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DURATION DEPENDENCE OF REAL ESTATE PRICE IN CHINA

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ยุนนา วัง: ระยะเวลาความต่อเนื่องของราคาอสังหาริมทรัพย์ในประเทศจีน. (Duration Dependence of Real Estate Prices in China) อ. ที่ปรึกษาวิทยานิพนธ์หลัก : รองศาสตราจารย์ ดร.โสตถิธร มัลลิกะมาส,อ. ที่ปรึกษาวิทยานิพนธ์ร่วม: อาจารย์ ดร. ดนุพล อริยสัจจากร 96 หน้า.

วิทยานิพนธ์ฉบับนี้มุ่งเน้นในการศึกษาปัจจัยที่กำหนด“ระยะเวลาความต่อเนื่องของราคา” (duration dependence)ในตลาดอสังหาริมทรัพย์สาธารณะรัฐประชาชนจีนการศึกษาปัจจัยดังกล่าวอาศัยข้อมูลในภาคอสังหาริมทรัพย์จากทั้งระดับประเทศและระดับท้องถิ่นซึ่งอยู่ในรูปข้อมูลภาคตัดขวางตามเวลา(PanelData)ของ30จังหวัดและเขตปกครองตนเองโดยศึกษาทั้งในรูปแบบของระยะเวลาความต่อเนื่องของราคาอสังหาริมทรัพย์โดยรวมของจีนระยะเวลาความต่อเนื่องของราคาอสังหาริมทรัพย์ในแถบชายฝั่งและระยะเวลาความต่อเนื่องของราคาอสังหาริมทรัพย์ในพื้นที่ตอนในของประเทศจีนการศึกษานี้อาศัย“แบบจำลองการอยู่รอดแบบเวลาไม่ต่อเนื่อง”(discrete time survival model)เป็นเครื่องมือหลักในการศึกษาซึ่งภายใต้แบบจำลองนี้ใช้การประมาณค่าแบบโลจิตส์(Logit)การวิเคราะห์ราคาอสังหาริมทรัพย์ถูกแบ่งออกเป็นสองสถานการณ์คือราคาอสังหาริมทรัพย์ขยายตัวและหดตัวประเด็นสำคัญอีกประการหนึ่งของการศึกษานี้คือการเปรียบเทียบผลกระทบของการกำหนดระยะเวลาความต่อเนื่องของราคาในกรณีที่วิเคราะห์โดยมีปัจจัยกำหนดราคาอสังหาริมทรัพย์และในกรณีที่ไม่นำเอาปัจจัยกำหนดราคาอสังหาริมทรัพย์มาร่วมพิจารณาผลการศึกษาให้ข้อสรุปว่าในตลาดอสังหาริมทรัพย์ของจีนความต่อเนื่องของราคามีลักษณะความสัมพันธ์เชิงบวก(positive duration dependence) ทั้งในสถานการณ์ที่ราคาอสังหาริมทรัพย์ขยายตัวและหดตัวซึ่งแสดงให้เห็นว่าโอกาสที่ราคาอสังหาริมทรัพย์ขยายตัวหรือหดตัวต่อเนื่องนั้นจะลดลงเมื่อเวลาผ่านไปผลดังกล่าวเกิดขึ้นทั้งในพื้นที่ชายฝั่งพื้นที่ตอนในและพื้นที่โดยรวมของประเทศจีน เมื่อวิเคราะห์ผลกระทบต่อ“อัตราเสี่ยง”(hazard rate)โดยคำนึงถึงปัจจัยมาตรฐานในการกำหนดราคาอสังหาริมทรัพย์ซึ่งประกอบด้วยดัชนีราคาสินค้าผู้บริโภคราคาที่ดินค่าเช่าและพื้นที่ภายหลังจากการก่อสร้างอาคารเสร็จสมบูรณ์มาเป็นปัจจัยควบคุมในการวิเคราะห์ผลการศึกษาพบว่าปัจจัยควบคุมกลับมีทิศทางความสัมพันธ์ที่ไม่สอดคล้องกับสถานการณ์และให้ผลที่ไม่แน่นอนในขณะเดียวกันปัจจัยเชิงนโยบายมหภาคของรัฐบาลมีบทบาทเป็นอย่างมากต่อระยะเวลาความต่อเนืองของราคาอสังหาริมทรัพย์ในช่วงเวลาที่ราคามีการขยายตัวนอกจากนี้เมื่อแยกพิจารณาเฉพาะกลุ่มอสังหาริมทรัพย์บริเวณชายฝั่งดัชนีราคาสินค้าผู้บริโภคการคาดการณ์ราคาและราคาจำนองสามารถส่งผลกระทบต่ออัตราเสี่ยงของราคาอสังหาริมทรัพย์เฉพาะในช่วงที่ราคาอสังหาริมทรัพย์ขยายตัวเท่านั้นและยังมีทิศทางความสัมพันธ์ของปัจจัยควบคุมยังไม่ชัดเจนและบางครั้งไม่สอดคล้องกับเหตุการณ์สำหรับกลุ่มอสังหาริมทรัพย์บริเวณพื้นที่ตอนในของประเทศพื้นที่ภายหลังจากการก่อสร้างอาคารเสร็จสมบูรณ์เป็นปัจจัยเดียวที่มีบทบาทต่ออัตราเสี่ยงและเป็นอัตราเสี่ยงในกรณีราคาอสังหาริมทรัพย์ขยายตัวนอกจากนี้ปัจจัยเชิงนโยบายมหภาคของรัฐบาลมีบทบาทต่ออัตราเสี่ยงในกรณีที่ราคาอสังหาริมทรัพย์หดตัว

สาขาวิชาเศรษฐศาสตร์และการเงินระหว่างประเทศ ลายมือชื่อนิสิต..................................
ปีการศึกษษ 2555 ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.........................
ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์ร่วม..........................

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KEYWORDS : DURATION DEPENDENCE /REAL ESTATE PRICE/SURVIVAL ANALYSIS / CHINA

YUNNA WANG: DURATION DEPENDENCE OF REAL ESTATE PRICE IN CHINA. ADVISOR: ASSOC.PROF.SOTHITORN MALLIKAMAS, Ph.D., CO-ADVISOR: DANUPON ARIYASAJJAKORN Ph.D., 96 pp.

The The main emphasis of this thesis is placed on the problem of duration dependence in Chinese real estate market. We probe data on real estate price at nationwide level and regional level. Making use of a panel of 30 provinces and autonomous regions, we examine the duration dependence in coastal and inland real estate market along with the overall Chinese real estate market. According to discrete time Survival model, the real estate price is divided into expansion and contraction phases. Survival model with a Logit characterization is adopted for real estate price expansion and contraction phases. This model is employed for all areas in our thesis. Major issues are addressed base on the models with and without standard real estate price determinant variables. The results support that Chinese real estate market has positive duration dependence in not only price expansion but also contraction phases since their phase-end possibility rise with duration. In addition, positive duration dependence appears in expansion and contraction periods of coastal region and inland region. Moreover, standard determinants of real estate price, such as CPI, land price, rental and completed building construction area are included as control variables. The results show that those variables have effect on hazard rate. However, the effects appear in different phases and with mixed sign. Government macro-control policies are effective to control the house price soar in real estate price expansion phases. In addition, CPI, house price expectation and mortgage rate affect the hazard rate in coastal area, but just in expansion and the signs of these significant determinants are mixed. For inland area, only completed building construction area in expansion has influence on hazard rate, besides, CPI affects hazard rate in contraction of inland area, and government policy is efficient to stimulate real estate consumption during the period of real estate price contraction.

Field of Study : International Economies and Finance Advisor's Signature ....

Student's Signature .... Co-advisor's Signature ....

