difference exceeds costs C, otherwise arbitrage turns out to be unprofitable. As soon as demand becomes such that local producers would supply the good at the price exceeding $P_K + C$, deliveries from k become profitable, thus beating the price back down to $P_k + C$. Therefore total supply turns out to be absolutely elastic in the section $Q_j \geq Q_2$. When demand falls to a quantity such that the good will have to be sold at a price below $P_k - C$, the price fixes itself at the level $P_k - C$, since all quantities that do not meet demand at this price can be exported to k, and be sold at price P_k. Thus, supply is absolutely elastic in the section $Q_j < Q_1$ as well. If demand is such that the equilibrium price is confined between the bonds $P_k - C \leq P_j \leq P_k + C$, then arbitrages are unprofitable. In this case, local producers supply the entire demand, and their entire output is sold in the local market, the total supply coinciding with curve S_L between Q_1 and Q_2. Thus a persistent difference in price P_j and P_k appears. Figure 2 illustrates the situation (S labeling the supply curve while S_L labeling the supply curve of local producers in region j).

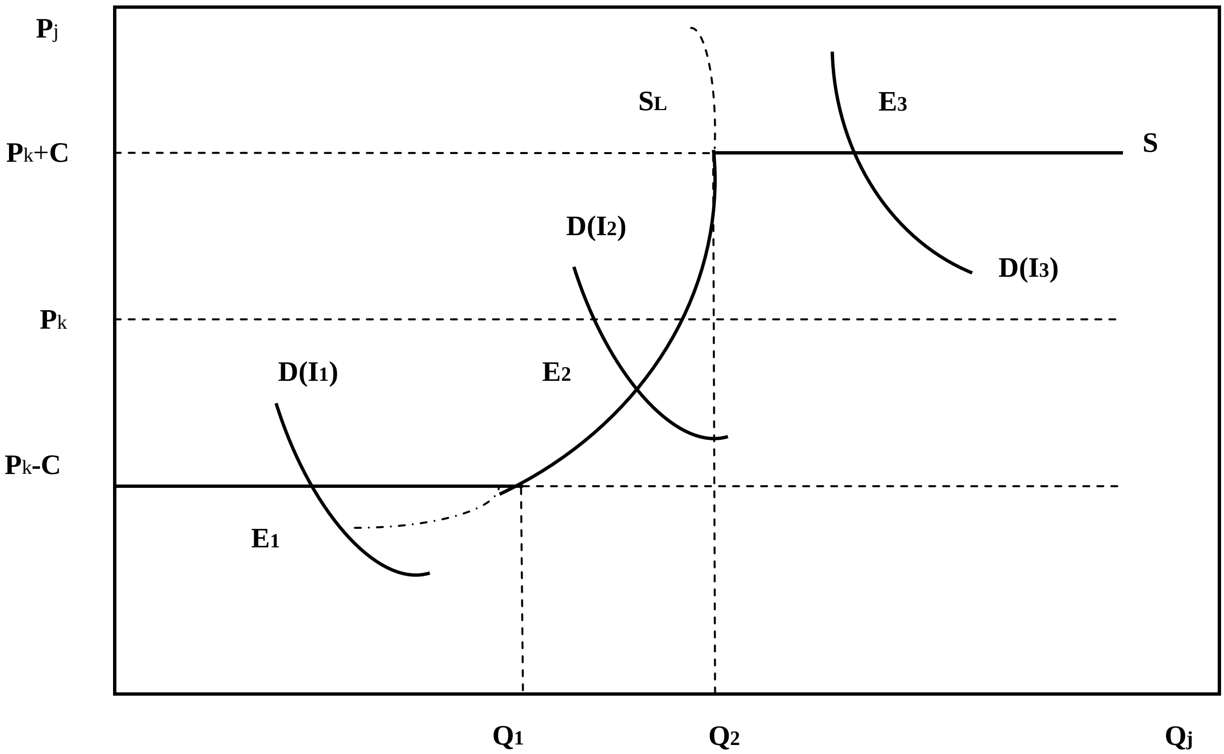


Figure 2.2 Market Equilibrium in a Local Market with Imperfect Arbitrage

There exist several potential explanations for the failure in the law of one price. These primarily include transportation costs, different currencies with sticky prices, labor market segmentation, tariff and non-tariff barriers to trade, fluctuations in nominal exchange rates, productivity differentials, pricing to market, aggregation bias etc. it is more likely instead that some combination of them provides the answer. By focusing on the degree of persistence in relative price differentials across cities within a single country, the approach this paper adopts testing the law of one price plays down the importance of most of the above explanations. Indeed, the implied speed of convergence in this context is expected to be faster than in studies testing the absolute law of one price in international price data. An alternative interpretation of the law of one price is that equilibrium price differentials exist, but there is a relatively fast convergence to them over time. The time invariant component of price differentials may in turn depend on the relative economic development of locations and the distance between them.

2.2 Two Versions of LOOP

There are two types of LOOP. This first is the absolute law of one price. Let $p_{i,j,t}$ and $p_{i,k,t}$ be prices of good i at time t in regions j and k respectively. Then according to the absolute version of LOOP:

$$\frac{p_{i,j,t}}{p_{i,k,t}} = 1 \tag{2.1}$$

The relative LOOP only requires that the rate of price change of good i in both regions should be the same. In this sense it is less restrictive. However, the absolute LOOP is less likely to hold in practice because of transportation costs and trade barriers. There are some difficulties associated with the relative LOOP. The relative LOOP may hold because:

A. Absolute prices are equal in all periods; the LOOP holds in all periods, which means:

$$p_{i,j,t} = p_{i,k,t} \quad \text{and} \quad p_{i,j,t-1} = p_{i,k,t-1} \tag{2.2}$$

B. Changes of prices in both locations are equal, which means

$$\frac{p_{i,j,t}}{p_{i,j,t-1}} = \frac{p_{i,k,t}}{p_{i,k,t-1}} \tag{2.3}$$

Therefore, if the available data is in the form of price indexes, it will be impossible to distinguish which relationship holds exactly. In addition, price indexes are not appropriate for testing the absolute LOOP.

Chapter 3 Industrial Backgrounds

3.1 An Overview of the Auto Industry

As China began to open itself to world trade and its economic reform in the late 1970s, change in its car industry emerged as an important part of the country's modernization drive. Both the infant passenger car industry and the relatively well-developed truck manufacturing sector faced new policies as a result of Deng Xiaoping's economic revitalization plans.

The passenger car industry was a minor part of vehicle production during the first three decades of China's socialist economy. As late as 1985, the country produced a total of only 5200 cars.[4] During the pre-reform era, the strategy for developing the economy as a whole gives priority to the development and growth of heavy industry. Further, both the city residents and government officials were discouraged from using private vehicles. The dearth of tourism and lack of disposable income among Chinese citizens also meant there was a low demand for taxis and other cars as means of local transportation. With an opening to international tourism and foreign business in the early 1980s, and relaxation of rules on perquisites for government officers, the need for car grew quickly. As domestic production could not meet the demand, imports rose dramatically, despite a 260 percent tariff on foreign cars. The country spent some $3 billion to import more than 350,000 vehicles (including 106,000 cars and 111,000 trucks) in 1985 alone.

China's answer to the growing demand and surging import wave was to encourage foreign investors to enter into join ventures with state companies:

1. In 1983, American Motors Corporation (AMC, later acquired by Chrysler Corporation) signed a 20-year contract to produce their Jeep-model vehicles in Beijing.
2. In the following year of 1984, Germany's Volkswagen signed a 25-year contract

[4] 1996 Automotive Industry of China (Beijing: Beijing Institute of Technology Press, 1996), P. 12.

to produce car in Shanghai and then with First Auto Works (FAW) in Changchun 7 years after.

3. Also in 1984, France's Peugeot signed an agreement for another car project to make car in the prosperous southern city of Guangzhou.
4. Japanese producers Suzuki and Daihatsu signed technology licensing agreements with TAIC (Tianjin Auto Industry Corporation) and Chongqing Chang'an machine factory to produce sub-compact models (Xiali 1.0 and Alto1.0) in mid 1980s.

Though joint venture agreements provided a window for foreign manufacturers to tap the Chinese market, there were limits on their participation. Foreign firms made investments oriented to market access rather than to operation efficiency. There were strict limits on joint ventures set by the Chinese government: foreign partners could purchase at most 50% share of assembly operations (e.g. Volkswagen's ventures took the up of 50 percent foreign ownership with SAIC in Shanghai and 40 percent with FAW in Changchun respectively). Furthermore, in principle a joint venture could assemble only one model or produce one type of parts, and could form partners with at most two Chinese companies. Car manufacturers were also given incentives and pressures to source parts from Chinese suppliers, with a 40 percent local-content rate bestowing reduced parts import duties of some 30 percent on the foreign partner.[5]The Chinese side also kept control of distribution networks for the jointly-produced automobiles.

The various incentives, combined with maintenance of import tariff duties, helped achieve success for at least some of the new joint venture companies. For example, with help from the Shanghai municipal government, which bought much of the output for taxis and municipal vehicles, and assessed a surcharge on sales to support a new localization fund to strengthen local parts suppliers, VW eventually captured half of

5 At 60% local content, the import duty fell to 24% and 80% local content meant only at 16% import tax. See Harwit (2001), "The Impact of WTO Membership on the Automobile Industry in China"

the Chinese market for cars. Volkswagen's Shanghai plant was the biggest winner under the regime. As car imports fell to some 34,000 in 1990, Shanghai-Volkswagen's (SVW) production of its Santana models reached nearly 19,000 cars that year. By 1993, the output of SVW had reached 100,000 cars.

[Insert Table 3.1 here]

In 1994, inspired by soaring motor vehicle output, which had tripled since 1991, and the apparent success of Japan and Korea in the industry, the state Council promulgated its first industry-specific policy document, more than ten years after the announcement of the first joint venture and subsequent formation of three other major joint ventures. The automotive industry policy anticipated a shift in demand toward car purchases by households from institutions, and reiterated the call for long-run consolidation into three to four groups akin to the "Big Three" model in the US, and with an emphasis placed on the ability to compete internationally. The policy also covered local content requirements, pollution and environmental considerations, conditions for the approval of foreign investment and so on. The policy contained an aggressive schedule for the development of the Chinese automotive industry, and was further amended in 2004.

Table 3.2 Stages of the 1994 Automotive Industry Policy

Stage	**Description**
1994-1996	"Foundation" Stage: Approved projects of light weight vehicles and passenger cars to commence production; the development of the components industry; vehicles to have a local content of 60-80%
1997-2000	"Attacking Difficulties" Stage: The target output for 2000 was 2.7 million vehicles, of which 1.35 million were to comprise passenger cars. The intention was fro there to be two or three large-scale automobile groups and six or seven "backbone" automobile enterprises. Basic R&D capabilities were to be established
2000-2010	"Rapidly Developing" Stage: The target output for 2010 was 6.0 million per year, of which 4.0 million were to be passenger cars. The industry was to be self sufficient for product development and competitive by international standards

Source: Holweg et al. (2005)

Unlike Korea, however, China refrained from utilizing either administrative compulsion or massive policy loans to favor key enterprises. The main effect of the policy was not domestic consolidation but a competitive rush by foreign auto assemblers and parts firms to enter the Chinese market and to establish a favorable position before China entered the WTO. With the 1994 Auto Industry Policy, entry to the industry was limited in order to foster economies of scale, and to centralize resources. The government prohibited car projects other than in the supported state-owned enterprises (SOE), which included the so-called "Big Three, Small Three &Mini Two" policy that clearly set out which manufacturers were to be sustained. By the end of 1990s, government regulation gradually loosened with the rapid growth of Chinese market, and then more international automakers poured into this industry to capture the fast growing demand for automobiles in China. The key contest came in Shanghai, where General Motors (GM) defeated Ford and Toyota to win a license to establish a second joint venture (after VW) with SAIC. Stimulated by GM's entry, Shanghai VW invested in the development of new models, pressed the municipal government for similar treatment, while the majority of parts firms in Shanghai sought out foreign partners to increase the quality of their products to qualify for supplying GM (Thun, 2004). Industrial policy and the prospect of WTO entry also spurred investment and local development by other big multinational automakers. In 1997, Honda took over Peugeot's troubled joint venture with Guangzhou Automotive Manufacturing Company, and then Ford entered negotiations with Chang'An in 1999. There was a veritable flood of investment into the Chinese auto industry during 1990s from both Chinese government and foreign sources. According to government statistics, total investment into the motor-vehicle and related industries from all sources totaled nearly US$ 60 billion during the 1990s. After China's entry into the WTO in 2002, virtually all of the major global carmakers and first tier auto suppliers had established major operations in China. VW and GM led the way, the three largest Japanese carmakers (Toyota, Honda and Nissan) and the two major Korean firms (Hyundai and KIA), strove to make up the lost time, while Ford, Daimler-Chrysler and the remaining major players tried to maintain themselves in an increasingly crowded and competitive market.

[Insert Figure 3.1 about here]

[Insert Table 3.3 about here]

In November 1999, Chinese leaders endorsed an agreement with the United States under which the U.S. would support China's entry into the World Trade Organization in the 2000. The WTO agreement included an explicit commitment by the Chinese government to substantially liberalize the restrictions it had imposed on automobile imports and on the operation of foreign manufacturers in China. Over the next three to six years, the institutional environment and the competitive environment in which both domestic and foreign-affiliated manufacturers operated would change fundamentally.

Table 3.4 Policies on Automobile Industry: Pre- and Post-WTO Membership

	Before entry into WTO	After entry in WTO
Tariffs	200 percent in 1980s 80-100 percent in 1990s	25 percent by 2006
Import quotas	30,000 vehicles a year allowed from foreign carmakers	Quota increased by 15 percent a year, phased out by 2006
Local content requirement	40 percent in first year of production;60 percent and 80 percent in 2nd and 3rd years	No local-content requirement
Auto financing for Chinese domestic consumers	Foreign non-bank financial institutions prohibited from providing financing	Foreign, non-bank financing permitted in selected cities prior to gradual national rollout
Foreign participation in sales and distribution	Limited to wholesaling through joint ventures; prohibited form consolidating sales organizations of imports, joint ventures	Will by 2006 be allowed to own vehicle wholesale, retail organizations, integrated sale organizations

Sauce: KPMG, China's automotive and components market 2004

As China entered the World Trade Organization (WTO) in 2001, international automobile giants paid a great deal of attention to the development of China's automobile industry, increasing their investments and production capacity, and offered their most recent products and latest technologies when embarking upon a cooperative project. On the other hand, major Chinese automobile groups, with the involvement of international automotive companies and by means of restructuring, joint production and merging, etc., have enhanced their ability in areas such as total production scale, product offering and product quality.

The Tenth Five-Year Plan for the Automotive Industry, issued in June 2001, emphasized the restructuring of China's automotive industry. It clearly indicated China's intention to turn its automotive industry into an internationally competitive one within the next decade. The plan stated that the guiding principles for the development of the automotive industry would be to persist in opening to the outside world while "boosting independent development capabilities".

Table 3.5 Aims of the Tenth Five-Year Plan for Automotive Industry

1	Simplify and standardize automobile purchase, registration and operation procedures.
2	Adjust consumption tax rates on automobiles, reduce the overall tax rate, and implement a gasoline tax;
3	Set uniform national fees for the purchase and operation of vehicles, and abolish unreasonable fees;
4	Permit foreign financial institutions to provide auto loans to Chinese customers;
5	Permit foreign financial institutions to provide auto loans to Chinese customers;
6	Revoke local protectionist policies;
7	Deny access for foreign used cars to the domestic market;
8	Promulgate the Law on Roads and Automobiles and other rules for automobile makers.

Source: Satyaprakash (2004)

Contrary to the expectations of many analysts, China's auto market boomed in the years immediately following accession to the WTO. In just two years, production tripled to the considerable total of over two million sedans in 2003, making China one of the largest auto producers and markets in the world. In 2003 alone, sales of cars grew by more than 50 percent. Among the causes of this unexpected boom were rising incomes generated by rapid economic growth, changes in consumption and tax policies that encouraged private car ownership, a rapid expansion of the road network; and a proliferation of the models available in China due to heightened competition.