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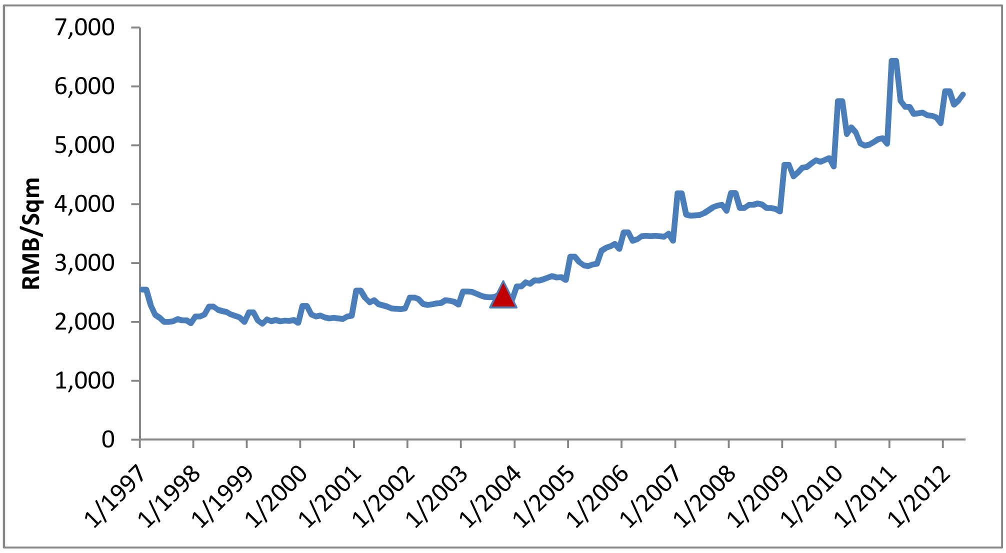
CHAPTER I

INTRODUCTION

1.1 History course and present status

Nowadays, real estate price is a popular topic of discussions in both Chinese government and residents. Chinese real estate price experienced unprecedented rapid increase since 1998 Chinese government terminated the “physical housing allocation system”.(i.e. Government or department investment gratis to build house for staffs , staffs pay for a little money to rent) Real estate industry plays more and more important part in Chinese economic development. In 1998, the average price of Chinese commercial housing was 2,002 RMB per square meter. Moreover, at the same period, annual per capita income was 6,796 Yuan.

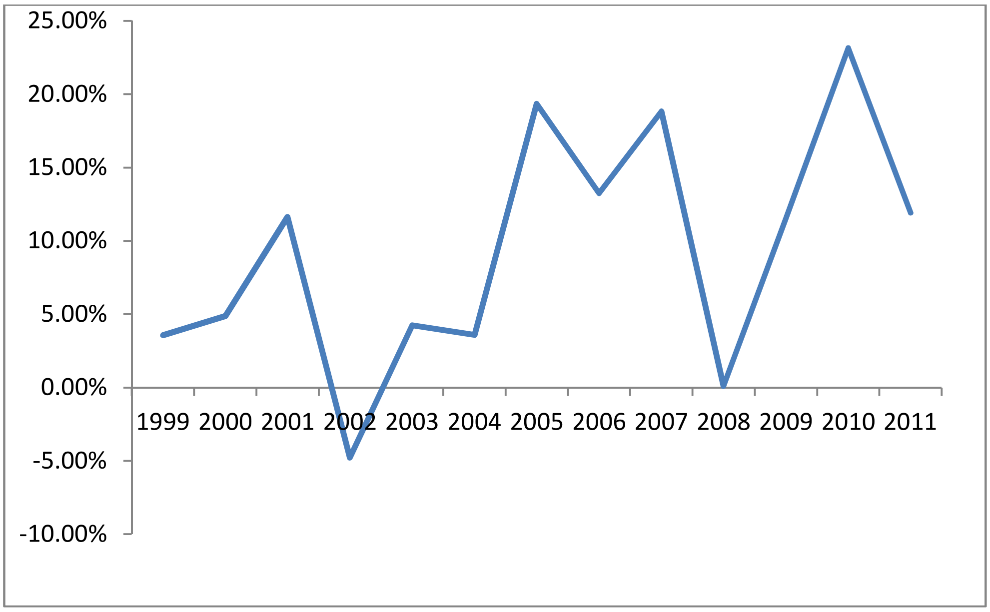
Figure 1 Real estate prices in China



Source: Data manage from CEIC

Figure 1 shows the price of real estate over the period from 1997 to 2012. It's clear that over the period from1996 to 2003 the house price remained 2000 to 2500 RMB/Sq. m. A considerable increase occurred from 2004 to 2012. The nation's land prices rose significantly as well as real estate prices, which keep aggrandizing at 11% on average annual till 2011, except 2008. Nevertheless, there were some price fluctuations in the process. In July, 2012, Chinese average real estate price is 6241 RMB/Sq. m.[1] In spite of exorbitant real estate price may diminish real estate turnover theoretically, real estate sold and real estate investment keep soaring. In July 2012, the real estate sold was about 2869.947 billion RMB, rose by 23% on a month-on-month basis. Further, there is around 30.4% increase in real estate investment in 2011, from 564.84 million RMB to 737.021 million RMB.

Figure 2 overall house price change rate from 1999-2011



Source: Data manage from CEIC

[1] Zhang, "Personal mortgage loan reached a peak within the year," Guang Zhou daily (10 September 2012): 4

Figure 2 provides the average real estate price change from 1999 to 2010.From 1999 to 2004，real estate price rate always is greater than one exclude 2002. The average growth rate is 3.85%. From then on, Chinese real estate price turned into steeply increase stage, the growth rate in 2005 is 19.35%. From 2005-2007, Chinese real estate industry developed rapidly, average yearly house price increase rate reached to 17.15%. Next, global economic crisis erupted, crisis made Chinese economic slowdown. Chinese government inputted four trillion to stimulate domestic demand, the great mass of these input distributed in construction industry, oppressed real estate demand explode. Great price soar has taken place in 2009 and then real estate price growth rate peaked at 23.14% in 2010. In the three years spanning from 2009 through 2011，average price growth rate is 15.52 unit. Until 2012，real estate price has a slight decrease with 8% change rate. Real estate price from January, 2003 to May 2012 is presented in Figure 3, Figure 3 reveals the overall trend in house price is upward in all of Chinese provinces.

Figure 3 Real Estate Price in 30 Chinese provinces (cities) from Jan, 2003-May, 2012

Note: number1-30 present: 1.Beijing, 2.Tianjin, 3.Hebei, 4.Liaoning, 5.Shandong, 6.Shanghai, 7.Jiangsu, 8.Zhejiang, 9.Fujian, 10.Guangdong, 11.Hainan, 12.Guangxi, 13.Jilin, 14. Heilongjiang, 15.Anhui, 16.Jiangxi, 17.Hubei, 18.Hunan, 19.Chongqing, 20.Sichuan,21.Guizhou, 22.Yunnan, 23.Henan, 24.Shaanxi, 25.Shanxi, 26.Inner Mongolian, 27.Gansu, 28.Qinghai, 29.Ningxia and 30.Xinjian.

1.2 Regional real estate price

Since Reform and opening-up, economic development is unbalanced in difference regions. Eastern coast area absorbs a lot of domestic productive forces and factors of productions with superior geographical position and national preferential policies. Economic developments in eastern coastal provinces are very ripe. Compared with eastern, the other provinces are relatively backward. Macroeconomic environment diversities lead to real estate price discrepancy.

Figure 4 Provincial Real Estate Price in May, 2012

As is shown in the Figure 4, high real estate price centralized distribution in eastern coastal provinces. Real estate price in Beijing, Shanghai, Hainan and Zhejiang are medially nearly 10000 RMB/Sq. m up. According to Figure 3 Beijing, Hainan and Shanghai's house price climbed more sharply than other provinces. Tianjin, Shandong, Jiangsu, Zhejiang, Fujian and Guangdong display comparatively sharp upward trend. On the contrary, there were fairly steady house price growths in provinces which are relatively backward in economic. We separate the whole Chinese into two regions depend on above characterization. Coast region consists of Beijing, Shanghai, Hainan, Zhejiang, Fujian, Tianjin, Guangdong, Jiangsu and Shandong. Other provinces are belonged inland region.

Table 1 real estate price statistic description 2003.1—2012.5

region	mean	sd	max	min
Inland	4346.89	7755.773	41030	973.4981
Coast	5995.343	3603.774	19962.14	1284.404
Overall	4830.721	6845.782	41030	973.4981

Table 1 depicts mean price from January 2003 to May2012 in each region in China. Overall real estate mean price is 4830.7 RMB/ Sq. m. coastal real estate price is 5995.343 RMB/ Sq. m, apparently higher than overall average price, as well as standard deviation, that means the price diversity in coastal provinces is larger. Meanwhile, inland house price 4346.89 RMB/ Sq.m is manifestly lower than overall average price, the volatility is smaller than overall average level since the standard deviation is 3603.

1.3 Governmental regulatory policy evolution

Focus on this complicated real estate price change, Chinese government adopts corresponding policy to guide real estate market development. In regulation direction perspective; we can separate the evolution into three stages. The first stage is from the first quarter in 2003 to the third quarter in 2008. Critical characteristics of real estate situation are brisk trade of commodity house, house price sharply increased, and considerable real estate investment. Under this circumstances, Chinese government implemented policy to not only prevent the rapidly increase real estate investment but also control house demand. Such as increased the down-payment of second house, taxation of transfer and elevated capital proportion in real estate project.