In May 2004, the Chinese National Development and Reform Commission issued its ten-year update to the 1994 Automotive Industry Policy. For the first time, the government noted the emerging contradictions between the development of the auto industry and the encouragement of auto consumption by individual consumers on the one hand, and urban traffic infrastructure and environmental protection on the other hand. To resolve these contradictions, the policy states that the industry should actively conduct research on electric and hybrid-electric research, technological innovation, industrialization of new technologies, and the creation of an enabling policy environment for the production and use of hybrid vehicles.

With respect to technological innovation and capacity building, the policy states that the industry should continue to abide by the principle of integrating transferred technologies with self-developed technologies, and that the state will support R&D activities through preferential tax policies.

The other major emphasis in the 2004 policy is continued industry restructuring. The objective stated is that automotive enterprises should grow into large-sized conglomerates, industrial alliances, and special-purpose vehicle to make the Chinese industry more competitive in the world market. For the first time, foreign investors will be allowed to control stakes of more than 50 percent in automobile and motorcycle joint ventures with Chinese partners if the joint ventures are built in China’s export-processing zones and shoot at overseas markets.

One of the interesting phenomena happening in the Chinese auto industry is the fast development of a few independent indigenous auto makers after the entering of WTO, including Chery from Anhui, Geely from Zhejiang, Great Wall from Hebei province and etc. Those young and independent companies have been burgeoning like the bamboo shoots in the spring in China's automotive industry. The direct cause is that the central government loosened its strict regulation on the car production licenses. Therefore many local government capitals, which had been eager to enter the profitable Chinese auto market for a long time, were injected into a few new auto companies to produce and sell automobiles from around 2001. Combining a high proportion of cheap local parts and aging chassis or engines from the Sino-foreign joint ventures, the purely domestic companies have been able to offer compact cars at prices as much as 50% lower than those of the joint venture companies, making them highly appealing in smaller cities and the hinterlands. However, they have also developed impressive mid-sized cars recently as well.

In 2003, Geely and Chery, which only began producing cars in the late 1990s, sold over 80,000 units each, and began exporting small numbers of cars both in assembled and CKD forms. Though their technical capabilities are still limited and they must rely on foreign suppliers and designers, these indigenous young players have gained more valuable experience in developing their own models than those state-owned partners of joint ventures, which only produce models introduced from their foreign partners. In this they follow in the tracks of Toyota and Hyundai, which also assembled their own packages of foreign parts, designs and licensers rather than relying on single foreign partner during their initial stages. . They have also been able to use high salaries to lure leading executives and technical experts from SOEs and joint ventures. Both Chery and Geely are beginning to invest abroad using their own brands. Chery established a joint venture assembly plant in Iran and Russia, signed an OEM agreement to produce compact car for Chrysler in 2007, and is looking to invest in other developing countries.

The combination of market and political pressure from the independent indigenous brands stimulated SOEs to begin emphasizing their own independent strategies. Shanghai Automotive (SAIC), which had abandoned its traditional Phoenix and Shanghai brands while concentrating on the joint ventures with VW and GM, acquired a controlling share in the South Korean sport utility producer Ssangyong and purchased the rights to produce two of the models of Britain's last impendent auto producer MG Rover. In April 2006 it announced plans to spend over a billion dollars to develop new models based on the Rover 75 and produce 200,000 independent cars a year by 2010. In mid-2005 First Auto Works (FAW), which had largely abandoned its venerable "Hongqi" (Red Flag) brand, announced that it would expand capacity to two million units a year by the end of the 11th five year plan in 2010, of which at least half would come from its own brands. In March of 2006, Guangzhou Auto, which previously had restricted itself to helping its Japanese partners, reluctantly announced a goal of selling 25 percent independently-designed cars by 2010. Brilliance Auto, BMW's Chinese partner, also has its independent car division and developed its Zhonghua and Zunchi by outsourcing and cooperating with European design companies from the beginning. In 2007, Brilliance Auto has signed a contract with its Germany dealers to export 250,000 Zunchi to Europe.

By 2005 these domestic brands accounted for 30 percent of the market. The fact that these new players have succeeded as catalysts in the industry fundamentally altered the terms of competition in the Chinese auto industry. They are attracting more and more attention in the global auto industry. In particular, the operation modes of these Chinese domestic players are challenging the long-term rules in the automotive industry, like economy of scale, learning effects, technical capability accumulation and brand power. Their emergence reflects a few transformative changes in the automotive industry, such as specialization, design outsourcing, production modularization, globalization and technical diffusion and fusion. They have been a positive power to optimize the competition environment and seed up the maturing process of China’s automotive industry.

In 2006, the total car sales in China rose to 3.87 million units by increasing about 1.1 million from a year earlier. At the end of the same year, China overtook Germany and Japan to become the world second largest car market after only the United States.

3.2 Significant Changes of Chinese Market

3.2.1 The Surging Waves of Private Owner Market

The shift from institutional customers to private customers has created a market that is more discerning. Before the 1985 China did not allow private citizens to purchase motor vehicles for personal use and therefore did not develop large scale in car production. Privately owned cars were strictly prohibited according to the policy before 1979. Cars had long been the prerogatives of a relatively small number of high-ranking officials or managers from state-owned companies. When the control on private purchase was lifted formally in 1984, the number of private cars began to grow. However, car prices in China were far above the average annual income of its citizens, making it difficult for private buyers to afford before the early 1990s. The China’s car market remained to be largely an “institutional” buyers’ market where government institutions, State-owned companies, and taxi fleets rather than individuals are the main buyers.

[Insert Figure 3.2 about here]

A major turn-point came in 1994. Automotive industry was designated as a pillar industry by the Chinese government according to its Automotive Industry Policy in July this year. It also indicated to encourage individual consumption of privately owned cars. Since then the private cars began its growth in China. The amount of private passenger cars outstripped 1.14 million in 1995 while the number was 0.78 million in 1994, 2.3 million in 1998, 8.5 million in 2003 and 13.8 million at the end of 2006. In 1995 Institutions and Taxis made up 82% of vehicle demand; in 2001 this fell to 50%, with more than 80 percent of micro-cars and compacted cars purchased by individuals. The total number of car sold in china in 2003 was 2.02 millions units, of which the private car segment was above 75 percent of the total sales, a progression of 55 percent to the last year. According to the State Development Planning Commission, private cars comprised 70 percent of China's car sales of 2005, and increased to 80% in 2006. Projections of rapid growth in car sales are more and more relied on a continued acceleration in sales to private buyers. More demanding consumers are leading manufacturers to dramatically increase the pace with which new models are introduced. In the there years after WTO accession the number of car models produced in China increased from 40 to over 120.

3.2.2 The liberalization of Car Prices

The reform of Chinese domestic market is closely related to the reform of the price system, and so did the auto market of China. From a long period, cars were classified as in the category of industrial consumption goods. The prices for those kinds of goods were firmly held by the state government under the centrally command economy. As price reform deepened, the government's control over the car price had been loosened steadily in the past decades. There exist several stages of the management policy for homemade car price in the history.

Under the planned economy, the auto manufacturers only needed to finish the production plan assigned by the State Planning Commission (SPC). The SPC would arrange the production plan, furnish the raw materials and the most important, and designate the ultimate consumers for all the products. For producers, there was no need to consider the relation between supply and demand in the market. As a result, the car price for the same model was unified nationwide by the SPC during this period.

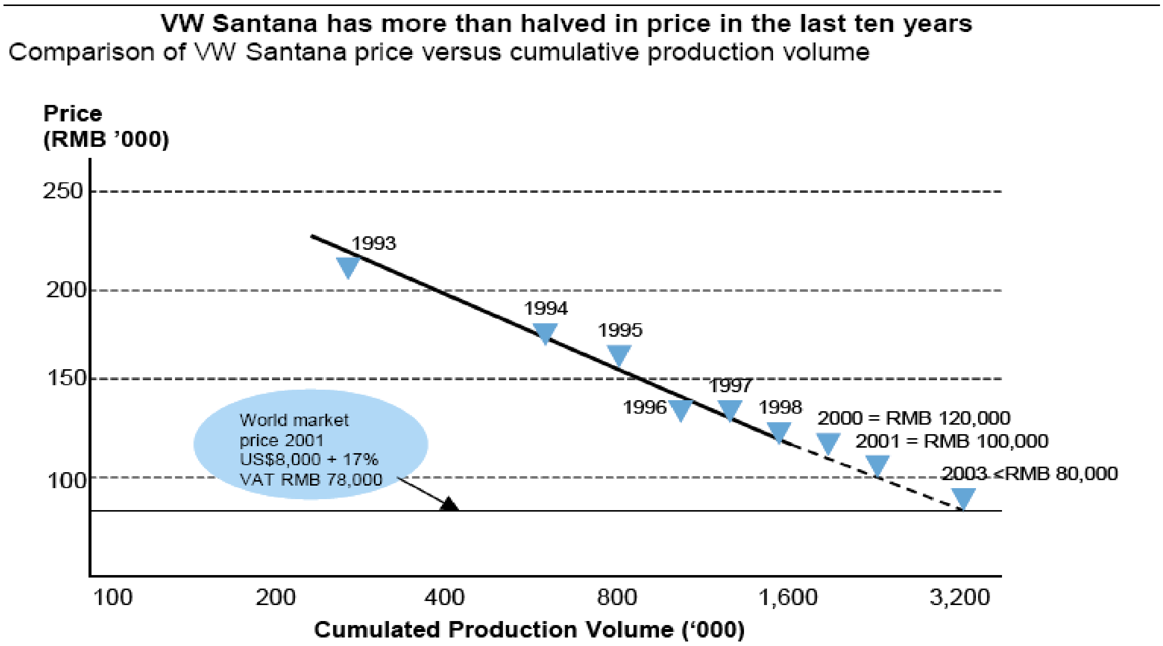
During 1984-1988, the government pursued expansionary macroeconomic policies that resulted in gradually increasing inflation. The two-track system (plan price and market price existed at the same time) with mandatory quota had been introduced to auto market. The market was extremely unstable under duo-track price system. The price was going to be disintegrated by unappeasable craving from the market for the first time. Take the case of BJ212 (the main product of Beijing Jeep before the introduction of XJ Cherokee), there existed four kinds of price in the market in 1988: the planed price was RMB28, 000, RMB32, 200 for the floating price, while the wholesale price from materials circulation sector was RMB35, 600, and the retail price was RMB38, 000 to private consumers in the market.

The SPC re-strengthened the price control of sedans by announcing “Measures for the implementation on strengthening the administration of sedan sales” in March 1989. According to it, the factory and retail prices of each sedan model were made by the State Bureau of Price together with departments concerned. The countrywide unified retail prices were base on the factory prices for each model, then plus the selling expenses and taxes and fees. The unified prices were adjusted according to the exchange rate fluctuations and the raising localization rates from 1989 to 1994.

New round price mechanism reform began in 1995. The SPC had set base prices for domestic cars, but allowed enterprises to adjust these prices by 10% based o benchmark levels in either direction since 1995. Some Chinese industry observers alleged that this policy had created a “price floor” for domestic producers, maintaining high prices even in the fact of domestic overcapacity since 1994. However, the policy was not resolutely carried out by domestic automakers, with the fact that the problem of overcapacity became even more serious in the following years. In fact, the government had given tacit consent to domestic carmakers’ dozens of price cuts since 1994.

There have been fierce reductions in the price of cars as the tariffs began to reduce, the price control began to decontrolled and competitive pressure intensified since 1994. Major local carmakers, such as the FAW, Tianjin Automotive Industry Corp, Shanghai Volkswagen slashed the price of their products since 1994. The steady price cuts dramatically boosted the consumption and extended the market scale. For example, the Santana LX, the best continued selling vehicle, cost RMB168, 000 plus extra U.S. $9100 in January 1994 according to the guided price. In March of 2000, the price of Santana LX was below RMB110, 000 and no foreign exchange required. In early 2000, a series of 'car wars' erupted as producers began to cut prices in hope to expanding market share and disposing of excess inventory. In January, Dongfeng-Citroen cut the price of its Fukang cars. Tianjin Automotive responded by reducing prices for its Xiali Cars. Several months later, Shanghai GM cut the price of its Buick Sail while Chang'an Suzuki cut the price of its car. Soon thereafter, Shanghai Volkswagen knocked RMB10, 000 off the price of its Santana and lowered prices for the Passat, leading Dongfeng Citroen to further reduce the price of the Fukang and FAW-VW to cut the price of its Volkswagen Jetta. Tianjin Automotive also dropped the price of the Xiali still further.

Figure 3.3 the Price Movement of Shanghai-VW's Santana



Source: Roland Berger, Volkswagen production figures.

On May 21 2001, the State Planning Commission (SPC) announced the elimination of price regulation for domestic cars and allowed carmakers full latitudes within the system. Since then, automakers of china finally and formally were granted the right to price their products according to market conditions.

3.2.3 from Underproduction to Overcapacity

Indeed, China's automotive industry is surging as the newest player in the global landscape, following the trail blazed by the U.S., Europe, Japan and South Korea. China's car market flourished in 1996, when deregulation allowed the entrance of foreign OEMs, and it began to heat up in 2001, when WTO entry loosened tariff regulations, effectively lowering prices and stimulated competition. The explosive growth peaked in 2003, when passenger car sales increased by 65 percent over 2002, fueled by increasing private consumption. However, the problem of overcapacity had existed for long under the superficies of this exceptionally boom for long time. The overcapacity was often viewed as one of the reasons for price drops in the whole industry. One of the key reasons for overcapacity was that foreign manufacturers had constantly overestimated the size of China's market. The reality was that the automobile market did not grow as fast as they expected, especially in a weak global economic environment after the East Asian Financial Crisis in 1997. Another reason comes from speculation. A critical distribution problem faced by carmakers was rampant speculation: dealers would order an excess number of cars from a plant, hold them to consumers at an inflated prices-keeping the profit for themselves. Sometimes speculators would bet wrong: what appeared to the factory to be a spike in sales would into a glut at the dealerships. In addition to depriving consumers of affordable cars, such speculation leaves carmakers with little sense of real demand and real inventory. It allows them no way to offer uniform prices nationwide-or even city-wide.

Just as China finally succeeded entering the WTO in late 2001, demand for autos accelerated, creating high profits and higher expectations. To cool its overheated economy after WTO accession, Chinese government paused private loans and increased car restrictions and fees in 2003. For example, the government imposed significant license fees, registration permits, and proof of a parking location prior to purchasing a car. It worked. Demand simmered down. Given huge ongoing investments by OEMs, the drop in demand caused by overcapacity, which forced OEMs to sharply cut production and cut prices further. Regardless, they continued to build capacity, even as they had a hard time absorbing it. Local firms, too, poured into the auto industry, pulled by the high profits and pushed by excess capacity in other industries such as motorcycles and the desire of local political leaders to expand their economies. A number of China’s numerous truck and pickup producers also tried to move into the rapidly growing market for passenger cars. At the end of 2006, the state government further released a circular upon the restructuring of the nation's automotive industry in a bid to put a clamp on its overcapacity. The circular raised the threshold for new complete vehicle projects. Complete vehicle manufacturers are permitted to kick off new projects if their sales in the previous year accounted for over 80 percent of their approved capacity. Manufacturers' built capacity, which has not gained regulatory approval yet, will be given the light if they sold no less than 100,000 sedans, 50,000 SUVs or 50,000 MPVs in the previous year.

The massive amount of investment in production by both foreign and domestic firms over the last five years translates into more severe overcapacity. According to National Development and Reform Commission (NDRC), auto production capacity in 2010 expected to be more than two times of the market demand. Production capacity is currently estimated to be 8 million units a year and expected to hit 10 million in 2007, further the current plans by foreign and domestic producers will increase this number to 16 million vehicles by 2011. The glut of capacity, combined with cuts in tariffs, intensified the competition, forced auto firms to reduce prices, cutting deeply into profitability. Despite the increasing rigors of competition and the ominous drop in profitability, the demand of Chinese market still has strong growth and continually to expand. The returns to those that can hang in should be huge. The Japanese and Koreans, who are grabbing market share, have every reason to continue expanding capacity. Once-dominant VW has lost a huge share of the market, and GM is potentially vulnerable, but each is losing more badly to the Asian makers elsewhere, so they are determined to hold onto China. Local officials will do everything in their power to keep firms in their jurisdictions from exiting the market. Thus, all players in China, OEMs, and the newly younger local producers are likely to face increasing competitive pressures from China.

Chapter 4 Related Empirical Literatures

Three streams of literature will be reviewed in this chapter. The first stream is research on market Integration en bloc; research focused on European car market is the second steam; those studies on China's market integration are the last. I will try to identify and demonstrate the limitations and gaps in the existing literature when it comes to understanding the complex factors that effect china's auto markets.

4.1 Research of Goods Market Integration

Research on goods markets has focused on differences in the size of intranational and international trade flows as well as price dispersion within and across countries. Typically, there is much more trade in goods between regions and cities within a country, than between countries-many barriers and distortions to trade are usually mush smaller inside a country. Thus, regional data allows the elimination of three major sources of deviation from the LOOP: exchange rate, tariffs and border. Moreover, intranational violations of the LOOP may matter more than international editions because the former are more likely to involve substantial regional quantity imbalances and, thus resource misallocations, which is of particular concern to the national policy makers. In addition, differences in cost of living between regions are important because the system of transfer payments may not take them into account.

McCallum (1995), Anderson and Smith (1999), Wolf (2000), Nitsch (2000), and Ceglowski (2003) for instance, have found a surprisingly large border effect by controlling for distance and other geographic variables (a dummy is used to distinguish between cross-border and internal trade flows). However, the results were strongly influenced by the approximate measures of intranational distances and remoteness. There is clearly considerable disagreement as to the size of the border effect.

In an influential set of papers, Engel and Rogers (1996, 2000, and 2001) found that even after controlling for distance, there was a substantial difference in prices across the U.S.-Canadian border. Parsley and Wei (2001) also found large border effect by performing a similar exercise on U.S.-Japanese data. McCallum (1995) found that intranational trade flows were 22 times larger than international trade flows. In a similar vein, provincial borders in Canada (Helliwell and Verdier, 2001) and state borders in the U.S.A. (Wolf, 2000) accounted for a significant fraction of the decreased trade flows across provinces and states relative to trade flows within states and provinces. In a study including the EU countries, Nitsch (2000) also came to the conclusion that the economic borders matter less in Europe than across the other OECD countries and demonstrated in addition that the border effect had declined over time. Furthermore, Ceglowski (2003) found that provincial borders in Canada accounted for a significant fraction of the discrepancy of prices across provinces. This has important welfare implications and Obstfeld and Rogoff (2000) include the border effect in their list of the major puzzles in international economics.

In the absence of any barriers or costs to the movement of goods, price differences expressed in a common currency between comparable items in different locations would be quickly eroded. However, due to natural (transportation, information and other transactions costs) and administrative impediments (e.g. differences in local tax rates) prices generally differ within countries, let alone across borders where far more significant trade barriers usually prevail. Indeed, the failure of the law of one price to hold in cross-border trade has been well documented by various studies.

Focusing on Canadian provinces and US States, Engel and Rogers (1996) found again a border effect on the variance of relative prices (over time), which was very large as compared to distance and by far too large to be explained by any remaining trade barriers. As with the empirical research on trade flows, distance captured again transport and information costs. While taking into account differences in costs (wages) across regions reduces the effect of distance on price variability, it does not affect the border effect. On the other hand, mark-ups appeared to fluctuate widely with exchange rate changed and cross-border prices mainly moved along with the exchange rate.

Using aggregate CPI data for 55 cities across 11 European countries, Engel and Rogers (2000) estimated how much of the border effect could be accounted for by nominal exchange rate fluctuations. The results indicated that controlling for currency swings indeed reduced substantially the size of the border coefficient, even though the latter still remained significant. This is taken as evidence that the deviations from the law of one price are largely explained by pricing-to-market strategies whereby prices set in local currencies are adjusted only gradually and infrequently, implying a very low exchange rate pass-through in the short term. For exporting firms, such pricing behavior implies a high sensitivity of mark-ups to nominal exchange rate fluctuations, compensated, however, by lower menu costs and a reduced risk of facing permanent market share losses. In distinguishing between the two types of border effects, Engel and Rogers concluded that the stickiness of prices and volatility of exchange rates mattered more than the “real” barriers highlighted in the aforementioned studies focusing on trade volumes.

Besides pricing-to-market practices, significant price differences between similar items could also reflect the capacity by producers in some sectors to price discriminate across national markets, allowing them to capture a share of the consumer surplus. The latter can be substantial in the case of high value-added items, in particular when important differences in living standards lead to cross-market variations in the price elasticity of demand. Sizeable and persistent mark-up adjustments, for instance, seem to have a strong effect on car price differences across the EU countries (Goldberg and Verboven, 1998, 2003). However, such practices can only persist if there are trade barriers in the form of technical specifications or vertical integration combined with a lack of competition in the distribution system, which keep the market segmented even in the absence of tariffs and border controls.

4.2 Empirical Studies from the EU Auto Market

Over the past decades, important steps have been taken in the European Union (EU) to integrate markets. One of the expected effects of the process of market integration in Europe is price convergence. This hope relies on the argument that the elimination of administrative and technical barriers to trade, as a result of the Single Market Project, and the recent adoption of the Euro reduce the potential for price discrimination across member states by bolstering cross-border trade and price transparency. However, the European car market has been a notorious example of deviations from the LOOP in international or intraregional markets. Large differences in car prices across countries were continually to be a persistent phenomenon in the Europe market.

Mertens and Ginsburgh(1985) are the first as I know who proposed to estimate hedonic price regressions for about 100 car models sold in five European countries (Belgium, France, Germany, Italy and the UK) to study the European market. This method allows them to estimate specification-adjusted price indices based on price and characteristics such as length, width, engine, horsepower maximum speed and so on. They also included country-of origin fixed effects and domestic firm effects. They concluded that the degree of market concentration could explain the observe price differences.

Ginsburgh and Vanhamme (1989) extended the hedonic analysis to consider a longer time period. They collected price and specifications data for about 120 models in the same five countries for the period 1984-1987. They found that specification-adjusted price differences had seriously decreased in 1986-1987 compared with 1983-1984.

Mertens (1990) considered a bit more than 100 models within an even longer time period (1970-1985). Using hedonic regressions, he decomposed the evolution of price differences into an exchange rate effect and a residual effect. He found the price differences and exchange rate movements seemed to move in a parallel direction for 1980-1985.

Gaul (1993) used data on list prices and transactions prices for 28models sold in 1986 in 8 European countries. He found taxes (VAT) were an important determinant of price differences. In addition, domestic market power and the presence of import restrictions were significant explanatory variables. In contrast, transportation costs did not seem to be significant explanatory variable for price differences across countries. The similar results were also concluded by Flam and Nordstrom (1995) by using a data set of 11 countries during 1989-1992.

Le Cacheux and Reichlin (1992) made the first attempts to quantify the degree of exchange rate pass- through by using monthly data form 1982-1987 for Belgium, France, Germany, Italy and the UK. Their econometric analysis indicated that the cross-country price differences fluctuated almost proportional to the exchange rate fluctuations.

Flam and Nordstrom (1995) considered the role of taxes, tariffs, and import quota constraints by using a data covering the prices of 43 models for 11 European countries sold during 1989-1992. They found that taxes significantly reduced the pre-tax price of cars, and the effects of tariffs on pre-tax prices were highly significant. Furthermore, they found the significant effects on price when the country adopted import quota constraints or if the car was domestically produced.

Gross and Schmitt (1996) considered exchange rate pass-through by German, Japanese, French and Belgium-based automobile producers in the Swiss market, using quarterly data on import unit values for the period 1977-1991.they found that long-run pass-through rates that were typically less than 50%, and frequently in the 20-30% range.

Verboven (1996) estimated a structural model of price-setting behavior by using a data set on list prices, technical characteristics and sales for all models sold in 1990. The approach allowed him to explicitly distinguish between the roles of differences in profit markups and differences in local costs. He found that, differences in profit markups across countries could be interpreted as evidence of international price discriminations.

Goldberg and Verboven (1998) computed hedonic price indices for the same five countries as Mertens and Ginsburgh (1985), covering about 100 models over the period 1980-1993. They found the volatility of the price differentials could be related to exchange rate fluctuations. They also found that price difference was contributed to cost and discount differences in the U.K., to domestic brand bias in Italy.

Bouckaerk and Verboven (2000) extended to panel approach by Pareja and founded that exchange rate pass –through was greater in the long run than in the short run and the large international price differences could fluctuate considerably and persist over rather long period.

Pareja (2003) investigated the price to market behavior in European car markets by using a data set including about 80 models over the period 1993-1998. He found evidence that there was strong pricing to market behavior or local currency price stability.

Goldberg and Verboven (2003) used approximately 150 models per year in five European countries over the period 1970-2000. Their findings provide strong evidence in favor of the relative version of the LOOP. They found the country/product fixed effects capturing long-term persistent price differentials across markets to be jointly significant.

Lutz (2004) also got the similar results as Goldberg and Verboven (2003) by examing

24 different brands and 88 models sold in twelve European countries for from 1993-1998. His finding supports the relative version of the law of one price. He also concluded that the determinants of arbitrage costs had more explanatory power. The single most important factor was the distance between markets. Moreover, the regime of single currency lowered price differences significantly.

4.3 Literature on Chinese Spatial Economy

Local protectionism and impediments to the economic unification of the national market remain topical issues.

Some early literature concluded that the local government tried to retain low priced raw materials within their own locality in order to favor local manufacturers, parallel with these struggles over low-priced raw materials were efforts to prevent inflows of manufacturing goods with high make-ups. Most of them were stories of semi-official tolls and police and customs checks. However, these descriptive accounts relied on anecdotes, and many were tied to specific circumstances, including price controls that have generally been abandoned in the 1990s.[6]

Much of the current literature portrays china as a group of insufficiently specialized regional economies, meaning that national economic integration is low. In addition, China's geographic expanse and rugged topography also means that there are significant physical barriers to inter-regional trade. Under such condition, many researchers argued that the Chinese economy looked like an aggregation of "fiefdom economies."

Regional protectionism by provincial or local authorities often blocks efficient distribution of goods and services inside China. These practices may restrict market

[6]During the mid-1980s, various examples such as "wool war" and the "silk war" were cited, in which local government tried to retain low priced raw materials within their own locality in order to favor local manufacturers (Waston, Finalay etal.(1989) Wedeman (1995)).

access for certain goods, raise production costs, and restrict market opportunities for enterprises in other regions. Kumar's (1994) World Bank report "Internal Market Development and Regulation" underlines the limited degree of regional specialization and the weak mobility of factors and goods in China.[7] One of the most evident perspectives is that regional price differentials for disaggregate commodities are prevalent.

Mody and Wang (1997) used of data on the output of 23 industrial sectors in seven costal regions over the period of 1985 to 1989 to study the correlates of growth. They found that although industrial-specific features had some influence on growth, much of the action came from region-specific influences and regional spillovers.

By carefully examining the input-output tables among Chinese provinces in 1987 and 1992, Naughton (1999) concluded on the basis of finding significant inter-and intra-industry cross-provincial trade that Chinese provinces were reasonably integrated.

Relying on indirect analyses of price and provincial economic structures data, Young (2000) showed evidence on the rise of local protectionism in China during the reform era and concluded that China had evolved into "a fragmented internal market with fiefdoms controlled by local officials" after 20 years of economic reform.

Gong et al. (2003) reported that even though regional governments engaged in the protectionism of goods markets, the trend towards protectionism was declining. They stated that it increased the inward orientation of provinces and caused serious losses to firms.

Poncet (2003) examined the inter-provincial trade flow data from provincial input-output tables for 1987, 1992 and 1997 to compare the magnitude and evolution

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7 See World Bank 1994 for a survey on constraints on domestic trade (p.38)

of Chinese provinces' engagement in domestic and international trade at the aggregate level. She found that provincial borders mattered more and more inside China in the sense that they implied greater discontinuities in the Chinese domestic market.

Bai et al.(2004) used a dynamic panel estimation method to examine a panel data set of 32 industries in nearly all the provinces over the period 1985-1997. They found that, while the effect of local protectionism on regional specialization was still evident in China, market forces had become more important, and had overcome the influence of local protectionism.

Fan and Wei (2005) used a panel of monthly prices for 93 products and services from March 1990 to September 2003. They used the dataset at individual product level to understand local protectionism in China. They obtained opposite results when working at the individual goods level as most of the goods in their sample displayed a clear trend of convergence in prices over the 1990s, with the convergence rate increasing over time.

Chapter 5 Data and Description

5.1 Data of Study

The primary dataset used in this study is a panel of monthly pre-tax retail prices of the most popular models of car sold among 36 cities over the period 1994-2003 and 2004-2006. The sample is drawn from the larger sample of consumer prices collected at the monthly frequency for the computation of the consumer price index for transportation sector by the Bureau of Statistics, which provides explicit instructions and data forms to data collectors. The reason that the dataset broken into two sub-periods is that the survey of the statistics in 2004 was suspended due to the restructuring of departments under the State Council. The first period sample consists of monthly series of retail prices of 21 most popular models collected in 36 cities of China over the period from January 1994 to March 2003. The second one covers 28 models sold in the same 36 cities form January 2004 to December 2006. Altogether, the dataset includes a total of 49 models.

The data set is unique in several ways. First, the data are three dimensional. The dimensions are time, model, and market. Second, it consists of pre-tax retail prices rather than post-tax prices. Because tax and levies are charged in the city where the car is registered rather than where it is purchased. So from the point of view of a potential buyer, pre-tax prices would have more influence on their purchase decision. Third, the sample covers 36 major Chinese cities, including all the capital cities of all provinces together with four municipalities, and several other important cities, like Shenzhen, Daling, Ningbo and Xiamen etc. Table 1 gives a complete list of cities. In essence, the data provide considerable geographic coverage for actual retail prices of over a set of comparable car models.

[Insert Table 5.1 about here]

All the price data are spot prices regularly collected by the local government agencies monthly. The dataset contained a few missing values, especially for earlier periods and some remote cities. For the purpose of our analysis, we have had to use continuous time series data for each model and city. When the price in the months proceeding and following a month with a missing value remained constant, the constant price was imputed to the month having the missing value. If the proceeding and following months were different, I would fill the missing value by the average price of the month before and after the missing value. We therefore could choose the longest possible continuous time series for each product and city. To avoid the small-sample problem, we first excluded any model for which there were fewer than 24 continuous observations in all cities. Next, we exclude those cities for which there were fewer than 24 continuous observations for each model. The result was unbalanced panel data set for a total of 44 models. Table 5.2 lists the car models together with the category to which they belong and their longest selling period available in the current sample.

[Insert Table 5.2 about here]

5.2 Basic Statistics

In this section I carry out a preliminary analysis of the degree of deviation from the LOOP. The data set allows me to abstract from the effects of nominal exchange rates, trade policies and similar issues arising in an international context. To measure the speed of price convergence across cities of China, first the model specific price differential between two cities is computed first. This requires the choice of a benchmark city for each panel. Given Beijing's central economic and political importance in China, Beijing is used as a benchmark city in much of the analysis. Moreover, the price data for Beijing are relatively the most complete ones when compared with other cities. Relative price or price variation is constructed as following:

$$p_{i,k,t} = \ln(P_{i,k,t} / P_{i,Beijing,t}) \qquad (5.1)$$

Where $P_{i,k,t}$ is the price of model i at time t in city k. Correspondingly,

$P_{i,Beijing,t}$ is the price of model i at time t in Beijing ($k \neq Beijing$). Thus $p_{i,k,t}$ measures the percentage difference between the prices of model i in cities k and Beijing at time t. In the absence of barriers to price equalization, the price differential measure $p_{i,k,t}$ would be zero. Otherwise, $p_{i,k,t}$ provides a measure of the size of the deviation from absolute price parity.