Fourth quarter in 2008, global economic crisis utterly erupted. Chinese economic growth slowed down, commercial house volume countrywide fell. In order to keep economic growth and deal with global economic crisis, Chinese government proposed to encourage real estate development. After that, Chinese real estate price went up again. This policy continued for one year, ended in fourth quarter, 2009.

Last stage is from first quarter of 2010 to present .since real estate price jumped dramatically. January, 2010, to restrain house price, Chinese government introduced several policy. For instance, property-purchasing limitations, mortgage loan limitation and so on. Afterward, markup of house price lessened, however, the price of real estate is still rising.

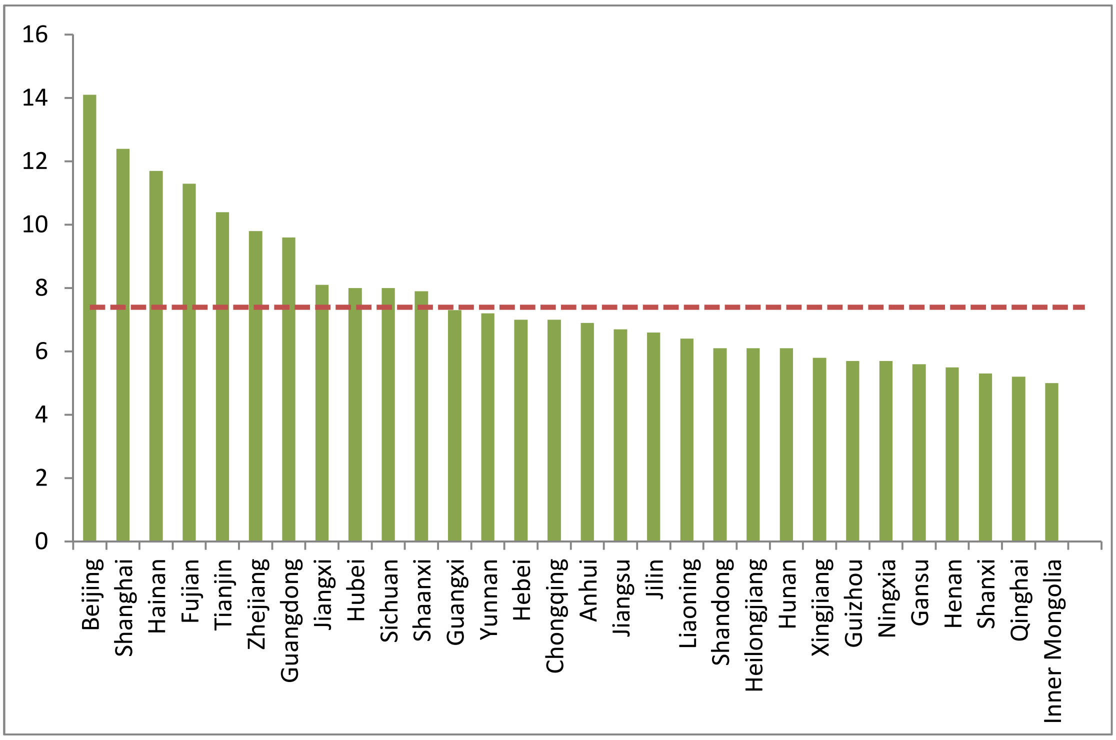
1.4 Statement of problems

Recently, whether real estate price has already reached a peak becomes an influential issue. Since 1998, Chinese government encouraged banks to enhance their lending to mitigate the economic slowdown, house mortgage loan and low down-payment have been playing prominent role in Chinese economic development.

Real estate industry expanding stimulated residents' consumption and boosted domestic demand in the early stage. Between 1998 and 2003, real estate price had risen smoothly. However, in 2004, the agreement on land transferring was replaced by "strokes linked to shoot". The nation's land prices rose significantly as well as real estate prices, which keep aggrandizing at 11% on average annual till 2011, except 2008.

The speed of rising in real estate prices was much faster than the growth of per capita income. Most of common residents no longer are able to afford such a high housing price. Taken Beijing as an example, at present, a three people-family's annual income are one hundred and twenty thousand RMB and one 100 square meters dwelling is now selling at one million and eighty hundred RMB, The ratio of the price of a house to the family income is now about 15, greater than double upperlimit of the standard that the World Bank and the United Nations residential center stated, rational house expenditure should be the sum of 4-6 years income of a family.

Figure 5 2011 Provincial Housing price-to-income ratio



Source: www.21ask.com/htmls/vf48c7fa80e7bf1fe.html

On the other hand, housing price-to-income ratio is clear different in coast and inland provinces. The red line shows overall housing price-to-income ratio 7.4. The diagram above describes Chinese provincial housing price-to-income ratio. Most of coast provinces have higher ratio than overall average. Top seven provinces (cities) are Beijing 14.1, Shanghai 12.4, Hainan 11.7, Fujian11.3, Tianjin 10.4, Zhejiang9.8 and Guangdong9.6. Others are below 9. Compared with 2010, approximately 60% of Chinese provinces (cities)' housing price-to-income ratios slowed down. Largest five drop completely occurred in coast provinces. This fact means that governmental macro-control policies are relatively efficient in these provinces. Although, housing price-to-income ratio in provinces like Yunnan, Shaanxi, Hubei and Hebei maintain rising. Definitely, governmental macro-control policies didn't work very well in 2010 and 2011.

To prevent real estate price booming, the People's Bank of China has improved its nominal interest rate and mortgage rate. Chinese government restricts house purchasing in Beijing, first time since 2010. Each family can buy 2 commercial houses at the most, simultaneously the measure also be implemented in more second- and third-tier cities to discourage speculators. Down-payment for the house now has been asked to grow up from 20% to 50% of the total house price. Moreover, government also adopts higher taxes on property. As a result, house prices in big city now grow up, relatively, moderately. Nevertheless, house prices in China are still at a very high level.

From the traditional of their country, Chinese people prefer to buy a house and own a house rather than rent. Because of the higher house price has turn down the requirement to buy a house. Therefore, the housing issue is not only a problem from an economic perspective, but also an issue of people' livelihood and also influence the social instability. For China, it is an urgent situation which needs to solve as soon as possible.

In order to settle earlier conundrum, it is necessary to figure out these following puzzles: will the duration of these expansion or the recession continued be able to change the probability of the situation to come to an end in the next period? And if it truly happened, are there any relationships between cores of the determinants of house price and the probability of the expansion phase or recession ending in the next period? Likewise, do these duration dependence and influence of determinants display variously in different regions? These are some problems that lead to the study of this thesis.

1.5 Objective

As discussed earlier, the broad objective of this paper is to analyze the duration dependence in Chinese house market and determinants of Chinese real estate price. However, in this part, for the specific objective of this paper we can narrow it down as given below:

a) Is there any duration dependence in expansion and contraction phases of Chinese real estate market, and whether duration dependence is same in different price phases?
b) How does the duration dependence perform in Chinese coastal and interior provinces?
c) Do the determinants have influence on house price in diverse price phases and how do factors affect the real estate price in both expansion and recession phases?
d) How do the Real estate price determinants affect hazard rate in coast and inland regions?

1.6 Scope

In this paper, we will focus on the study of duration dependence in Chinese house market. However, determinates of Chinese real estate price also should be included as well. I adopt the factors which affect house price in Chinese real estate market both supply side factors and demands side factors. Supply sides factors include land price index, completed building construction area, CPI. Beside, income, house rent index and mortgage interest rate are treated as demand factors. As mentioned above, Chinese real estate control policy was distributed into three stages basing on the regulation direction. Considering the influence of government's micro-policy, we also put a dummy variable base on these time stages as policy efficacy in our research. All of determinates are common and certified the relative previous research.

Most of previous interrelated researches divide China into three regions, western China, central China and eastern China. However, an amount of their final results indicate western and central areas have similar economic environment and real estate market sentiment. Importantly, regional real estate price analysis in above section has also ascertained that real estate price trend and housing price-to-income ratio are similar in western and central China. Consequently, we separate China into only two regions in this thesis. Coast region consists of Beijing, Shanghai, Hainan, Zhejiang, Fujian, Tianjin, Guangdong, Jiangsu and Shandong. And then Hebei, Liaoning, Guangxi, Jilin, Heilongjiang, Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Guizhou, Yunnan, .Henan, Shaanxi, Shanxi, Inner Mongolian, Gansu, Qinghai, Ningxia and Xingjian belongs inland or interior region.