Before discussing the regression results, it is useful to look at some summary statistics on the variability of price differentials and on the mean absolute price differentials which are presented in Table 5.3 and Table 5.4 respectively. The variability of price differentials is defined as the standard deviation over time of the price variations ($p_{i,k,t} = \ln(P_{i,k,t} / P_{i,Beijing,t})$). The mean absolute price differential is defined as the mean absolute deviation of the price variations. That is the mean over time $|p_{i,k,t}|$.

[Insert Table 5.3 about here]

[Insert Table 5.4 about here]

As a first look at the data in table 5.3, the variability of price differentials averages at 0.002 for all models and range from about 0.278 for NorthernStar 0.8 to -0.262 for GreatWall Safe 4WD. Another useful summary measure is the mean absolute price differentials. The variability was measured as the standard deviation of the relative price over time. This measure of variability averages 0.09 for all 20 models. Doesn't like the mean of variability of price differentials, it shows smaller variation across models. Most of the models show standard deviation around 0.1.

Table 5.4 presents the descriptive statistics of the mean absolute price differentials for all the models in my study. The mean absolute price differentials average 0.076 for all models and range from 0.285 for NorthernStar 0.8 to 0.027 for Accord 2.4I-VTEC. The lower bound for the individual price differentials is zero but the data reveal some substantial price differences, with a few low-price models exceeding 0.4. The standard deviations for the mean absolute price differentials average 0.075, slightly lower than that for the variability of price differentials.

From table 5.3 and 5.4, we can see that there exist significant differences of price differentials among models regardless whether the variability of price differentials or the mean absolute price differentials is used.

Chapter 6 Results on Convergence

The LOOP implies that profit incentives and market forces induce the prices for the same product sold in different markets to tend to converge to the same level. This implies that the time series of relative prices are mean reverting, or stationary. To test for stationarity, it is a common practice to apply unit root tests, where rejection of the unit root hypothesis implies that the time series of relative prices are stationary, and will in the long-run converge. If the test fails to reject the unit root hypothesis, relative prices follow a random walk and any deviation in prices becomes derangement.

The fundamental objective of this study is to characterize the degree of persistence in intra-city price differentials. Though the data exhibit sizeable deviations from absolute price parity in the short run (see Table 5.3 and Table 5.4), it doesn't mean there is not a long-run tendency towards parity. Rejection of the unit root hypothesis implies that relative prices are stationary and converge to a long-run value. This can be interpreted as consistent with long-run relative parity when convergence is to a non-zero constant or long-run absolute parity when convergence is to zero. The reason for long run relative parity is evident: persistent income differences and local non-tradable factors of production, transportation costs, selling expense and other potentially time-invariant barriers of trade may create a constant price gap among retail prices at different cities. The price differentials may never fully converge to zero but just approach to a common, potentially non-zero level, being identical across different cities.

We will begin with a series of individual tests for unit roots in all the price series measuring the price in each city relative to Beijing.

6.1 Univariate ADF Test

The most common tool for testing whether a data series is non-stationary is the Augmented Dickey-Fuller test. Univariate Augmented Dickey-Fuller (ADF) tests were performed to each individual time series to examine whether the relative price series are stationary based on a unit root null and an alternative of mean-stationarity. The test regresses the first difference of a variable on a constant, its lagged level and Z lagged first differences using the following equation:

$$\Delta p_{i,k,t} = c_{i,k} + \alpha_{i,k} p_{i,k,t-1} + \sum_{z=1}^{Z} \beta_{i,k,t} \Delta p_{i,k,t-z} + \varepsilon_{i,k,t} \qquad (6.1)$$

where the term $p_{i,k,t}$ is the price differential measure ($p_{i,k,t} = \ln(P_{i,k,t} / P_{i,Beijing,t})$ (5.1)), Δ is a first difference operator ($\Delta p_{i,k,t} = p_{i,k,t} - p_{i,k,t-1}$) and ε is an error term; i , k and t represent model, city and month, respectively. Z is the optimal number of lags. The constant is included to capture city-specific characteristics, like taxes, market structure, the price elasticity of demand and specific geographies. The parameter of primary interest in the empirical specification is β_0, capturing the degree of persistence in price differentials. The unit root test is a one-tailed t-test on the parameter $\alpha_{i,k} = 0$ against $\alpha_{i,k} < 0$. Dickey and Fuller (1979) considered tests with $z = 0$ (DF-test), whereas Said and Dickey (1984) "augmented" the Dickey and Fuller (1999) regression to allow for serial correlated errors in the process under investigation (The ADF test). The ADF test in (1) is thus appropriate for alternatives in the linear ARMA-class of processes. The researcher must pick a sensible value of Z to adjust for additional serial dependence. Usually an information criterion is used to select Z. The ADF test is given by the t-statistics $ADF = \hat{\alpha}_{i,k} / s.d.(\hat{\alpha}_{i,k})$, where $\hat{\alpha}_{i,k}$ is estimated by OLS and $s.d.(\hat{\alpha}_{i,k})$ is estimated deviation of $\hat{\alpha}_{i,k}$. Asymptotic critical values can be found in Fuller (1976). Ng and Perron (2001) proposed a new class of modified information criteria (MIC) for selecting the appropriate number of lags in the auto-regression, and within this class they suggested a modified version of the Akaike information criterion (MAIC). They argued that MAIC had better theoretical and empirical properties than other criteria. The optimal lag structure which capturing the possible serial correlation is determined for each series individually using Modified Akaike Information Criterion (MAIC).

[Insert Table 6.1 about here]

[Insert Table 6.2 about here]

Table 6.1 and Table 6.2 report the results for single time series ADF Tests by model and city respectively. Specifically, we list the proportion of cities for each car model where the null hypothesis can be rejected at 5% significance levels in column 3, 10% significance levels in column 4. As can be seen from column 3, at 5% significance level, the proportion ranges from the lowest of 1 out of 29 cities (BuickCentury 3.0) to the highest of 20 out of 29 cities (Jetta 1.6GiX). Using 10% significance level, the proportion changes to from the lowers of 1 out 29 cities ((BuickCentury 3.0) to the highest of 20 out of 29 cities (Jetta 1.6GiX and RedFlag CenturyStar2.0E). On a more aggregate level, 266 out of 1305 city time series (20.38%) can reject the unit root hypothesis at 5% level, while 378 out of 1305 city time series (28.97%) can reject the unit root hypothesis at 10 % level. Thus, the results revel a little bit evidence for auto market convergence. This is not surprising, however, given the unit root test's low power against a highly persistent alternative.

6.2 Panel Unit Root Test

It is now generally known that the traditional unit root tests such as Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) test statistics lack power in distinguishing the unit root null form stationary alternatives, especially with short time span. They tend not to reject the unit root null even if it is false. Researchers have tried to exploit the panel dimension of the data as one way of increasing the power of unit root tests. The other way is to turn to a panel test procedure to examine the null of unit root in our panel of price series. In recent years, to overcome the problem of low power of the univariate ADF test, a number of methodological developments by Levin and Lin (1993), Im, Pesaran, and Shin(1997), Maddala and Wu (1999), have provided foundations for the application of panel tests to a wide variety of economic and financial variables. The main advantage of the panel test procedure over the standard augmented Dickey-Fuller test is that it exploits the extra information provided by the pooled cross sectional time series and dramatically increases the power of the tests. Therefore this analysis follows recent studies in using panel methods to test for unit roots in the relative price series.

The three tests mentioned previously are all based on the well-known ADF test for univariate time series. They differ in the assumptions made about the heterogeneity of the regression parameters for the observed unites and in the derived test statistics.

The test developed by Levin and Lin (1993) provided the statistical foundation for panel unit root tests, which is applied to the panel data set, assuming an identical regression parameter Under the LL test, the null and alternative hypothesis for model i is given by

$$H_0 : \alpha_{i,1} = \alpha_{i,2} = ... = \alpha_{i,k} = \alpha_i = 0 \text{ and } H_1 : \alpha_{i,1} = \alpha_{i,2} = ... = \alpha_{i,k} = \alpha_i < 0$$

Their specification, provided for lagged differences to correct for serial correlation of the error terms. However, they don't address the problem of contemporaneous cross correlation of the errors and restricted all panel members to have identical orders of integration. This limitation becomes all the more important in panels with mixed orders of integration. Although the null hypothesis that all series have a unit root is correctly rejected, the alternative of 'all stationary' is also false in these mixed panels. Consequently, rejection of the null hypothesis with LL test may have lead to over support of law of one price or purchasing power parity.

Recognizing this problem, Im, Pesaran and Shin (1997), Maddala and Wu (1997, 1999) present second generation panel unit root tests that allow the auto regressive coefficient to differ across the panel under the alternative hypothesis. IPS-Test applies the ADF test separately to the individual time series, which allows different autoregressive coefficient as well as heterogeneity of lag structures in the K individual series. While the null hypothesis for model i assumes the same as LL-Test, which can be represented as $H_0 : \alpha_{i,1} = \alpha_{i,2} = ... = \alpha_{i,k} = \alpha_i = 0$, the alternative hypothesis states that at least one unit shows asymptotic stationarity by $H_1 : \alpha_{i,k} < 0$, for some k. This test is constructed as a simple average of the t-statistics on the $\alpha_{i,k}$'s generated from N single-equation augmented Dickey-Fuller tests. Specifically, to compute the statistic, one first needs to estimates the argument DF regression given in equation (1) above individually for each of the $k = 1, 2, ..., 36$ cities of each model i and then constructs the 36 corresponding ADF t-statistics, $t_{i,k}$. These individual statistics are averaged to obtain the t-bar statistic $\overline{t_i} = \frac{1}{K}\sum_{k=1}^{K} t_{i,k}$. Since the distribution of the individual ADF t-statistics is not centered around zero under the unit root null hypothesis, it becomes necessary to adjust for this feature to ensure that the distribution of the t-bar does not diverge under the null hypothesis as the number of cities grows large. Fortunately, under the null hypothesis, the mean of the individual $t_{i,k}$ is a known constant as the sample size T grows large, as is the standard deviation of the individual $t_{i,k}$.Finally, the t-bar statistic is adjusted by subtracting off the mean and dividing by the standard deviation, so that the statistic becomes

$$\overline{z_i} = \sqrt{K}(\overline{t_i} - u_i)/s_i \rightarrow N(0,1) \qquad (6.2)$$

where u_i is the known mean of the individual ADF t-statistic distribution for model i, and s is the known standard deviation of the individual ADF t-statistic distribution for model i, both of them are from Monte Carlo simulations. The power to reject the null increases with $\sqrt{K}$.

Maddala and Wu (1999) use the single-equation OLS estimation similar to the IPS test except that the p-values corresponding to the individual t-statistics for a unit root in each cross-sectional unit are used to construct the Fisher test statistic, a Chi-Square test statistic. The Maddala-Wu test assumes the resulting statistics from the N individually applied Augmented Dickey-fuller tests to be distributed independently. Again, the null hypothesis for model i assumes that all units exhibit a unit root, which can be represented as $H_0 : \alpha_{i,1} = \alpha_{i,2} = ... = \alpha_{i,k} = \alpha_i = 0$, and the alternative hypothesis states that at least one unit shows asymptotic stationarity, $H_1 : \alpha_{i,k} < 0$, for some k. Specifically, for each city k the results of the univariate unit root tests for model i were combined to perform Fisher's p_λ test. The overall test statistic is

$$p_\lambda = -2\sum_{k=1}^{K} \log(p_{i,k}) \qquad (6.3)$$

where K is the number of cities included for model i, $p_{i,k}$ is the marginal significance level associated with the individual member test statistics, for example, time series of model i in city k. Maddala and Wu have shown that since the marginal significance levels for the individual tests are uniformly distributed between 0 and 1, $-2\log(p_{i,k})$ is distributed as a χ^2 with two degree of freedom. For the K number of the panel, under the assumption that the individual statistics are independent, p_λ has a χ^2 distribution with a degree of freedom 2K, based on a theorem developed by R.A. Fisher (1932). The advantage of Fisher's (p_λ) Test is that it is applicable to both unbalanced and balanced panel data sets and allows the autocorrelation coefficients to differ across panel members, which means one can use different lag lengths in the individual Augmented DF regressions. Another advantage of the Maddala-Wu test is that it is an exact test, while the IPS test is an asymptotic test. From this point, it convinces me that the Fisher's Test is more powerful than IPS test in my study.

Table 6.3 displays the results for Maddala and Wu's Fisher type panel unit root tests in column 3. The table shows than we can reject the null of a unit root for the majority but 6 car models at 10% level of significance: There is strong tendency for car prices to converge to LOOP.

[Insert Table 6.3 about here]

Like the IPS test, the Maddala-Wu test is also constructed under the assumption that that the individual tests are independent of one another across cities. But in practice, it is highly possible that these price differentials are contemporaneously correlated. In this case, the Maddala-Wu tests are not strictly valid. As Maddala and Wu (1999) point out the individual $p_{i,k}$ can be used to construct a test based on the Dufour-Torres (1998) criteria which does not depend on the independence of the individual test statistics and is thus affected by the presence of cross-correlation. This testing method generally has lower power than the Maddala-Wu test, making it a more conservative test of the null hypothesis of non-stationarity. The Dufour-Torres test involves segmenting the null hypothesis: $H_0 : \alpha_{i,1} = \alpha_{i,2} = ... = \alpha_{i,k} = \alpha_i = 0$ into K sub-hypothesis of the form: $H_{0k} : a_{i,k} = 0$. The null hypothesis can by rejected if any of the sub-hypothesis H_{0k} is rejected. The Bonferroni inequality constraint indicates that the marginal significance level P for a rejection of the null hypothesis H_0 applied to the panel of K members is given by $P \leq \sum_{k=1}^{K} p_{i,k}$, where $p_{i,k}$ is the marginal significance level of the *k*th sub-hypothesis. Dufour and Torres recommend using the criteria that $P_{DT} = P / K$, to determine the rejection area. In this paper, the

Dufour and Torres criteria P_{DT} are different among models since the panel of each model includes different number of series. For an overall significance level of $P = 10\%$, at least one $p_{i,k}$ must be less than $10\% / K$.[8] Based on the p-values from univariate Augmented DF tests, those criteria are met for 31 of 44 models (Table 6.2). Among the exceptions are 6 models for which the Maddala-Wu test could not reject the null. For the others-Xiali1.3, Fukang1.4AL, Fukang988, RedFlagLuckstar1.8AE, Bora1.8T, Santana1.8GLi, Minyi1.0H, and Landcruiser4500 4.5AT-the hypothesis of non-stationarity is rejected in the Maddala-Wu test but cannot be rejected in the Dufour-Torres test. The results of Dufour-Torres test indicate that, with the exception of the later models, the presence of cross correlation is not sufficient to reverse the findings of mean-stationarity based on the Maddala-Wu test.

While unit root tests can provide evidence on whether or not shocks to individual cities are transitory they are silent on how long the effects of these shocks will persist. One of the most common methods of measuring persistence is to calculate the half-life of price deviations, i.e. the amount of time it takes a shock to a series to revert half-way back to its mean value. The approximate half-life of a shock to $P_{i,k}$ is computed as $h = |\ln(0.5) / \ln(1 + \alpha_{i,k})|$, Our primary focus is on the $\alpha_{i,k}$, the coefficients on the lagged logarithm of the price, $p_{i,k,t}$. The nearer $\alpha_{i,k}$ is to zero, the longer is the estimated half-life of a shock. The average half lives for all convergent price series of each model are presented in Table 6.2 too. The speed of convergence gives us some insights about the process of market integration of auto market in China. A fast speed of convergence is an indication of well-functioning markets with rather strong competition. According to the results showing in Table 6.3, the average half life ranges from 0.389 month for Hiace2.2ME to 2.669 months for Santana2000GSi, with the overall average half life 1.383 months and the median

[8] For 5% significance level, the way is similar. In the paper, I only report the results at 10% significance level for Dufour-Torres test.

1.246 months.

6.3 Nonlinear Unit Root Test

A common problem with the tests proposed by Im et al.(1997) and Maddala and Wu (1997) stems from the joint hypothesis that is tested. Under the joint hypothesis, rejection does not provide information about how many panel members reject the null hypothesis and how many do not. Consequently, the rejection of null hypothesis can be produced with as few as one stationary member of the panel, and therefore that it would be inappropriate to infer that all members of the panel are stationary. Another problem is that the standard linear unit root test is not expected to be very powerful when the true process is stationary but non-linear. Kapetanios, Shin and Snell (hereafter, KSS) (2003) developed a new technique for the null hypothesis of a unit root against an alternative of nonlinear stationary smooth transition autoregressive (STAR) process. They argued that, under the assumption that the price differences follow nonlinear stationary processes, the alternative hypothesis of linear stationarity in the standard ADF tests would be misspecified. Using quarterly bilateral real exchange rates with the US dollar and real interest rates for the 1957-198 and 1957-2000 period, respectively, for some selected OECD countries, KSS (2003) have illustrated that their tests are more powerful than the standard ADF tests. Chortareas and Kapetanios(2004), Hasan(2004) and Liew, Baharumshah, and Chong(2004) have applied the KSS tests to the bilateral real exchange rates of Japan, India, and a group of Asian countries, respectively. More recently, Chortareas and Kapetanios (2006) apply the KSS tests to the yen real exchange rates against the other G7 and Asian currencies during the post-Bretton Woods era, and found more support for PPP than the linear ADF tests.

Here I give an account of the non-linear stationary test procedures developed by Kapetanios et al (2003) to incorporate non-linearity in time series movement in testing for stationarity of price difference. KSS has expanded the standard ADF test by keeping the null hypothesis as nonstationarity in a time series variable against the alternative of a nonlinear but globally stationary process. Consider a univariate smooth transition autoregressive of order 1 (STAR (1)) model,

$$p_{i,k,t} = \beta p_{i,k,t-1} + \beta^* p_{i,k,t-1} F(p_{i,k,t-d}) + \varepsilon_{i,k,t},\ t = 1,...,T;\ d \geq 1 \tag{6.4}$$

Where $p_{i,k,t}$ is the de-meaned or de-trended data, ε_t is an i.i.d. error with zero mean and constant variance, β, β^* are unknown parameters and $F(p_{i,k,t-d})$ is the exponential transition function adopted in the test to present the nonlinear adjustment which by convention is bounded by zero and one.

Following the literature on the $STAR$ models, the popular exponential transition function is applied.

$$F(p_{i,k,t-d}) = 1 - \exp(-\theta p_{i,k,t-d}^2) \tag{6.5}$$

where I assume that $\theta \geq 0$, and the delay parameter $d \geq 1$ is given.

Using (6.5) in (6.4) gives an exponential $STAR(ESTAR)$ model

$$p_{i,k,t} = \beta p_{i,k,t-1} + \beta^* p_{i,k,t-1}[1 - \exp(-\theta p_{i,k,t-d}^2)] + \varepsilon_{i,k,t} \tag{6.6}$$

which can be reparameterised as

$$\Delta p_{i,k,t} = (\beta - 1) p_{i,k,t-1} + \beta^* p_{i,k,t-1}[1 - \exp(-\theta p_{i,k,t-d}^2)] + \varepsilon_{i,k,t} \tag{6.7}$$

The null hypothesis of a unit root is considered, which in terms of the above model implies that $\beta = 1$ and $\theta = 0$ (and thus $[1 - \exp(-\theta p_{i,k,t-d}^2)] = 0$). Under the null, then (6.7) becomes the non-stationary linear model:

$$\Delta p_{i,k,t} = \varepsilon_{i,k,t} \tag{6.8}$$

Under the alternative of stationarity ($\beta = 1$ and $\theta > 0$), θ is strictly positive and (6.7) becomes

$$\Delta p_{i,k,t} = \beta^* p_{i,k,t-1}[1 - \exp(-\theta p_{i,k,t-d}^2)] + \varepsilon_{i,k,t} \tag{6.9}$$

We set $\beta = 1$ both under the null and under the alternative hypothesis. In this specification, the null hypothesis of nonstationarity with the KSS test procedure is $H_0 : \theta = 0$ against the mean-reverting nonlinear alternative hypothesis $H_1 : \theta > 0$. Obviously because β^* in (6.9) is not identified under the null, we cannot directly test $H_0 : \theta = 0$. To deal with the issue, KSS suggests to reparameterize (6.9) by computing a first-order Taylor series approximation to specification (6.9) to obtain the auxiliary regression expressed by (6.10) below:

$$\Delta p_{i,k,t} = \delta p_{i,k,t-1}^3 + \varepsilon_{i,k,t} \tag{6.10}$$

A relevant issue that emerges is the possibility of serial correlation in the error term. The presence of serial correlation may be dealt with by an augmentation similar to that undertaken for the Dickey-Fuller tests. In particular, lagged differences of the dependent variable may be included in the regression. For a more general case where the errors in (6.10) are serially correlated, regression (6.10) is extended to

$$\Delta p_{i,k,t} = \sum_{j=1}^{p} \rho_j \Delta p_{i,k,t-j} + \delta p_{i,k,t-1}^{3} + \varepsilon_{i,k,t} \qquad (6.11)$$

With the p augmentations, which are used to correct for serially correlated errors. The null hypothesis of nonstationarity to be tested is $H_0 : \delta = 0$ against the alternative $H_0 : \delta < 0$ with either 6.10 or 6.11 based on t-type statistic of δ, in which the asymptotical distribution is non-normal and thus decision cannot be based on the conventionally tabulated t table. They tabulated the asymptotic critical values of the statistics via stochastic simulations and presented the table in their paper.

Following the suggestions of Kapetanios et al (2003), the number of augmentations p for either the ADF tests or the KSS tests is selected using the Modified Akaike Information Criterion by Ng and Perron (1995), which are the same as doing ADF test previously.

[Insert Table 6.1 about here]

[Insert Table 6.2 about here]

We report the test results for the non-linear KSS Test in Table 6.1 and 6.2 too. The KSS Test statistics based on regression 6.10 are denoted by KSS1, while the test results based on regression 6.11 are denoted by KSS2. To accommodate stochastic processes with non-zero means and/or linear deterministic trends, we first obtain the demeaned and demeaned as well as de-trended price data before subject the time series to the KSS1 or KSS2 test. For each car model, we list the proportion of cities for all four test statistics where the null hypothesis can be rejected at ten percent significance levels in column 5 to column 8 of Table 6.1. As can be seen from the table, the performance of four type KSS tests is fundamentally different from the linear ADF Test done before.

For example, using 10% significance level, the proportion has been improved from the 1 out 29 cities by applying ADF Test to 3 out of 29 cities by applying all four kinds of KSS Test for BuickCentury3.0. For Passat2.0L, the performance has changed from 13 out of 35 cities for ADF Test to 30 out 35 cities for KSS1 test with demeaned price series. On a more aggregate level, at 10% level of significance, 468 out of 1305 car price series (35.86%) can reject the unit root hypothesis by applying demeaned KSS1 test, 474 out of 1305 car price series (36.32%) can reject the unit root hypothesis by applying de-meaned KSS2 Test, 506 out 1305 time series (38.77%) can reject unit root by applying de-trended KSS1 Test, while 508 out of 1305 time series (38.93%) can reject the unit root hypothesis for KSS2 Test after de-trend the price data. If we look at the individual models, we can find that there are about 16 models which the proportion of the null hypothesis can be rejected at 10% significance levels are larger than 50%. Thus, the results indicate that nonlinear KSS Test support long run convergence more often than the standard linear ADF Test. KSS Test provides more substantial evidence to support long run price parity in Chinese auto market.

As I mentioned before, Maddala-Wu test is an exact and non-parametric test, and may be computed for any arbitrary choice of a test for the unit root in a cross-section unit. We may want to construct the MW test statistic by using KSS type nonlinear procedure for each city. However, the KSS test does not provide a similar p-value of the test statistic in city k for model i.

6.4 The Determinants of Price Dispersion

My measure of integration of two locations-the dependent variable in my regressions-is the yearly standard deviation of the log price difference of model i between city k and Beijing, $Std.Dev.(p_{i,k,t})$. As mentioned before, all the car prices are collected on month frequency. I exclude Lhasa from my analysis due to the incompleteness of other data.

When consider changes in prices, the dependent variable is $|\overline{p_{i,k,t}}|$, which means the absolute value of average price difference at year t. This data then runs from 1995-2002 and 2004-2006, for a time dimension of 15 years. This panel has 3852 observations.

The first explanatory variable in the regression is the log railway distance from city k to Beijing. Distance can serve as the proxy of transportation cost and is the most frequently motioned barriers to goods arbitrage in testing for LOOP. Engel (1993), Engel and Rogers (1996) and Parsley and Wei (1996) explain how the distance between cities might help to explain deviations from the law of one price.

The second explanatory variable is the yearly absolute value difference in the log of the per capital annual income between city between city k and Beijing[9]. It is conceivable that markets are integrated to the extend that wholesale price from the producers are nearly equal but that differences in local income level drives a wedge between prices in different cities. The income difference can serve as both a measure of local purchasing power and a measure of local cost, such as wages.

The third explanatory variable is the absolute value difference in the log of the population between city k and Beijing, This variable is included because larger cities means lager markets and more fierce competition, then lager cities tend to have lower auto prices than smaller ones. The population variable is time varying in the regressions, with data in each year from 1995-2006.

The fourth explanatory variable is a dummy variable that takes the value of one if the manufacturer's headquarters or the production of model i is based in city k, zero other wise. Basically local protectionism is a series of practices that provincial and municipal governments use to limit the inflow of potentially competing products or

9 The per capital income data for all 34 cities is from CEIC.

otherwise protect the interests of local companies. Local protectionism may take the forms of favorable financing, favorable regulations, assistance in restructuring and restrictions on outside participation. It is difficult for me to get all these variables or their proxies to measure the extent of local protectionism. This dummy variable is meant to partially capture the advantage of local production or the potential influence of local protectionism.

The fifth variable is a dummy variable that takes the value of one if city k locates in coastal provinces of China, and zero other wise. This variable is introduced to capture the difference of economic openness between in inner cities and coastal cities. We also include dummy variables for each model, $Model_i$. This variable takes on the value of one if the price data is for model i. It is intend to capture any idiosyncratic aspects of a given model than tends to make it different. Finally we also performance regressions using a time trend variable.

Thus, when we estimate equations for differences in price levels, our regression takes the form:

$$Std.Dev.(p_{i,k,t}) = \alpha_1 \ln(DISTANCE_{k,Beijing}) + \alpha_2 \ln(INCOME_{k,Beijing,t}) + \alpha_3 \ln(POPULATION_{k,Beijing,t}) + \alpha_4 LOCAL_{i,t} + \alpha_4 COASTAL + \alpha_5 TREND + \sum_{i=1}^{42} \beta_i MODEL_i + \varepsilon_{i,k,t} \quad (6.12)$$

For changes in prices, the equation is similar:

$$|\overline{p_{i,k,t}}| = \alpha_1 \ln(DISTANCE_{k,Beijing}) + \alpha_2 \ln(INCOME_{k,Beijing,t}) + \alpha_3 \ln(POPULATION_{k,Beijing,t}) + \alpha_4 LOCAL_{i,t} + \alpha_4 COASTAL + \alpha_5 TREND + \sum_{i=1}^{42} \beta_i MODEL_i + \varepsilon_{i,k,t} \quad (6.13)$$

Table 6.4 reports regression results for equation (6.12). The COASTAL variable and POPULATION variable are proved not to be statistically significant in my regressions, so I report results only for those specifications that drop those variables. The remaining variables are highly significant, and the coefficients all have the expected sign. The coefficients on DISTANCE and INCOME have interpretations as elasticity.

A 10 percent increase in the distance between the two cities ceteris paribus increases the absolute price difference between the cities by 1.4 one-hundredths of one percent. Similarly, the effect of a 10 percent increase in relative income between two cities is to increase the absolute value of the price differential by 4.6 one-hundredths of one percent. The dummy variable LOCAL is not significant enough. Since the dependent variable is the standard deviation of price, it would also be difficult to interpret the variable as a measure of economic integration.

[Insert Table 6.4 about here]

The estimated coefficients for equation (6.13) when all items are included in the panel are reported in Table 6.5. While the INCOME variable is still statistically significant, distance no longer is. That is, changes in the absolute price differences are not significantly linked to distance, which contrasts with the finding of the first regression. The magnitude of the INCOME effect is larger than that in regression (1)-it accounts for a 0.79 percent difference in price change. The coefficient on the LOCAL gives us the absolute average difference in price if the car is locally produced, holding other explanatory effects constant. We see from Table 6.5 that the difference is 0.95 percent and it is statistically significant.

[Insert Table 6.5 about here]

Chapter 7 Concluding Remarks

7.1 Major Conclusions

In the paper, I have examined the issue of convergences of 44 car models' prices across 36 cities in China for the period 1994-2003 and 2004-2006. Based on panel unit root test for the period 1994-2003 and 2004-2006 respectively, I find evidence against a panel unit root for the majority of models sold in china and thus support for the law of one price for car market in China.

With regard to the degree of persistence of deviations from LOOP after a shock, my empirical estimations show an average half-life less than 2 months for all car models passing the panel unit root tests, which is overwhelmingly shorter than the estimation by Wei and Fan (2005) for 93 products (including 4 car models) sold in China from 1994 to 2003.

I have also applied a new test developed by Kapetanios et al. (2003) which incorporates non-linearity in the mean reverting process of a time series variable. It also provides more support for LOOP in as compared to the standard linear ADF test.

At the end of this study, after investigating possible explanatory factors in price disparities of auto markets among cities, I find that the geographic distance between markets, difference of per capital income, and the existence of local production all play important roles in the absolute price differentials as well as the standard deviation of price differentials among Chinese cities.

Contradicting to the general expectation, my findings indicate that local protectionism hasn't blocked the progress towards integration in China's auto market in the last decade even though discriminative treatments against non-local products have been used by some provincial and city governments so as to favor their local car manufacturers. Market force has played a key role in the price mechanism and the

Central government has made certain achievements in actively eliminating regional market blocks and local protectionism.

7.2 Recommendations

As I mentioned before, choosing Beijing as the benchmark is because that the price data for Beijing are more complete and cover a longer period of time than those for other cities for nearly all car models sold in the first period (1994-2003). In future research, for the test of market integration section of the second period (2004-2006), we could first generate city pairs rather than only choose Beijing as the benchmark, which I believe could generate more convincing results regarding market integration. Therefore, it is likely to be a more complicated improvement or extension.

Second, car models could be divided into different classes, such as mini, compact, middle size or luxury cars according to size, horse power and inside configurations. Car models in different classes generally will meet different customers and competitors. They may show different competition behaviors and pricing strategies. Thus, another extension is to categorize them into different classes, and then examine the price differentials as whole within each category.

Finally, in this research, due the availability of data, we do not integrate other control variables into the models explaining the price differentials except income, distance and population. This could be a shortcoming since the price differentials could be caused by discrimination pricing from the producers, brand preference in different regions, the access ability of after selling service for different car models in the same city , or the difference of car registration system among regions.

7.3 Policy Implications

The panel unit root method analysis in this paper shows strong evidence that China's auto market tends to be truly integrated with the implementation of a sequence of laws and regulations aimed to remove interregional trade barriers and eliminate local protectionism. However, the results of univariate unit root tests, including the traditional ADF tests together the latest and more powerful KSS nonlinear tests, suggest that those policies or the auto market itself still have some imperfections. Thus, it is in the government's interests to further enhance the magnitude of market mechanism. It needs to ensure that the domestic auto market is functioning smoothly, combating local protection and alleviating regional monopoly, so as to create an open market environment.