In order to get more complete information, the data have be collected and managed as panel data which is monthly and quarterly data from the period of 2003/1-2012/3 include 30 provinces or municipalities in China. Duration model is exploited in our research.

Firstly, we will test whether the length of one economic phase affects the probability that this phase will end in the next period in Chinese real estate market, using panel data in both contraction and recession phase.

Secondly, the duration dependence will be tested in coast and inland regions respectively.

Subsequently, we will put house price determinants into the equation as control variables to test duration dependence again, Estimate the relationship between hazard rate and these determinants in expansion and contraction of overall China.

Finally, the influence of determinants on hazard rate in coast and inland regions will be examined.

Following section devoted to basic aspects of hazard (duration) model.

1.7 Concept

1.7.1 Concept of duration dependence

First, the duration model (also called hazard model or survival model) is used in biomedical sciences to estimate patients' time, the possibility of the time of patients' survival to death. Engineers also employed this model to understand and can be able to predict when one machine is likely to break down. Nowadays, duration model have become broadly applied in political science emphatically economics. In parametric model, especially the Weibull model, the most important part supports duration analysis in economics. Uniquely, Weibull has strong capacity for dealing with duration dependence: the extent to the conditional possibility of the event of interest occurring is increasing or decreasing over the time. In our paper, if the probability of the exit is changing with the length of a spell, therefore, the spell is said to be exhibit duration dependence. (I.e. a spell refers to the time that one state or situation has sustained before transitioning to another)

To understand survival model and duration dependence and the fundamentals of duration dependence indeed, we study following situation first.

In state, we set a time length variable T, *F (t)* is the distribution function of T.

$F(t)=Prob(T<t)$, *F(t)* describes the conditional probability distribution when random variable T smaller than critical value t. its density function is $f(t)=dF(t)/dt$.

Survival function $S(t)=1-F(t)=Prob$ (T≥t), conditional probability of random variable T≥t, frankly speaking , the probability that random variable T survives longer than t.

Hazard rate function $h(t)=prob\ (T=t\,/T\geq t)=f(t)/S(t)$, it means the probability of a run ends at t, given that it lasts until t.(a run is defined as a sequence of house price change of the same sigh). For instance, when T=t, $dh(t)/dt>0$, it implies, there is a positive duration dependence .

For continuous random variables y, Hazard rate indicates the probability of a run ends at y, given it lasted until y:

$$h(y) = lim_{y\to\infty} \frac{P(y\leq Y\leq y+\Delta y|Y\geq y)}{y}, 0 < y < \infty \qquad \textbf{E1}$$

By comparison, to discrete random variable, hazard rate means probability of appearing an opposite sign run after a continuous series which have the same sign. For discrete variable I, the hazard rate can be written as:

$h_i = prob\ (I=i|I\geq i)$, the nonparametric hazard rate function is

$$h_i = \frac{N_i}{N_i+M_i} \qquad \textbf{E2}$$

Where *Ni* is the count of runs of length *i* and *Mi* is the count of runs with a length greater than *i*, in other words, "*Ni+Mi*" presents the total counts we have observed in all expansion or contraction phases

Survival function can be present as:

$$S(t_j) = \prod_{i=1}^{j}[1 - h(t_i)] \quad \textbf{E3}$$

(McDonald, McQueen, and Thorley, 1994)[2], set up the hazard rate function based on the logistic transformation using *lni*. The hazard rate function can avert the incorrect result which fitting discrete random data with continuous duration model.

$$h_i = \frac{1}{1+e^{-(\alpha+\beta lni)}} \quad \textbf{E4}$$

The log likelihood version of the density function is

$$lnL(\theta|S_T) = \sum_{i=1}^{\infty} N_i lnf_i \quad \textbf{E5}$$

Where θ is the parameter

Accordingly, *"I"* is a positive valued discrete random variable generated by discrete density function: f_i = *prob (I=i)* matching cumulative density function is F_i*=prob (I<i).* Ni means the count of completed runs and partial runs, respectively, number of runs whose length are *i* in the example. The hazard function h_i*=prob(I=i|I≥i),* represents that a run, ends at *I*, given that it lasts until *i*. The hazard function specification describes data in term of conditional probability in contrast to the density function specification, which focus on unconditional probability abilities. In order to identify the one you should be adopting is depends on the economic question you want to analyze.

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[2] McQueen,G., and Thorley, S. Bubbles, Stock Return, and Duration Dependence. Journal of Financial and Quantitative Analysis 29 (September 1994) : 379-401 Cited in Wanida Ngienthi. Bubbles, Stock Rturns and Duration Dependence: A Case of Thailand. Master's Thesis, Department of international Economics and finance faculty of economics Chulalongkorn University, 2002

This paper is trying to investigate whether the probability of the real estate price runs continuingly is conditional on the length of the run or not. Hence, the hazard specification is more suitable for our analysis.

Another advantage for applying the hazard function is that we can also employ the multi-parameters, which is a discrete density function.

$$h_i = \frac{1}{1+e^{-(\alpha+\beta lni)}} \quad \textbf{E6}$$

Here h_i means the condition probability of expansion or contraction phases terminate. The log-logistic function switches the unlimited range of α+βlni into the (0,1) interval. The null hypothesis of no duration means the probability of an expansion or a contraction ending is independent from the length of the expansion or contraction. In the terms of the model, the null hypothesis of no duration dependence is that β=0, the hazard rate is constant.

The relationship between hazard rate and density function can be written as following:

$$h_i = \frac{f_i}{1-F_i} \quad \textbf{E7} \quad \text{and} \quad f_i = h_i \prod_{j=1}^{i=1}(1-h_i) \quad \textbf{E8}$$

The log likelihood of density function is:

$$lnL(\theta|S_T) = \sum_{i=1}^{\infty} N_i lnf_i \quad \textbf{E9}$$

Rewriting earlier formulation, we will get the log likelihood function which includes hazard rate and the counts we can observe immediately:

$$lnL(\theta|S_T) = \sum_{i=1}^{\infty}[N_i ln\, h_i + M_i ln(1-h_i)] \quad \textbf{E10}$$

As shown earlier, $lnL(\theta|S_T) = \sum_{i=1}^{\infty}[N_i ln\, h_i + M_i ln(1-h_i)]$ **E10** here is performed as following：

$$lnL(\alpha,\beta|S_T) = \sum_{i=1}^{\infty}[N_i ln\, h_i + M_i ln(1-h_i)] \quad \textbf{E11}$$

We maximize the log likelihood function with respect to α and β. Under appropriate description of the data set, hazard rate can be estimated with a logit regression. The independent variable is the log of the length of the run and the dependence variable is 1 or 0 depend on the run ends or not in the next period. The likelihood ratio test (LRT) of $\beta=0$ is asymptotically a $\chi 2$ distribution with one degree of freedom. Moreover, if we get a significant positive β, that will mean duration in the run or phase is increasing the possibility of termination, there is said to be positive duration dependence. On the contrary, if β is significant and negative, duration is decreasing the likelihood of end, there is negative duration dependence.

1.7.2 Logit model

Now, let's turn our attention to regression model for dichotomous data. In this model, they suppose the dependent variable Y is quantitative, whereas the explanatory variables are not only quantitative but also qualitative. In the regression model, dependent variable only can take value 1 or 0. But dummy variable and quantitative are both allowed in independent variables.

According to above situation, the most commonly way to estimating such model is the linear probability model. However, there are some problems associated with the employ of linear probability model such as no fulfillment of $0 \le E(Y|X) \le 1$, or R^2 cannot used be standard measure the goodness of fit , and so on .

Linear probability model is not academically a very suitable model since it assumes that P_i= *E(Y=1|X)* rises linearly with X, that is, the marginal effect of X keeps commonly constant. However, this sometimes it seems not to be so strict.

Consequently, the model which we can adopt must possess two characteristics:

1) With X increase, the *Pi*= *E(Y=1|X)* increases but only in range [0,1].
2) The relationship between *Pi* and *Xi* is non-linear, in this case, approaches "one" which approaches zero with a slower and slower rates as *Xi* gets small and approaches one at slower and slower rate as *Xi* get very large.

The logit model can perfectly fulfill above two features. Logit regression is an approach that uses to estimate the probability of an event to occur or not, we have binary data as dependent variable, the set of independent variables can be dummy variables or continue random variables.

In our case where the dependent variable, Y=1 is if one month in an expansion or contraction will end in the next period or (0) not, X is *lni*, I is the length of this phase. The linear probability Model describe is as following:

$$P_i = E(\,Y = 1 \mid X_i\,) = \alpha + \beta\, X_i \quad \textbf{E12}$$

Our hazard rate function is:

$$P_i = E(\,Y = 1 \mid X_i\,) = h_i = \frac{1}{1+e^{-(\alpha+\beta lni)}} = \frac{1}{1+e^{-Z_i}} \quad \textbf{E13}$$

Where $Z_i = -(\alpha + \beta\, X_i)$

In E13 Zi is known as ranges from -∞ to +∞; not same as Z_i, the interval of Pi is (0, 1), P_i is non-linearly to Z_i, however P_i is nonlinear not only to X but also to α and β. These imply that Ordinary Least Squares procedure cannot be used to estimate α and β.

Hence, we have to process logit transfer, bring in the survival function which is simply one minus the hazard rate.

Survival function present as$(1 - h_i)$, here is$(1 - P_i)$,

$$1 - P_i = 1 - h_i = \frac{1}{1+e^{Z_i}} \quad \textbf{E14}$$

Then, Combination and rewrite the formula:

$$\frac{P_i}{1-P_i} = \frac{h_i}{1-h_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \quad \textbf{E15}$$

Where $\frac{p_i}{1-p_i}$ is the odds, simply, it is the ratio of the probability that a phase will terminate at time i to the probability that a run won't end at i.

Taking natural log of odds, we can get,

$$L_i = \ln\,[h_i/(1 - h_i)] = \mathrm{Zi} = \alpha + \beta\, X_i \quad \textbf{E16}$$

The state of the logit model

The linear probability model supposes that the P_i is linearly related to Xi, the logit model assumes that the log of odds is linearly related to Xi. Here, L is linear in X, however, the probability of a run will end is not linear in X.

We can interpretation the logit model as following: β means the relative change in the odds due to a small change ∆x in *Xi*. If *X* is a dummy variable valued1or 0, βmeans when *X* adopts 1, comparing with *X* adopts 0 how much the log of odds will also change.

The linear probability model supposes that the Pi is linearly related to *Xi*, the logit model assumes that the log of odds is linearly related to *Xi*.

1.7.3 General Logit mode

We can generalize the logit models to several explanatory variables, suppose the hazard function is a function of covariates such that:

$$h_i = \wedge\, (\beta_0 + \beta_1 X_1 1 + \beta_2 X_2 + \cdots . + \beta_p X_p) = \frac{1}{1+e^{-x_i' \beta}} \quad \textbf{E17}$$

Equivalently,

$$ln \frac{h_i}{1-h_i} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots . + \beta_p X_p \quad \textbf{E18}$$

Where *Xi* is a vector of covariates and β is a vector of regression coefficients. The X's in the linear predictor can be as general as in the general linear model, including, for instance:

¬ quantitative explanatory variables

¬ transformations of quantitative explanatory variables;

¬ dummy repressors representing qualitative explanatory variables

¬ interaction regressor

1.7.4 Estimate Logit mode

First, we must calculate the estimated probability of a run end at i.

$$h_i = \frac{N_i}{N_i + M_i} \quad \textbf{E19}$$

Where N_i is the count of runs of length i and M_i is the count of runs with a length great than i.

Secondly, for each length i, we can get the log of odds also called Logit as

$$\widehat{L_\iota} = ln\left[\widehat{P_\iota}/\left(1 - \widehat{P_\iota}\right)\right] \quad \textbf{E20}$$

Then, run to most important step: transform the logit regression to avoid the heteroscedasticity as following:

$$\sqrt{W_i}L_i = \sqrt{W_i}\alpha + \sqrt{W_i}\beta\, ln\, i + \sqrt{W_i}\mu_i \quad \textbf{E21}$$

Where the weights $W_i = (N_i + M_i) \times P_i/(1 - P_i)$

Use OLS framework and test hypothesis, all conclusions will be valid strictly when the samples are relatively large. The same way can be applied estimate the generate logit regression model.

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1.7.5 Null hypothesis of logit model

To start with testing joint significant, to confirm the whole model we found is statistical significant, in this case, testing whether total covariates coefficients are zero.

Null hypothesis:

H0: $\beta_1 = \beta_2 \ldots = \ \beta_p = 0$

Alternative hypothesis

H1: $\beta_1 .. \beta_2 \ldots \ \beta_p$ (Not all of the covariate coefficients are zero)

It is also likelihood ratio test, the full model is:

$$logit\ H = ln\frac{h_i}{1-h_i} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \ \beta_p X_p \qquad \textbf{E22}$$

The null model is:

$$logit\ H = ln\frac{h_i}{1-h_i} = \beta_0 + 0X_1 + 0\ X_2 + \cdots . + 0\ X_p \quad \textbf{E23}$$

Both two models produce a maximized likelihood: L_1 for the full model, L_0 for null model.

The generalize likelihood ratio test statistic for the null hypothesis is:

$$\text{G} = 2\ln L_1 - 2\ln L_0$$

G can present how much the fit goodness proves when compares full model with null model. Under the null hypothesis, this test has an asymptotic χ^2 distribution with p degrees of freedom. We can test the whether the single covariates coefficient with likelihood ratio test in spite of the most commonly approach is Wald test , since the likelihood ratio test is less prone to breaking down than the Wald test.

1.7.6 Interpretation of coefficient in the survival model

To understand the meaning of β, here we introduce two concepts: Odds and Odd ratio (OR).

The Odds is the ratio of the probability that something is true divided by the probability that it is not true. Thus, in our logit model,

$$Odds(x) = \frac{h_i}{1-h_i} = exp(\alpha + \beta X_i) = e^{\alpha}(e^{X_i})^{\beta} = e^{\alpha}\left(e^{\beta}\right)^{X_i} \quad \textbf{E24}$$

The odds ratio is the ratio of two odds for different values of X_i, set $X_i = x$ and $X_j = x + \triangle x$

$$Odds\ ratio = \frac{Odds(x+\triangle x)}{Odds\ (x)} = \frac{exp(\alpha+\beta x+\beta \triangle x)}{exp(\alpha+\beta x)} \quad \textbf{E25}$$

Assume

$$ln\frac{h_1}{1-h_1} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots . + \beta_p X_p \quad \textbf{E26}$$

Then X_1 increased by one

$$ln\frac{h_2}{1-h_2} = \beta_0 + \beta_1 (X_1 + 1) + \beta_2 X_2 + \cdots . + \beta_p X_p \quad \textbf{E27}$$

Use E27 minus E26,

$$ln(\frac{h_2}{1-h_2})/\left(\frac{h_1}{1-h_1}\right) = lnOR = \beta_1 \quad \textbf{E28}$$

So β can be interpreted as the relative change in the log of Odds with independent variable *X* increasing by one unit, hold other variables fixed. Usually we can find a more realistic interpretation of coefficient β_1, with $\text{Odds Ratio} = \exp \beta_1$, it's the advantage of logistic transformation.

So, $\exp\beta$ is multiplicative effect on the odds with increasing X by 1, while holding the other X's constants. There is no simple way to express the effect on the probability of increasing a predictor by one unit while holding the other variables constant in logit model.

Table 2 comparison of hazard rate odds and Logit

Hazard rate	Odds	Logit (ln of odds)
0.01	0.010101	-4.59512
0.05	0.052632	-2.94444
0.1	0.111111	-2.19722
0.25	0.333333	-1.09861
0.3	0.428571	-0.8473
0.45	0.818182	-0.20067
0.5	1	0
0.65	1.857143	0.619039
0.7	2.333333	0.847298
0.8	4	1.386294
0.99	99	4.59512

Through comparison of the values Table 2, we can find that among hazard rate, odds and log-odds appear a uniform orientation when they are changing. Recording to actuality, hazard rate rises with the increasing of log-odd. for this reason, The relationship between hazard rate and independent variable can be found by the sign of β, as an illustration, suppose β of X_1 is positive, that mean when rising X_1 , log-odds will upward, the odd ratio increasing , as well as hazard rate . We can say that X_1 and hazard rate have a positive relationship.

Indeed, we can get check the partial of independent variable on the probability of the phase ends by taking the partial derivative with respect to independent variable X.

$$\frac{\partial h(y=1 \mid x)}{\partial x_p} = \frac{\partial\left[e^{\alpha+\sum \beta_p x_p}/\left(1+e^{\alpha+\sum \beta_p x_p}\right)\right]}{\partial x}$$

$$= \frac{\beta_p e^{\alpha+\sum \beta_p x_p}}{\left(1+e^{\alpha+\sum \beta_p x_p}\right)^2}$$

$$= \beta_p \frac{e^{\alpha+\sum \beta_p x_p}}{\left(1+e^{\alpha+\sum \beta_p x_p}\right)} \frac{1}{\left(1+e^{\alpha+\sum \beta_p x_p}\right)}$$

$$= \beta_p h(1-h)$$

Thus, the effect of independent variables x_p on the probability ofh_p depends on the product coefficient β_p times $h(1-h)$. Because of the value of $h(1-h)$ is always positive, so, the sign of partial effect depends on β_p.