Appendix

Table 3.1 Production of Cars by Manufacturers in 1992 and 1993

		1992		1993	
Producer	Model	Volume	%	Volume	%
Shanghai-VW	Santana	65000	32.2	100001	32.4
Tianjin Automobile	Xiali	30150	14.9	47850	15.5
FAW	Audi 100	15127	7.5	17807	5.8
Guangzhou Peugeot	Peugeot505	15410	7.6	16763	5.4
Beijing Jeep	XJ Cherokee	20001	9.9	13809	4.5
FAW-VW	A2 Jetta	8062	4	12117	3.9
Changan	Alto	5565	2.8	10463	3.4
Dongfeng Citroen	Citroen ZX	801	0.4	5062	1.6
Others		41884	20.7	85128	27.5
Total		202000	100	309000	100

Source: China, International Motor Business; Third Quarter 1994, P192

Table 3.3 The Production of Main Auto Plants in China from 1994-2006

Producer	Dominant Brand	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Shanghai VW	Santana/ Passat	115,326	160,070	200,222	230,443	235,000	230,946	221,524	230,281	278,890	405,252	347,531	229,463	342,073
FAW VW	Jetta/Bora/Audi	8219	20,001	26,864	46,405	66,100	81,464	110,177	133,893	191,695	302,346	287,117	241,002	343,621
Dongfeng Citroen	Fukang /Citroen	—	1,314	9,158	30,035	36,240	40,200	53,900	53,680	84,378	105,475	88,034	141,661	201,858
FAW Xiali	Xiali	58,500	65,000	88,000	95,155	100,021	11,828	81,951	51,019	89,921	117,186	130,506	192,964	201,663
Beijing Jeep	Chrokee	14,703	25,127	26,051	19,377	8,344	9,294	4,867	4,653	9,052	19,441	33,764	26,493	n.a
Shanghai GM	Buick	—	—	—	—	—	23,290	30,024	58,543	111,623	206,964	251,941	221,321	268,006
Guangzhou Honda	Accord/FIT	—	—	—	—	344	10,008	32,228	51,131	59,024	117,178	202,312	203,762	226,183
FAW	Hongqi/Audi	20,228	17,968	17,968	22,182	15,051	15,731	31,225	17,094	30,165	48,219	50,009	58,817	n.a
Beijing Hyundai	Hyundai	—	—	—	—	—	—	—	—	1,356	55,113	150,158	220,934	262,115
Changan Suzuki	Alto/ Swift	10,020	12,508	16,425	35,155	35,555	44,181	48,235	43,123	67,864	102,083	107,337	168,242	112,565
Dongfeng Nissan	Nissan	—	—	—	—	—	—	—	—	38,897	66,134	64,197	164,766	195,714
Chery	Chery	—	—	—	—	—	—	—	2767	50,398	101,141	79,565	185,588	307,232
Others		23,337	23,473	6,411	8,943	11,206	98,424	-9,454	57,337	88,433	421,679	432,034	723,758	1,408,464
TOTAL		250,333	325,461	391,099	487,695	507,861	565,366	604,677	703,521	1,101,696	2,068,211	2,224,505	2,778,771	3,869,494
		1,353,368	1,452,697	1,474,905	1,582,628	1,629,182	1,834,349	2,077,371	2,340,209	3,262,947	4,443,744	5,079,356	5,744,958	7,279,726
Number of plants producing >10,000			3	4	5	5	5	8	9	15	15	15	20	24
Number of plants producing >50,000			2	2	2	3	3	4	7	6	7	4	2	4
Number of plants producing >100,000			1	1	1	2	2	2	2	7	10	12	13	15
Number of plants		122	122	122	119	119	118	118	116	117	115	117	117	117

— Not available because plants have closed or were not yet opened

n.a : Not applicable

Sources: Zhongguo qiche gongye nianjian (China Automotive Industry Yearbook) (various issues)

TABLE 5.1 Descriptions of 36 Cities

City	Province	Rank or Status	City	Province	Rank or Status
Eastern Area			**Central Area**		
Beijing	Beijing	National capital and municipality	Taiyuan	Shanxi	Provincial capital
Tianjin	Tianjin	Municipality	Hefei	Anhui	Provincial capital
Shi Jiazhuang	Hebei	Provincial capital	Nanchang	Jiangxi	Provincial capital
Shanghai	Shanghai	Municipality	Zhengzhou	Henan	Provincial capital
Nanjing	Jiangsu	Provincial capital	Wuhan	Hubei	Provincial capital
Hangzhou	Zhejiang	Provincial capital	Changsha	Hunan	Provincial capital
Ningbo	Zhejiang	Second largest city of the province	**Werstrn Area**		
Fuzhou	Fujian	Provincial capital	Hohehot	Inner Mongolia	Provincial capital
Xiamen	Fujian	Second largest city of the province	Nanning	Guangxi	Provincial capital
Jinan	Shandong	Provincial capital	Chongqing	Chongqing	Provincial capital
Qingdao	Shandong	Second largest city of the province	Chengdu	Sichuan	Provincial capital
Guangzhou	Guangdong	Provincial capital	Guiyang	Guizhou	Provincial capital
Shenzhen	Guangdong	Second largest city of the province	Kunming	Yunnan	Provincial capital
Haikou	Hainan	Provincial capital	Lahsa	Tibet	Provincial capital
Northeastern Area			Sian	Shaanxi	Provincial capital
Shenyang	Liaoning	Provincial capital	Lanzhou	Gansu	Provincial capital
Dalian	Liaoning	Second largest city of the province	Xining	Qinghai	Provincial capital
Changcun	Jilin	Provincial capital	Yinchuan	Ningxia	Provincial capital
Harbin	Heilongjiang	Provincial capital	Urumchi	Xinjiang	Provincial capital

Table 5.2 Model Description

Model Name	Classification	Sample Period	Manufacturer	OEM Partner	Location
1994-2003 Models produced by domestic makers or joint ventures					
Xiali 1.0	Microcar	1994/04-2000/06	Tianjin Automobile	Technology transfer from Daihatsu (TOYOTA)	Tianjin
Xiali 1.3	Microcar	1999/03-2003/03	Tianjin Automobile	Technology transfer from Daihatsu (TOYOTA)	Tianjin
Citroën Fukang 1.6AL	Sub Compact Car	1997/01-2000/05	Dongfeng Citroen	CITROEN (PSA)	Wuhan
Citroën Fukang 998 1.6EL	Compact Car	1999/03-2003/03	Dongfeng Citroen	CITROEN (PSA)	Wuhan
Citroën Fukang 1.4RL	Sub Compact Car	2000/06-2003/03	Dongfeng Citroen	CITROEN (PSA)	Wuhan
Jetta 1.6CL	Compact Car	1997/01-1999/02	FAW-VW	VW	Changchun
Jetta 1.6GL	Compact Car	1998/05-2000/06	FAW-VW	VW	Changchun
Jetta 1.6GTX	Compact Car	1999/03-2003/03	FAW-VW	VW	Changchun
Jetta 1.6GiX	Compact Car	2000/06-2003/03	FAW-VW	VW	Changchun
Santana 1.8LX	Compact Car	1994/01-2000/05	Shanghai-VW	VW	Shanghai
Santana 1.8ED	Compact Car	2000/06-2003/03	Shanghai-VW	VW	Shanghai
Santana2000 1.8GSi	Midsize Car	1997/01-2003/03	Shanghai-VW	VW	Shanghai
RedFlag Luckstar 1.8AE	Midsize Car	1998/04-2003/03	FAW		Changchun
Adui 200 2.6L	Midsize luxury car	2000/06-2003/03	FAW-VW	AUDI (VW)	Changchun
BuickCentury 3.0 AT	Midsize luxury car	2000/03-2003/03	Shanghai-GM	GM	Shanghai
Northernstar 0.8	Minivan	1998/01-2000/05	Changhe-Suzuki	Technology transfer from SUZUKI	Hefei
BJ2020S	Mini SUV	1997/07-2003/03	Beijing-Jeep	DCX	Beijing
Chrokee 7250 2.5EL	Compact SUV	1997/07-2003/03	Beijing-Jeep	DCX	Beijing
2004-2006 Models produced by domestic makers or joint ventures					
Alto HappyPrince	Microcar	2004/01-2006/12	Changan Suzuki	Technology transfer from SUZUKI	Chongqing
Xiali Junya	Microcar	2004/01-2006/12	FAW-Xiali		Tianjin

Model Name	Classification	Sample Period	Manufacturer	OEM Partner	Location
Fukang 1.6AXCA	Sub Compact Car	2004/01-2006/12	Dongfeng Citroen	CITROEN (PSA)	Wuhan
Elysee SX16V	Compact Car	2004/01-2006/12	Dongfeng Citroen	CITROEN (PSA)	Wuhan
Bora 1.8T	Compact Car	2004/01-2006/12	FAW-VW	VW	Changchun
Jetta 1.6CiX	Compact Car	2004/01-2006/12	FAW-VW	VW	Changchun
Polo 1.4L	Sub Compact Car	2004/01-2006/12	Shanghai-VW	VW	Shanghai
BuickSail 1.6SL	Sub Compact Car	2004/01-2006/12	Shanghai-GM	GM	Shanghai
WindCloud 1.6	Compact Car	2004/01-2006/12	Chery Automobile		Wuhu
Accord 2.4I-VTEC	Midsize Car	2004/01-2006/12	Guangzhou-Honda	HONDA	Guangzhou
RedFlag CenturyStar2.0E	Midsize Car	2004/01-2006/12	FAW		Changchun
Santana 1.8GLi	Compact Car	2004/01-2006/12	Shanghai-VW	VW	Shanghai
PASSAT 2.0L	Midsize Car	2004/01-2006/12	Shanghai-VW	VW	Shanghai
BuickRegal 2.5GL	Midsize Car	2004/01-2006/12	Shanghai-GM	GM	Shanghai
Audi A6 2.8AT	Midsize luxury car	2004/01-2006/12	FAW-VW	VW	Changchun
GreenStar 1.0FHK	Minivan	2004/01-2006/12	Changan Suzuki	Technology transfer from SUZUKI	Chongqing
Minyi 1.0H	Minivan	2004/01-2006/12	Hafei Motor		Harbin
HIACE 2.2ME	Van	2004/01-2006/12	Brilliance China Auto	TOYOTA	Shenyang
Foton View 2.2	Van	2004/01-2006/12	Beijing Automobile		Beijing
Chrokee 2500 2.5EB	Compact SUV	2004/01-2006/12	Beijing-Jeep	DCX	Beijing
Changfeng Plat fourvat2.3	Midsize SUV	2004/01-2006/12	Changfeng Motor	Technology transfer from MITSUBISHI	Changsha
GreatWall Safe 2.2DY	Midsize SUV	2004/01-2006/12	Great Wall Motor		Baoding
2004-2006 Import Cars					
Camry 2.4L	Midsize Car	2004/01-2006/12	TOYOTA		Japan
Benz S350 3.5AT	Full-size luxury car	2004/01-2006/12	DCX		Germany

Model Name	Classification	Sample Period	Manufacturer	OEM Partner	Location
BMW 745i 4.4L	Full-size luxury car	2004/01-2006/12	BMW		Germany
Landcruiser 4500 4.5AT	Full-size SUV	2004/01-2006/12	TOYOTA		Japan

TABLE 5.3 Summary Statistics-Variability of Price Differentials

Model	Mean	Min	Max	Std. Dev.	Obs
1994-2003 Models produced by domestic makers or joint ventures					
Xiali 1.0	-0.012	-0.417	0.545	0.135	2430
Xiali 1.3	-0.047	-0.425	0.184	0.097	1192
Citroën Fukang 1.6AL	0.064	-0.202	0.401	0.103	1314
Citroën Fukang 988 1.6EL	0.004	-0.216	0.185	0.057	1346
Citroën Fukang 1.4RL	-0.008	-0.237	0.243	0.098	623
Jetta 1.6CL	0.043	-0.163	0.232	0.072	578
Jetta 1.6GL	-0.031	-0.190	0.362	0.117	348
Jetta 1.6GTX	0.002	-0.204	0.163	0.056	1554
Jetta 1.6GiX	0.008	-0.176	0.317	0.048	941
Santana 1.8LX	-0.015	-0.182	0.260	0.077	2325
Santana 1.8ED	0.012	-0.193	0.249	0.074	939
Santana2000 1.8GSi	-0.027	-0.293	0.118	0.058	2552
RedFlag Luckstar 1.8AE	0.022	-0.240	0.223	0.075	1833
Adui 200 2.6L	-0.022	-0.255	0.182	0.102	782
BuickCentury 3.0AT	0.033	-0.269	0.241	0.105	941
Northernstar 0.8	0.278	-0.239	0.636	0.147	723
BJ2020S	0.074	-0.268	0.343	0.082	1913
Cherokee 7250 2.5EL	0.086	-0.191	0.310	0.087	2249
2004-2006 Models produced by domestic makers or joint ventures					
Alto 0.8A	-0.006	-0.289	0.224	0.072	1133
Xiali Junya 1.0A	0.013	-0.320	0.314	0.087	1050

Model	Mean	Min	Max	Std. Dev.	Obs
Citroën Fukang 1.6AXCA	-0.010	-0.312	0.274	0.107	937
Elysee 1.6SX16V	-0.054	-0.375	0.171	0.084	1092
Bora 1.8T	-0.056	0.330	0.166	0.091	1127
Jetta 1.6CiX	0.003	-0.206	0.183	0.073	880
Polo 1.4L	0.037	-0.269	0.235	0.074	1159
BuickSail 1.6SL	0.045	-0.293	0.331	0.094	1157
WindCloud 1.6L	-0.013	-0.672	0.431	0.148	1137
Accord 2.4I-VTEC	0.015	-0.123	0.195	0.046	1117
RedFlag CenturyStar2.0E	-0.011	-0.135	0.159	0.050	1023
Santana 1.8GLi	0.000	-0.266	0.224	0.091	966
Passat 2.0 MT	0.018	-0.117	0.241	0.051	1226
BuickRegal GL2.5	-0.024	-0.325	0.148	0.064	1191
Audi A6 2.8AT	-0.012	-0.321	0.222	0.070	1188
GreenStar 1.0FHK	-0.006	-0.273	0.494	0.098	965
Minyi 1.0H	0.001	-0.259	0.265	0.085	1173
Hiace 2.2ME	-0.086	-0.546	0.111	0.207	949
Foton View 2.2	-0.014	-0.362	0.472	0.148	763
Chrokee 2500 4WD	-0.052	-0.338	0.123	0.077	815
Changfeng Plat fourvat2.3	-0.024	-0.245	0.268	0.108	924
GreatWall Safe 4WD	-0.262	-0.533	0.115	0.102	882
2004-2006 Import Cars					
Camry 2.4L	0.011	-0.371	0.260	0.078	1166
Benz S350 3.5AT	0.008	-0.291	0.297	0.081	1090

Model	Mean	Min	Max	Std. Dev.	Obs
BMW745i 4.4L	0.046	-0.210	0.315	0.079	918
Landcruiser 4500 4.5AT	0.036	-0.371	0.316	0.104	1014
mean	0.002	-0.269	0.267	0.090	

TABLE 5.4 Summary Statistics- Mean Absolute Price Differentials

Model	Mean	Min	Max	Std. Dev.	Obs
1994-2003 Models Produced by Domestic Makers or Joint Ventures					
Xiali 1.0	0.101	0.000	0.545	0.090	2430
Xiali 1.3	0.075	0.000	0.425	0.076	1192
Citroën Fukang 1.6AL	0.084	0.000	0.401	0.088	1314
Citroën Fukang 988 1.6EL	0.042	0.000	0.216	0.038	1346
Citroën Fukang 1.4RL	0.080	0.000	0.243	0.056	623
Jetta 1.6CL	0.054	0.000	0.232	0.064	578
Jetta 1.6GL	0.094	0.000	0.362	0.075	348
Jetta 1.6GTX	0.040	0.000	0.204	0.040	1554
Jetta 1.6GiX	0.035	0.000	0.317	0.033	941
Santana 1.8LX	0.047	0.000	0.260	0.063	2325
Santana 1.8ED	0.060	0.000	0.249	0.045	939
Santana2000 1.8GSi	0.045	0.000	0.293	0.046	2552
RedFlag LuckStar 1.8AE	0.062	0.000	0.240	0.049	1833
Adui 200 2.6L	0.085	0.000	0.255	0.060	782
BuickCentury 3.0 AT	0.086	0.000	0.269	0.069	941
NorthernStar 0.8	0.285	0.000	0.636	0.133	723
BJ2020S	0.089	0.000	0.343	0.065	1913
Chrokee 7250 2.5EL	0.096	0.000	0.310	0.074	2249
2004-2006 Models Produced by Domestic Makers or Joint Ventures					
Alto 0.8A	0.040	0.000	0.289	0.060	1133
Xiali Junya 1.0A	0.049	0.000	0.320	0.073	1050