In our duration model, the duration variable is Napierian logarithm of the length of a run, it's lnx_p.

$$\frac{\partial h(y=1 \mid x)}{\partial x_p} = \frac{\partial\left[e^{\alpha+\beta_p lnx_p+\sum \beta_{p-1} x_{p-1}}/\left(1+e^{\alpha+\sum \beta_p x_p}\right)\right]}{\partial x_p}$$

$$= \frac{\beta_p e^{\alpha+\sum \beta_p x_p}}{\left(1+e^{\alpha+\sum \beta_p x_p}\right)^2} \times \frac{1}{x_p}$$

$$= \beta_p \frac{e^{\alpha+\sum \beta_p x_p}}{\left(1+e^{\alpha+\sum \beta_p x_p}\right)} \frac{1}{\left(1+e^{\alpha+\sum \beta_p x_p}\right)} \times \frac{1}{x_p}$$

$$= \beta_p h(1-h) \times \frac{1}{x_p}$$

$$\frac{\partial h(y=1|x)}{\partial x_p/x_p} = \beta_p h(1-h)$$

There is a little difference when we explain marginal effect when independent variables are exponential forms. The marginal effect means, one percent change in duration will elevate the probability a phases ends in next period by $\beta_p h(1-h)$ unit.

A lot of dissertations place a strong emphasis on the sign and significant of coefficient and explain using odds instead of marginal effect. Otherwise there are few of emphases on the size of marginal effect, unlike scholarship in other fields, most economist let alone use marginal effect in their work.So far, there are three common methods to calculate the marginal effect, we list following:

1. The simplest way is that adopt the mean value of binary dependent variable to calculate the value of $h(1-h)$.

2. Marginal Effect at Mean (MEM). We calculate MEM by setting all of independent variables at their mean value, and then count the product of hazard rate and survival rate. And then check how a change in one unit (or one percent) of x_p variables changes the hazard rate, in short, probability of dependent variable equals one.

3. Average Marginal Effect (AME). With AME, marginal effect is computed for each case, in other words, put each observation in the logit equation and count the corresponding hazard rate, and then marginal effect in each case. These effects are then averaged.

Generally speaking, MEM is widespread and easier to understand, however, the MEM result may be unrealistic scenarios when independent variables include dummy variable or independent variables are highly correlated. On this account, researchers prefer AME, they consider AME provides a better representation of how changes in independent variables influence the probability of dependent variable equals one. In our paper, we list not only AME but also MEM, the numerical interpretation is same, we can observe the difference AME and MEM, and it may give some references for further research. Relative technique is represented in detail in Appendix B.

CHAPTER II

LITERATURE REVIEW

2.1 Main determinants of real estate prices

In concise, real estate price is a hot topic in current economic research. Some of the economists analyze the factors which effect house price from microeconomic and macroeconomic view. A majority of macroeconomic factors used in this analysis are GDP, income, consumer price index, inflation rate, government tax and real estate policy, population growth and then vacancy rate etc.

On the other hand, residential environment, the property of building (such as the afforestation rate or ancillary facility), as well as the location advantage, are considered as micro level factors. Li (2010) claimed the population in city, resident income, individual deposit, interest rate and inflation rate had significant influence on commercial real estate. In addition, living space in a house, natural lighting and viewpoint, house vacancy rate are important determinants by Quigley, J (2005) opinion. Moreover, according analyzed real estate price of Hong Kong, Choy, L.H.T., Mak, S.W.K., and Ho, W.K.O (2007) believed that house age and seascape, transportation facilities dominate the real estate price.

To Wachter, S.M., Pavlov, A.D., and Pozsar, Z (2001) opinion, there is a close relationship between real estate cycle and financial cycle, thus, he added some financial sectors to decompose the determinants of real estate, which are expected growth income, anticipated real interest rate, tax, availability of credit resource, moreover, demographic situation as a micro level factor .

Wit, I.D., and Dijk, R.V (2003) strongly approved that the vacancy rate and unemployment rate drive the real estate returns. In their case, GDP, inflation rate, unemployment, vacancy rate, and store are treated as independent variables, all of them have an effect on real estate return.

Zeng, Z.X., and Jin, Y (2004), his study presented that monetary policy and nominal interest rate affect house price. Moreover, tax is considered that a factor has influence on real estate market. In addition, a powerful correlation between house price and GDP was demonstrated. In Zhen's research, he found a general equilibrium model that discussion the relationship between business cycle and residential investment as well as real estate price.

Mavrodiy (2005) analyzed almost all of the determinants which have effect on real estate market with Kiev's relevant data. His analysis referred that there is the direct relationship between GDP, resident income, population and housing price. Interest rate has a negative effect on real estate price. For the overview, at microeconomic level, the location and qualitative attribute reveal significant influence on house price.

Moreover, there also were a lot of researches studied the real estate house price relative to fundamental determinants. These fundamental determinants generally used in a basic demand and supply model. By summarizing the findings of these studies, several main demand side factors can be pointed out: household income, GDP, mortgage rate, and rent price, property tax and so on. Land cost, construction cost, and the land control policy and development technology were included in supply factors.

Glaeser, Gyourko, E.J., and Saks, R (2005) illustrated the house price function from demand and supply view as following:

Demand: $Q_D = f(P, Y, W, N, [(1- ty) (Rm+ tp) + d – cg])$

Supply: $Q_S= f(P, C, Z)$

$P^* = F(Y, W, N, [(1- t_y) (Rm+ t_p)+ d – cg]; C, Z)$

Where P is house price, Y is resident income, W is wealth, N means population ,mortgage interest rates is Rm. t_p predicts tax rates, t_y represents income tax rates, maintenance and repair costs (d), and expected capital gains (cg). C is construction cost, Z measures the probability developers can obtain the land exploitation right.

Sun, D., Guo, H., and Gao, Y (2011) considered the effect on income change as a shock on the house price, the change rate of real estate price has a oscillatory relationship with price elasticity of house supply. They built a VEC model within house price and average income as variable. Analyzed with 1987-2008 data in China, they proved that there is a long-run co-integration relationship between house price and average income, the long-run supply of real estate market is short of elasticity. Income variation has a strong effect on house price in short-run.

Zhao (2010) studied the dynamic model about macroeconomic and real estate price. He used structural vector autoregressive (SVAR) model to test the impulse response. The results present a positive house price shock will lead to inflation rate and the growth rate of GDP going up to a new level, conversely, decrease the growth rate of money supply. Furthermore, positive supply, demand shock and monetary police shock will raise the increase rate of house price.

Liang, Y.F., and Gao, T.M (2007)'s study discussed real estate price determinants in various regions in China. Error correction model is adopted to examine house price fluctuation diversity in eastern China, central region and western China. Subsequently, they analyzed the factors which contribute to house price fluctuation in above three regions. Liang, Y.F., and Gao, T.M (2007) alleged that credit quota drives house price rise and fall in western and eastern China, rather than central China. Besides, real interest rate has no relationship with real estate price change in all three regions in

China. Price expectation has large influence on house price volatility in eastern China. Per capita income is not the main house price determinant. However, Liang,Y.F., and Gao, T.M (2007) didn't illuminate how those house price factors act on the house price.

It has been proved that land price is the substruction of real estate price formation in monolithic areas in China by Pan, X., and Wang, T (2011). Simultaneously, inflation enhances house price in Chinese eastern since consumers treat real estate as hedging tool. Overall, construction investment price index and urban consumer price index are crucial elements. Afterward, land price, rental index, transportation route and per capita income have fairly large impact on house price index. Furthermore, this research supports that exorbitant house price in eastern China is induced by undue investment in real estate market. On the contrary, economic growth in central and western China lags comparatively, as a consequence, demand is prime factor in house price change. Pan, X., and Wang,T (2011)'s work is based on 31 cross-sections data in 2008, time correlation is neglected, the result may isn't complete.