Model	Mean	Min	Max	Std. Dev.	Obs
Citroën Fukang 1.6AXCA	0.080	0.000	0.312	0.071	937
Elysee 1.6SX16V	0.078	0.000	0.375	0.063	1092
Bora 1.8T	0.078	0.000	0.330	0.073	1127
Jetta 1.6CiX	0.055	0.000	0.206	0.048	880
Polo 1.4L	0.060	0.000	0.235	0.057	1159
BuickSail 1.6SL	0.080	0.000	0.331	0.067	1157
WindCloud 1.6L	0.113	0.000	0.672	0.097	1137
Accord 2.4I-VTEC	0.027	0.000	0.195	0.040	1117
RedFlag CenturyStar2.0E	0.036	0.000	0.159	0.036	1023
Santana 1.8GLi	0.072	0.000	0.266	0.055	966
Passat 2.0L	0.039	0.000	0.241	0.038	1226
BuickRegal 2.5GL	0.046	0.000	0.325	0.050	1191
Audi A6 2.8AT	0.048	0.000	0.321	0.052	1188
GreenStar 1.0FHK	0.073	0.000	0.066	0.494	965
Minyi 1.0H	0.065	0.000	0.265	0.055	1173
Hiace 2.2ME	0.096	0.000	0.546	0.103	949
Foton View 2.2	0.113	0.000	0.472	0.095	763
Chrokee 2500 2.5EB	0.063	0.000	0.338	0.068	815
Changfeng Plat fourvat2.3	0.070	0.000	0.268	0.085	924
GreatWall Safe 2.2DY	0.263	0.000	0.494	0.100	882
2004-2006 Import Cars					
Camry 2.4L	0.051	0.000	0.260	0.060	1166
Benz S350 3.5AT	0.051	0.000	0.297	0.064	1090

Model	Mean	Min	Max	Std. Dev.	Obs
BMW745i 4.4L	0.067	0.000	0.315	0.062	918
Landcruiser 4500 4.5AT	0.090	0.000	0.371	0.064	1014
mean	0.076	0.000	0.320	0.075	

TABLE 6.1 Univariate Unit Root Tests by Model

		ADF Test		Nonlinear Unit Root Test							
				KSS1 Demeaned		KSS2 Demeaned		KSS1 Detrended		KSS2 Detrended	
Model	No. of Series	5%	10%	5%	10%	5%	10%	5%	10%	5%	10%
1994-2003 Models Produced by Domestic Makers or Joint Ventures											
Xiali 1.0	35	5/35	6/35	9/35	12/35	9/35	12/35	11/35	11/35	9/35	9/35
Xiali 1.3	30	3/30	5/30	8/30	9/30	8/30	10/30	4/30	4/30	4/30	5/30
Fukang 1.4AL	20	5/20	5/20	8/20	9/20	7/20	7/20	10/20	12/20	11/20	13/20
Fukang 1.6AL	34	4/34	4/34	4/34	6/34	4/34	6/34	4/34	5/34	4/34	5/34
Fukang988 1.6EL	32	3/32	7/32	4/32	8/32	6/32	9/32	2/32	6/32	2/32	6/32
Jetta 1.6CL	23	5/23	9/23	7/23	8/23	7/23	9/23	9/23	13/23	11/23	14/23
Jetta 1.6GL	14	1/14	2/14	1/14	3/14	1/14	3/14	2/14	2/14	2/14	5/14
Jetta 1.6GTX	34	4/34	6/34	3/34	5/34	5/34	7/34	5/34	9/34	6/34	10/34
Jetta 1.6GiX	29	20/29	20/29	23/29	23/29	23/29	23/29	23/29	23/29	23/29	23/29
Santana 1.8LX	35	9/35	19/35	22/35	24/35	21/35	25/35	18/35	26/35	17/35	25/35
Santana 1.8ED	29	12/29	14/29	13/29	16/29	10/29	12/29	12/29	14/29	11/29	13/29
Santana2000 1.8GSi	35	12/35	15/35	9/35	10/35	9/35	9/35	6/35	9/35	9/35	16/35
RedFlag Luckstar 1.8AE	34	2/34	3/34	6/34	8/34	4/34	6/34	5/34	9/34	7/34	10/34
Adui 200 2.6L	24	2/24	2/24	3/24	4/24	3/24	3/24	8/24	9/24	8/24	9/24
BuickCentury 3.0	29	1/29	1/29	3/29	3/29	3/29	3/29	2/29	3/29	2/29	3/29
Northernstar 0.8	26	7/26	10/26	14/26	16/26	16/26	17/26	13/26	14/26	12/26	14/26
BJ2020S	33	5/33	9/33	6/33	9/33	8/33	11/33	8/33	9/33	8/33	10/33
Chrokee 7250 2.5EL	35	2/35	2/35	4/35	5/35	4/35	5/35	3/35	6/35	3/35	6/35
Ovearall 1994-2003	531	102/531	139/531	148/531	178/531	152/531	177/531	161/531	184/531	151/531	196/531

2004-2006 Models Produced by Domestic Makers or Joint Ventures											
Alto 0.8A	32	4/32	10/32	15/32	17/32	17/32	19/32	12/32	17/32	17/32	20/32
Xiali Junya 1.0A	30	6/30	10/30	12/30	13/30	13/30	14/30	9/30	11/30	13/30	15/30
Fukang 1.6AXCA	27	5/27	7/27	7/27	9/27	8/27	12/27	7/27	7/27	6/27	6/27
Elysee 1.6SX16V	31	5/31	8/31	3/31	3/31	3/31	3/31	4/31	6/31	3/31	5/31
Bora 1.8T	32	4/32	6/32	7/32	7/32	9/32	11/32	8/32	13/32	8/32	11/32
Jetta 1.6CiX	25	5/25	7/25	8/25	8/25	8/25	8/25	8/25	9/25	6/25	8/25
BuickSail 1.6SL	33	12/33	17/33	15/33	18/33	18/33	22/33	10/33	12/33	10/33	15/33
Polo 1.4L	33	10/33	12/33	8/33	8/33	8/33	8/33	14/33	18/33	12/33	16/33
WindCloud 1.6	33	3/33	7/33	11/33	11/33	11/33	12/33	9/33	10/33	8/33	11/33
Santana 1.8GLi	27	5/27	7/27	7/27	11/27	7/27	11/27	7/27	9/27	4/27	7/27
Passat 2.0L	35	11/35	13/35	16/35	21/35	16/35	18/35	23/35	30/35	20/35	27/35
BuickRegal 2.5GL	34	10/34	15/34	17/34	18/34	16/34	18/34	14/34	18/34	14/34	18/34
Accord 2.4I-VTEC	32	9/32	11/32	13/32	15/32	12/32	13/32	11/32	13/32	9/32	11/32
RedFlag CenturyStar2.0E	29	18/29	20/29	20/29	21/29	18/29	20/29	15/29	17/29	13/29	15/29
Audi A6 2.8AT	34	2/34	2/34	7/34	8/34	6/34	7/34	8/34	10/34	8/34	10/34
GreenStar 1.0FHK	28	8/28	9/28	9/28	10/28	9/28	10/28	10/28	14/28	9/28	14/28
Minyi 1.0H	34	5/34	7/34	8/34	10/34	8/34	10/34	9/34	10/34	9/34	11/34
Hiace 2.2ME	28	3/28	5/28	10/28	10/28	10/28	11/28	12/28	13/28	12/28	13/28
Foton View 2.2 MT	22	1/22	3/22	5/22	7/22	5/22	7/22	12/22	13/22	12/22	14/22
Chrokee 2500 2.5EB	23	1/23	2/23	5/23	5/23	5/23	5/23	5/23	6/23	5/23	7/23
Changfeng Plat fourvat2.3	26	4/26	9/26	8/26	9/26	9/26	9/26	14/26	15/26	14/26	16/26
GreatWall Safe 2.2B	26	5/26	8/26	8/26	9/26	7/26	9/26	10/26	13/26	8/26	11/26
2004-2006 Import Cars											
Camry 2.4L	34	13/34	18/34	12/34	13/34	12/34	14/34	8/34	10/34	10/34	10/34
Benz S350 3.5AT	31	5/31	12/31	12/31	13/31	5/31	10/31	9/31	10/31	5/31	5/31

BMW 745i 4.4L	26	6/26	9/26	5/26	6/26	5/26	8/26	5/26	8/26	5/26	7/26
Landcruiser 4500 4.5AT	29	4/29	5/29	8/29	10/29	6/29	8/29	7/29	10/29	5/29	9/29
Ovearall 2004-2006	774	164/774	239/774	259/774	290/774	258/774	297/774	277/774	322/774	259/774	312/774
Total	1305	266/1305	378/1305	403/1305	468/1305	399/1305	474/1305	405/1305	506/1305	394/1305	508/1305

NOTES: For each series, in column 3 and column4, the following ADF equation was estimated： $\Delta p_{i,k,t} = c_{i,k} + \alpha_{i,k} p_{i,k,t-1} + \sum_{z=1}^{Z} \beta_{i,k,t} \Delta p_{i,k,t-z} + \varepsilon_{i,k,t}$. In all equations the lag length, Z was determined for each series by using the Modified Akaiki Information Criterion (MAIC). KSS1 test refers to the estimation based on the equation $\Delta p_{i,k,t} = \delta p_{i,k,t-1}^{3} + \varepsilon_{i,k,t}$, KSS2 refers to $\Delta p_{i,k,t} = \sum_{j=1}^{p} \rho_j \Delta p_{i,k,t-j} + \delta p_{i,k,t-1}^{3} + \varepsilon_{i,k,t}$.

TABLE 6.2 Univariate Unit Root Tests by City

		ADF Test		Nonlinear Unit Root Test							
				KSS1 Demeaned		KSS2 Demeaned		KSS1 Detrended		KSS2 Detrended	
City	No. of Series	5%	10%	5%	10%	5%	10%	5%	10%	5%	10%
Tianjin	40	7/40	13/40	10/40	12/40	10/40	12/40	13/40	18/40	12/40	16/40
Shijiazhuang	37	7/37	10/37	11/37	14/37	10/37	12/37	12/37	14/37	14/37	14/37
Taiyuan	33	9/33	12/33	12/33	14/33	14/33	16/33	11/33	15/33	11/33	14/33
Hohehot	35	7/35	7/35	11/35	11/35	10/35	11/35	8/35	11/35	7/35	9/35
Shenyang	39	8/39	12/39	13/39	14/39	11/39	12/39	15/39	17/39	14/39	18/39
Dalian	42	5/42	6/42	7/42	9/42	7/42	8/42	8/42	11/42	8/42	10/42
Changchun	35	10/35	13/35	9/35	10/35	12/35	13/35	8/35	10/35	8/35	12/35
Harbin	39	7/39	11/39	16/39	16/39	14/39	14/39	19/39	21/39	17/39	19/39
Shanghai	33	3/33	10/33	9/33	10/33	7/33	9/33	8/33	11/33	6/33	10/33
Nanjing	39	8/39	10/39	9/39	10/39	10/39	10/39	12/39	14/39	14/39	16/39
Hangzhou	38	5/38	12/38	14/38	17/38	15/38	18/38	12/38	14/38	13/38	16/38
Ningbo	40	9/40	10/40	15/40	16/40	11/40	12/40	11/40	13/40	7/40	9/40
Hefei	40	8/40	9/40	15/40	16/40	14/40	14/40	18/40	21/40	17/40	20/40
Fuzhou	37	7/37	10/37	10/37	12/37	13/37	15/37	13/37	14/37	13/37	15/37
Xiamen	37	9/37	13/37	7/37	9/37	9/37	13/37	7/37	8/37	7/37	9/37
Nanchang	35	6/35	8/35	9/35	9/35	9/35	11/35	6/35	12/35	8/35	15/35
Jinan	42	10/42	19/42	14/42	17/42	13/42	17/42	17/42	21/42	17/42	20/42
Qingdao	44	8/44	11/44	11/44	15/44	11/44	13/44	11/44	12/44	11/44	15/44
Zhengzhou	31	7/31	11/31	9/31	11/31	9/31	13/31	10/31	11/31	8/31	10/31
Wuhan	43	7/43	10/43	12/43	15/43	13/43	15/43	12/43	15/43	11/43	16/43
Changsha	39	10/39	13/39	15/39	15/39	14/39	15/39	13/39	15/39	14/39	18/39

Guangzhou	39	11/39	11/39	13/39	14/39	14/39	15/39	17/39	19/39	14/39	17/39
Shenzhen	32	9/32	11/32	12/32	13/32	13/32	14/32	11/32	13/32	11/32	14/32
Nanning	43	5/43	8/43	9/43	12/43	9/43	12/43	12/43	12/43	11/43	13/43
Haikou	33	5/33	8/33	5/33	8/33	5/33	8/33	5/33	9/33	5/33	10/33
Chengdu	34	8/34	12/34	10/34	13/34	10/34	14/34	11/34	11/34	8/34	9/34
Chongqing	24	6/24	7/24	5/24	7/24	4/24	7/24	6/24	9/24	5/24	9/24
Guiyang	40	10/40	14/40	12/40	15/40	11/40	16/40	10/40	12/40	11/40	15/40
Kunming	43	12/43	15/43	17/43	20/43	16/43	19/43	19/43	23/43	20/43	24/43
Lahsa	23	5/23	5/23	6/23	6/23	10/23	10/23	5/23	7/23	8/23	11/23
Sian	43	6/43	12/43	19/43	20/43	16/43	17/43	12/43	22/43	12/43	19/43
Lanzhou	42	8/42	12/42	16/42	17/42	17/42	18/42	15/42	21/42	15/42	21/42
Xining	37	12/37	15/37	14/37	18/37	12/37	17/37	12/37	20/37	12/37	19/37
Yinchuan	36	8/36	10/36	14/36	18/36	13/36	17/36	14/36	17/36	13/36	14/36
Urumchi	38	4/38	8/38	13/38	16/38	13/38	17/38	12/38	13/38	12/38	12/38
Total	1305	266/1305	378/1305	403/1305	468/1305	399/1305	474/1305	405/1305	506/1305	394/1305	508/1305

NOTES: For each series, in column 3 and column4, the following ADF equation was estimated： $\Delta p_{i,k,t} = c_{i,k} + \alpha_{i,k} p_{i,k,t-1} + \sum_{z=1}^{Z} \beta_{i,k,t} \Delta p_{i,k,t-z} + \varepsilon_{i,k,t}$. In all equations the lag length, Z was determined for each series by using the Modified Akaiki Information Criterion (MAIC). KSS1 test refers to the estimation based on the equation $\Delta p_{i,k,t} = \delta p^3_{i,k,t-1} + \varepsilon_{i,k,t}$, KSS2 refers to $\Delta p_{i,k,t} = \sum_{j=1}^{p} \rho_j \Delta p_{i,k,t-j} + \delta p^3_{i,k,t-1} + \varepsilon_{i,k,t}$.