Ma (2011)'s work contains a number of innovative and minute insights in real estate price determinants in difference areas of China. Principal consumers in Chinese western and central provinces purchase for living. Per capita GDP is the basic factor which drives house price in western and central provinces, however, it's not in eastern area. Per capita commodity house sale area has significant influence on house price in eastern rather than other regions in China. On the whole, dense speculative atmosphere and well-developed financial sector explain real estate price change in estate provinces. By comparison, fundamental macro-economic factors dominate house price in western and central China.

Contrary to Liang, Y.F., and Gao, T.M (2007), Wang (2011) considered that the impact of credit quota and interest rate are notable diversity in disparate regions in China. Monetary policy can inhibit real estate price more efficiently in eastern China than others areas.

Difference with the majority of literatures, Luo,G.Q., and Zhao, T (2010) pointed out that per capita disposable income, per capita GDP and growth in population have significant positive effect on eastern house price, meanwhile the influences of consumer price index, building construction cost and interest rate on real estate price are relatively weak. The major real estate price determinants in central China are disposable income, CPI and interest rate change. Population density, per capita GDP and construction cost have slight impact on house price. To western China, CPI, interest rate and construction cost are dominant price determinants, moreover, disposable income, per capita GDP and population don’t control real estate price.

2.2 Duration dependence

In the past, survival analysis is invented and used in biomedical area to estimate patient's time to death and the treatment effect. In economics, survival model (also called hazard model or duration model) is widely used to study the probability of exiting from a given phase as well as the length of time that an individual keeps up its current situation, for an instance, unemployment, bankruptcy and so on. These studies often required test whether the length the current state remained impacts the possibility of continuation or exit from this state. In the duration model, scholars test whether the duration of the current phase affects its hazard rate, directly speaking, and its ending probability conditional on having survived to the current situation.

There are a lot of literatures that apply survival model to analysis economic cycle, in commonly, business cycle or stock market bubble. In general, most researches that test for duration dependence found that business cycle contraction exhibit positive duration dependence. Nevertheless evidences of duration dependence in expansion somehow have a mixed result.

Layton, A.P., and Smith, D.R (2006) tested US business cycle with annual data from 1949-2002, they considered there were positive duration dependence both in business recessions and expansion. However, the positive duration dependence appeared from time to time.

In Ohn, J., Taylor, L.W., and Pagan, A (2004) research, they studied not only business cycle but also stock market cycle. They divided time into two periods, pre- the Second World War and after- the Second World War. They came up with attitudes positive duration dependence in pre- and after-war contraction. Moreover, there are positive duration dependence in bull and bear markets.

Compared to Layton, A.P., and Smith, D.R (2006), Lam, P.S (2004) claimed negative duration dependence occurs in American business expansion and positive duration occurs in contraction, after studied American business cycle using data 1952-2001.

Mills, T. C (2001) examined output per capita in 22 countries and found that for peak-to-peak and trough-to-trough horizons, both Canada and the American don't exhibit duration dependence. Mills' results differ when the sample is divided into expansions and contractions. He finds that there are more evidences of negative duration dependence in contractions than expansions across countries. Canadian expansions and contractions and U.S. contractions are found to exhibit negative

Diebold, F.X., Rudebusch, G.D., and Sichel, D.E (1991) examined business cycle for American, France, and Germany, Great Britain within annual data from 1854-1982. They approved of less duration dependence in post-war U.S. business cycle expansions, more duration dependence in post-war contraction. Positive duration dependence was found in pre-war expansions of four countries.

Majority duration dependence tests which applied in stock market are in order to estimate stock bubble. If there is a bubble in stock market, then, the duration dependence test result must show that there is duration dependence in stock price market.

Stock market bubble and duration dependence test by McQueen, G., and Thorley, S (1994), the first paper which test duration dependence based on the log-logistic function transforms.

The test specifically addressed nonlinearity by allowing the parameters (probabilities of ending a run) to vary depending on the length of the run and on whether the run belongs to positive or negative abnormal returns. If bubbles are present, then the probability that a run of positive abnormal returns ends declines with the length of the run. As a matter of fact, run belongs to positive abnormal returns, but not negative abnormal returns will exhibit positive duration dependence or a negative survival function.

According to Yvette, S.H., and Zuehlke, T.W (2005)'s work, the evidence was found that duration dependence is not monotonic in American, the sample data is from 1927 through 1997. The estimated duration elasticity is initially positive, but becomes negative as the duration of the run in abnormal returns increases. The significant duration dependence found in runs of both positive and negative abnormal returns is inconsistent with the model of rational speculative bubbles proposed by McQueen and Thorley (1994).

Quan (2003) analyzed rational speculation bubbles in Chinese stock market.

He believed that there is negative duration dependence in positive abnormal returns. In addition, the rational speculation bubble in A share market is larger than rational speculation bubble in B share market. Furthermore, the rational speculation bubble of Shanghai's A share market is larger than the rational speculation bubble in Shenzhen's A share market.

In Zhang, B., and Li, X.D (2002) opinion, negative duration dependence appears in positive abnormal returns. Therefore, they rejected the null hypothesis: no bubble in Chinese stock market. By contrast, there is no duration dependence in negative abnormal returns.

Besides, Wanida Ngienthi (2002) tested duration dependence based on abnormal continuously compounded real monthly returns for value-weight portfolio of all stock in stock exchange of Thailand. The result presented that there is no duration dependence in Thailand stock market. In the other words, no evidence supports that bubble appears in both positive and negative abnormal returns in Thailand stock market.

Although this is true, duration dependence test is popular to analysis bubble and business cycle, however, relatively less literatures analysis house market cycle or house market bubble applying duration dependence test, extremely Chinese house market.

The first paper that applied this model focused on the question of duration dependence in real estate market Diebold, F. X.,and Rudebusch,G.D (1990): does the probability of an expansion or contraction in house cycle termination change with its duration? Afterward studies have modeled the exit from expansion and contraction adding other explanatory variable Castro, V (2011).

Bracket, P (2010) used a hazard model to study the duration of house price expansions and contractions in 19 OECD countries. Separate the house price data into two parts, expansions and contractions. He identified three series of expansion and contraction for each countries, they are t=4, 6, 8 which indicate one year, one year and a half, two years.(Bracket,P.,2010) estimated a complete model that includes the relevant explanatory variables, price–income ratio, and GDP growth, short–term real interstate rate using a complementary log-log model. Evidence found that longer expansions are followed by longer contraction. Furthermore, high price-income ratio and changes in interest rates make expansions more likely to end.

Another IMF working paper written by Bracket, P (2012) studied the duration of house price upturns and downturns in the last 40 years, with the same data as the earlier research, 19 OECD countries. He provided two sets of results, one pertaining to the average length and the other to the length distribution with applying a nonparametric model to analysis duration dependence. At average level, upturns are longer than downturns, but the different disappears once the last house price boom is excluded. On the other hand, upturns are more likely to end as their duration increase, in this case, there is positive duration dependence in upturns period. However, he had no evidence to demonstrate the duration dependence in downturns phase. Moreover, this duration dependence is consistent with a boom-bust view of house price dynamics, where booms represent departures from fundamentals that are increasingly difficult to sustain.

Cunningham, R.,and Kolet, I (2007) claimed house market in American and Canada have positive duration dependence in expansions, while contractions seem to have no duration dependence.

There are some summary of literature on duration dependence analysis in Table 3 As I have shown in the following Table 3, someone analysis duration dependence employing Markov switching model. There is a few diversity between hazard model and Markov switching model, which one to adopt, it's depend on what's you focus on.

Table 3 summary of literature about Markov-switching and survive model

Author name	Study object	Model and data	Conclusion
Zuehlke,T.W,2002	U.S. Business cycle	Weibull hazard model Prewar1854-1938 Postwar1945-2001	Prewar both expansion and contraction have positive duration dependence as well as postwar
Lam, P.S.,2004	U.S. Business cycle	Regime-switching model 1952:2-1996:4.	Negative duration in expansion and positive duration in expansion
Castro,V.,2012	Portuguese stock market cycle	Duration dependence Markov-switching model 1989-2010.	Positive duration dependence in bear market, no duration dependence in bull market
Bracket,P.,2012	House price cycle	Hazard model panel data of 19 OECD countries, 1970-2010,	Positive duration dependence in upturns and no duration dependence in downturns, price-income ratio and changes in interest rates have positive effect on the hazard rate in boom .price-income ratio and interest rate have negative effect on hazard rate in contraction phase, on the contrary, GDP has a positive relationship with hazard rate
Layton,A.P.,and Smith, D.R.,2003	US business cycle	Markov-switching models 1/1949-12/2002	Positive duration dependence in expansion and weakly positive duration dependence in contraction
Zuehlke,T.W,1987	House market	Hazard model Cross-section data 290 single-family in Florida	Positive duration dependence for vacant house however no duration dependence for occupied house
Lunde,A.,andTimmermann,A.,2004	US stock market	Hazard model 1885.2.17 to1997.12.31	Negative duration dependence in bull market and positive duration dependence in bear market
McQueen,G., and Thorley, S.,1994	US stock market	Hazard model Monthly 1927 to 1991	Positive duration dependence in positive abnormal returns. No duration dependence in negative abnormal returns
Yvette,S.H., and Zuehlke, T.W.,2005	US stock market	Hazard model From 1927to 1997	Negative duration dependence in both positive and negative runs of abnormal real returns
Cunningham,R.,and Kolet,I.,2007	US house market cycle	Hazard model Panel data with 134 city From 1976 to 2005	Positive duration dependence in expansion of house market , no duration dependence in contraction phase Income has a negative effect on hazard rate , interest rate ,population growth have positive effect on hazard rate in expansion .income has positive effect on hazard rate and interest rate and population have negative duration dependence in contraction phase .