TABLE 6.3 Panel Unit Root Tests

Product	No. of Series	MW Statistic	No. of Significant Constants	DT Test (p<10%/N)	Half Life (Month)
1994-2003 Models Produced by Domestic Makers or Joint Ventures					
Xiali 1.0	35	104.207*	4	1	2.330
Xiali 1.3	30	78.7274**	10	0	1.346
Fukang 1.4AL	20	75.9501*	10	0	1.194
Fukang 1.6AL	34	107.51*	1	1	1.112
Fukang988 1.6EL	32	86.0858**	15	0	1.760
Jetta 1.6CL	23	90.4676*	3	1	0.650
Jetta 1.6GL	14	24.5882	4	0	—
Jetta 1.6GTX	34	113.045*	7	2	2.084
Jetta 1.6GiX	29	432.218*	19	16	0.724
Santana 1.8LX	35	196.665*	2	4	2.327
Santana 1.8ED	29	153.192*	18	4	1.590
Santana2000 GSi	35	200.926*	10	4	2.669
RedFlag LuckStar 1.8AE	34	85.8635***	9	0	2.337
Adui 200 2.6L	24	42.99	5	0	—
BuickCentury 3.0	29	37.6785	4	0	—
NorthernStar 0.8	26	190.694*	20	4	1.475
BJ2020S	33	111.681*	19	1	2.535
Chrokee 7250 2.5EL	35	64.0059	9	0	—
2004-2006 Models Produced by Domestic Makers or Joint Ventures					
Alto 0.8A	32	94.9983*	5	2	1.225
Xiali Junya 1.0A	30	146.452*	5	2	1.480
Fukang 1.6AXCA	27	98.1483*	6	3	1.253

Product	No. of Series	MW Statistic	No. of Significant Constants	DT Test (p<10%/N)	Half Life (Month)
Elysee 1.6SX16V	31	110.445*	18	1	1.411
Bora 1.8T	32	94.5113*	16	0	1.492
Jetta 1.6CiX	25	94.4972*	8	2	1.129
BuickSail 1.6SL	33	203.995*	10	3	1.174
Polo 1.4L	33	171.412*	14	4	1.296
WindCloud 1.6	33	107.463*	9	1	1.240
Santana 1.8GLi	27	84.5113*	8	0	1.226
Passat 2.0L	35	154.25*	7	2	0.996
BuickRegal 2.5GL	34	154.396*	9	1	1.050
Accord 2.4I-VTEC	32	131.451*	3	2	1.070
RedFlag CenturyStar2.0E	29	248.378*	14	9	1.316
Audi A6 2.8AT	34	56.4336	5	0	—
GreenStar 1.0FHK	28	131.939*	10	4	0.592
Minyi 1.0H	34	112.111*	11	0	1.100
Hiace 2.2ME	28	76.7283*	13	2	0.398
Foton View 2.2 MT	22	62.5*	9	1	1.595
Chrokee 2500 2.5EB	23	37.2967	4	1	—
Changfeng Plat fourvat2.3	26	103.018*	6	3	1.190
GreatWall Safe 2.2B	26	113.514*	16	3	1.376
2004-2006 Import Cars					
Camry 2.4L	34	212.517*	10	5	0.968
Benz S350 3.5AT	31	130.545*	4	1	1.188
BMW 745i 4.4L	26	87.2832*	11	1	1.519
Landcruiser 4500 4.5AT	29	70.4681**	9	0	1.130

NOTES: For each series, the ADF equation used to construct MW test was estimated： $\Delta p_{i,k,t} = c_{i,k} + \alpha_{i,k} p_{i,k,t-1} + \sum_{z=1}^{Z} \beta_{i,k,t} \Delta p_{i,k,t-z} + \varepsilon_{i,k,t}$. In all equations the lag length, Z was determined for each series by using the Modified Akaiki Information Criterion (MAIC). *, ** and *** indicate statistical significance at the 1%, 5%, and 10% error level. The reported number of significant constants refers to the number of univariate ADF equations for which the intercept is significant at 10% level. The reported half lives are the median value of $h = |\ln(0.5)/\ln(1+\alpha_{i,k})|$ from the univariate ADF equations for those series which can past the ADF test at 10% significance level. The marginal significance levels fro the DT (Dufour-Torres) test were adjusted as follows: for each model, at least one p-value, p_i must be less than 0.1/N（10%）, N is the number of series for each model in my study.

Table 6.4 Pooled OLS Result A

Dependent variable: Std. Dev. of yearly average price				
Variable	Coefficient Estimate	Standard Error	t statistic	p value
Constant	0.0370671	0.0078830	4.70	0.000
Income	0.0046495	0.0022919	2.03	0.043
Distance	0.0014207	0.0006541	2.17	0.030
LOCAL	0.0030461	0.0032175	0.95	0.344
Time Trend	-0.0008298	0.0004573	-1.81	0.070
Model Dummies	YES			
R Squared	0.1869	Number of obs	3842	

Table 6.5 Pooled OLS Result B

Dependent variable: Yearly Average of |price difference|				
Variable	Coefficient Estimate	Standard Error	t statistic	p value
Constant	-0.0591853	0.0134478	-4.40	0.000
Income	0.0079483	0.0039178	2.03	0.043
Distance	0.0000336	0.0011163	0.03	0.976
Local	0.0095599	0.0055030	1.74	0.082
Time Trend	0.0087885	0.0007805	11.26	0.000
Model Dummies	YES			
R Squared	0.4540	Number of obs	3852	

Figure 1.1 Vehicle Production from 1994-2006 (Thousand Units)

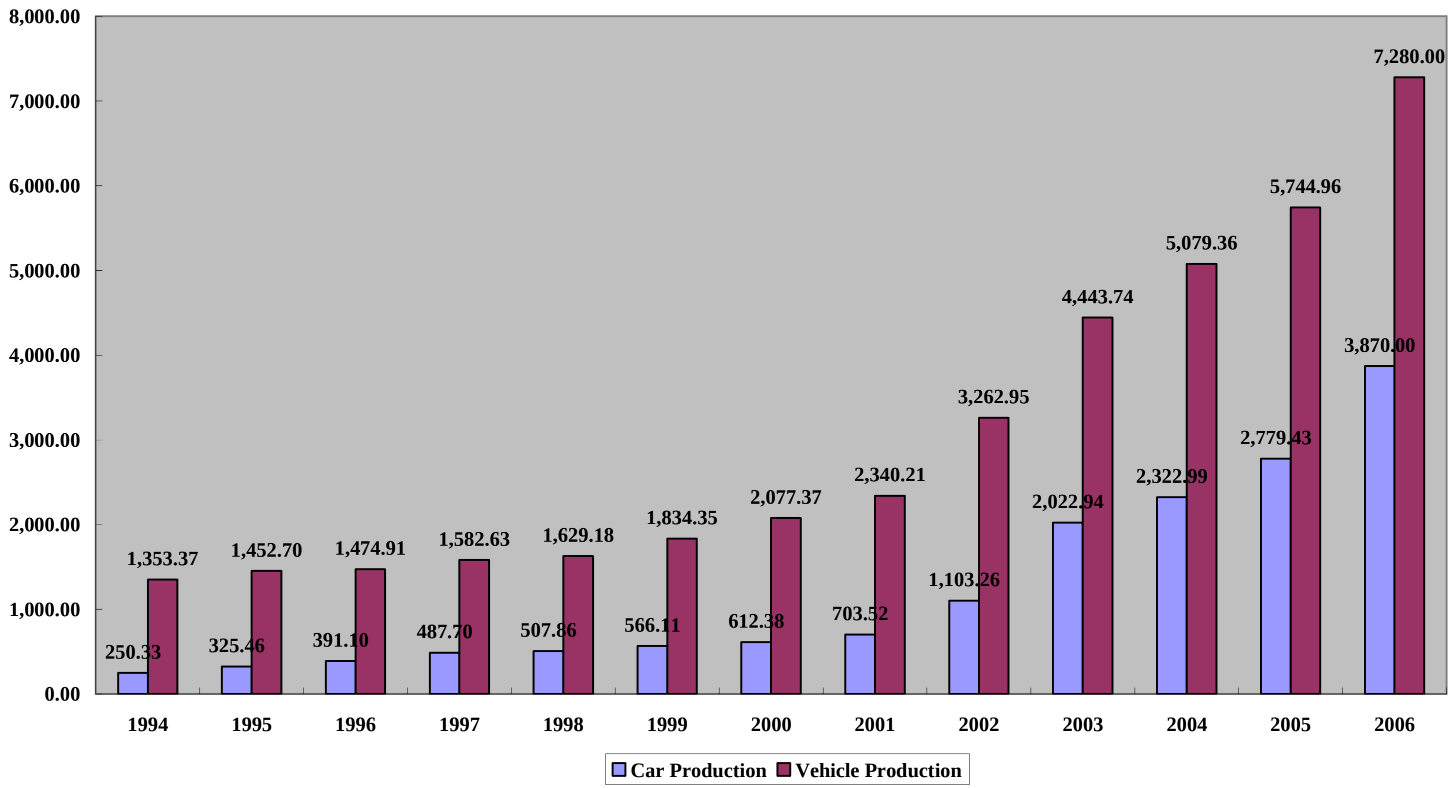


Figure3.1 Passenger Car Market Structure 1994-2006

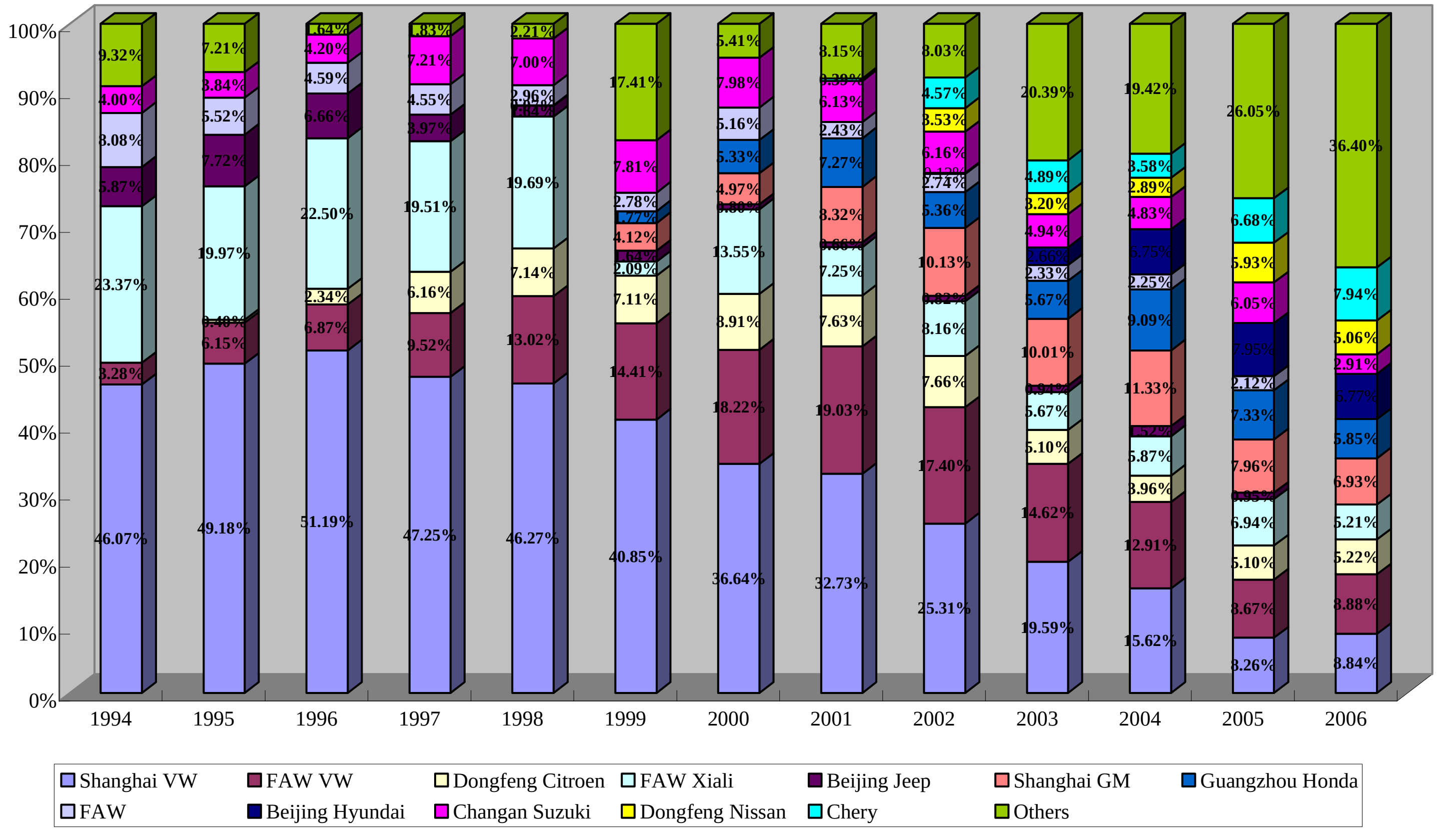
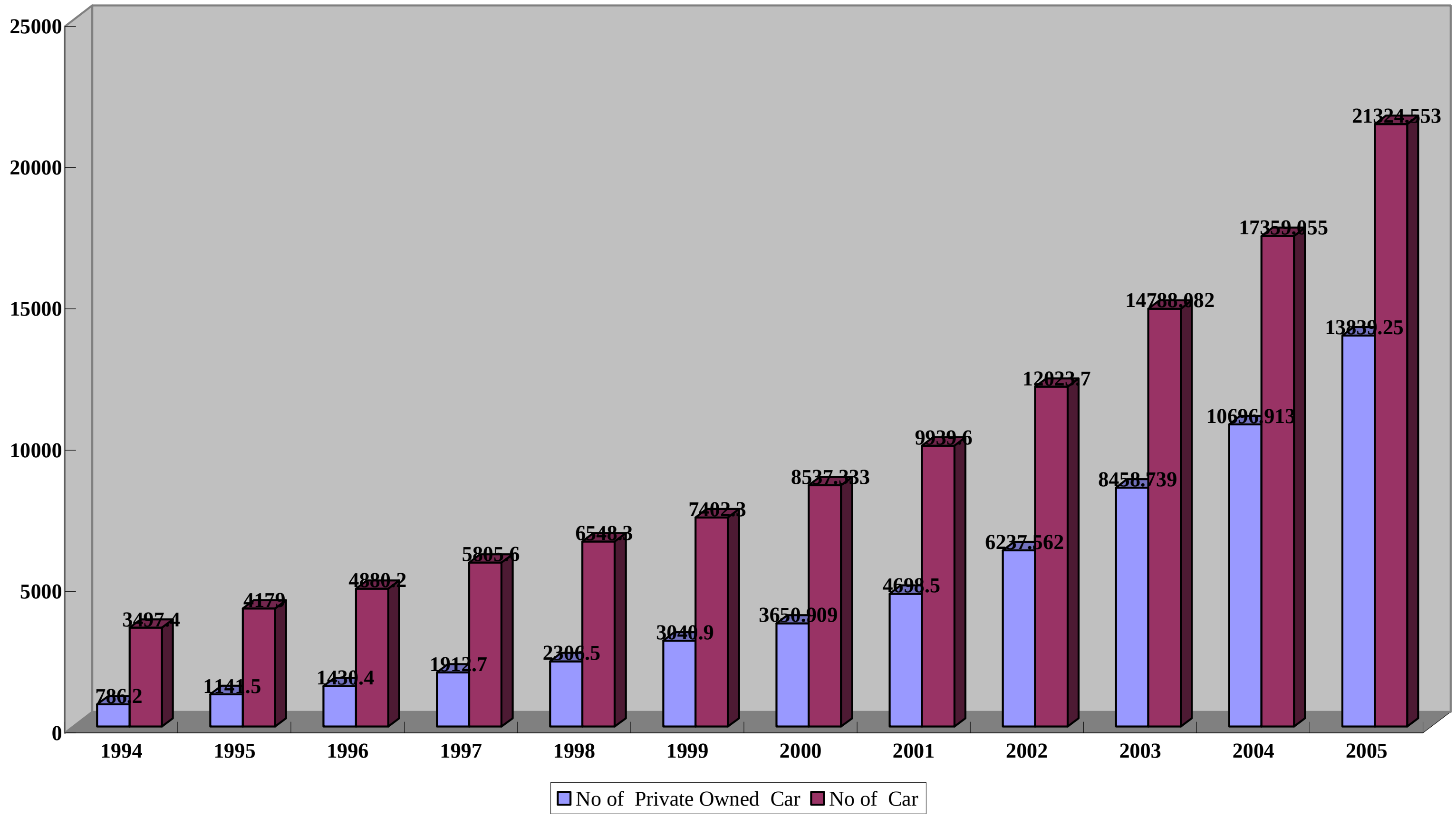


Figure 3.2 Number of China Privately Owned Car (thousand units)



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