CHAPTER III

DATA AND RESEARCH METHODOLOGY

3.1 Data and variables

3.1.1 Data

To analysis duration dependence in Chinese real estate market, we use panel data which contains relatively more observations. The data set is divided into two parts base on the different model.

In duration dependence test without determinates model, we use monthly level data; the dataset contains 26 provinces and 4 municipalities. Data covers 114 months, from January 1st, 2003 to May 1st, 2012.

For the hazard model with fundamental factors, the data has quarterly observations, spanning from first quarter of 2003 to the first quarter of 2012.

The panel data is not strong balanced, as some provinces enter the data later or miss several data. Jilin province lacks of the first two months price data in each year from 2003-2011， Qinghai lacks of first two months price data in each year from 2003-2012，expected 2011. Inner Mongolia lacks of lacks of first two months price data in 2003, 2009, 2010, and 2011. Completed Building Construction Area covers data from the first quarter of 2004 to the third quarter of 2012.

The main sources of data are CEIC, National Bureau of statistics of China and website of Bank of China.

3.1.2 Fundamental Variables

We select the independent variables which affect the house price from both real estate demand and supply sides, referring to the previous researches. Each variable is interpreted in detail below.

1.Real estate price

In this paper, real estate price is Commodity building Selling Price per square meter. As an important weather vane, in contraction, from the Equilibrium price model view, decrease of house price leads to house demand increase, the contraction may exits. Contrary to contraction, in a price upturns, growth price diminishes the demand for house and exorbitant house price might imply that an overheating in real estate market and real estate price tends to the peak of house price. Selling real estate should be intellectual. All these activities impel the price expansion to exits.

2. Consumer Price Index

We use consumer price index to present inflation in China. Higher inflation makes consumers to buy a real estate for keeping value. And so, expansile house demand raises the house price. It’s expected to have a positive influence on hazard rate in recession and negative influence on hazard rate in expansion.

3.Land price

As a crucial component of house cost, land price should dominate house price conspicuously. Because of Chinese National Statistics Bureau announces only city level land price index, consult previous literatures, we adopt land price index of provincial capital city to instead of provincial land price index . In some province we use the average land price index in main cites of this provinces. House construction cost goes up with land price. As a result, house price jumps. The variable is expected to have a negative impact on hazard rate in house price upturn and positive impact on hazard rate in contraction.

4.Rental price

Same with land price, we replace provincial rental index with city-level rental price index. Growth rental enhances the willingness of agents to buy a house. Extensive house demand stimulates house price. We consider there is positive effect on hazard rate in contraction and negative effect on hazard rate in expansion.

5.Individual housing common reserve fund rate on loan

Individual housing common reserve fund rate on loan mirrors household's debt financial condition. It is five years up long time loan rate. Growth in loan rate may increase the cost of house purchasing, retrenches house purchasing demand. Since, it tends to reduce the probability of a bust ends, besides, increase the possibility of a boom exits.

6.Average income per capita

Income growth, consumer would like to take more debt and spend more money on house. We may hence meet higher income being positive associated with higher possibility of a contraction terminates and lower possibility of an expansion ends.

7.Completed Building Construction Area

Completed Building Construction Area indicates real estate supply. Supply growth, reduces the equilibrium price. It is expected that has positive impact on hazard rate of expansion and negative impact on hazard rate of recession.

8.Decade variable:

As mentioned above, Chinese real estate policy control was distributed into three stages basing on the regulation direction. Considering the influence of government's macro-policy, we put a Categorical variable into the robustness model. The value of categorical variable is presented following:

Table 4 value of decade variable

Time range	Value of categorical variable
2003Q1-2008Q3	1
2008Q4-2009Q4	2
2010Q1-2012Q2	3

Interpretation of categorical variables in logit model is complex and controversial. Therefore, in our model, we just inspect the significant of decade variable, if coefficient of decade variable, we consider that governmental macro-policies are resultful in real estate market regulation.

3.2 Research Method

We use two main types of models in our paper. Both of them are estimated by panel logit model.

In theoretical point of view, the applying of logit modeling way in a panel framework supports to capture potential “trigger effect” in real estate market because of their corporate degree of cyclicality and synchronization, meanwhile, to estimate the probability of simultaneous expansion or contraction in house market of different province.

From an economic perspective, adopting a panel data has several merits. Think about that, for each province, the number of discerned expansion and recession is relatively small. The estimation of logit model on a province –by –province basis is not recommended since the robustness of the result may be unreliable. The characterizations of panel data usually afford more observations and enhance the degree of freedom, which presumably make the result more precise. What’s more, the information includes not only cross-section but also time series variables, which can adequately decrease the omitted variable problem.

There is little literature highlighted the heteroscedasticity problem in panel logit model. At present, heteroscedasticity test and control in panel logit model still be blindness in econometrics .Some people Bracket, P (2010) and Cunningham, R., and Kolet, I (2007) support to exploit fixed-effect in the model may avoid this problem to some extent. For this reason, we make use of fixed-effect panel logit model, after all models pass the Hausman test.

Starting with identifying the expansion and contraction in real estate market, if real estate price grows consecutively for two or more months (quarters), we can say this period is price expansion. In the same way, if average real estate price continually falls for two or more months (quarters), it must be in a contraction phase. Second, we divide the data into contraction and expansion part.

The set of dependence variable is same in all models. We set Y_{tj} is a binary variable which Y_{tj}=1 if the phase of province j ends in the next month quarter), if not, Y_{tj}=0. In our database, there are a few of months, the number of price is same with previous month, and we treat the situation as special and small probability event. In our research, these months will define same with last month. For instance, the house price of December 2003 is 4736.6 RMB/Sqm in Beijing, lower than November 2003, house price is 4515.7 RMB/Sqm in January, 2004 and the price in February is same with January 2004. We define that December 2003, January 2004 and February 2004 are in real estate price recession.

Duration means the months (quarters) that real estate price goes up or down ceaselessly. In our duration model, the napierian logarithm of a phase’s length is adopted. Likewise, a one period lagged price variable was added to the models in the second part to examine the lag effect of price, frankly speaking, the house price expectation’s effect. In the first place, we test the duration dependent in Chinese real estate market in expansion and contraction of overall China, coast and inland regions.

Secondly, we test the effect of fundamental factors on hazard rate in both expansion and contraction phase. Same process will be executed for three times base on three regions.

3.2.1 Duration Model

We perform test of duration dependence based on the logistic transformation of lni, $h_i = \frac{1}{1+e^{-(\alpha+\beta lni)}}$. Furthermore run the Log-logistic Test.

Overall duration dependent test,

$$ln\frac{h_{tj}}{1-h_{tj}} = \alpha + \beta lnI_{tj} \quad \textbf{Model 1}$$

h_{tj} Means the probability of province j will exit the current phase in period $t+1$

Null hypothesis: no duration dependence in Chinese house market

For coastal provinces,

$$ln\frac{h_{t'j}}{1-h_{t'j}} = \alpha + \beta lnI_{t'j} \quad \textbf{Model 2}$$

Null hypothesis: there is no duration dependence in Coastal real estate market, in this case, the length of a price phase doesn't affect the possibility the price phase will end in next month.

For inland provinces:

$$ln\frac{h_{t''j}}{1-h_{t''j}} = \alpha + \beta lnI_{t''j} \quad \textbf{Model 3}$$

Null hypothesis ： There is no duration dependence in inland, in other words, the length of an expansion or contraction phase doesn't affect the possibility the price phase will end in next month

Every model will be test twice, make use of expansion and contraction data separately. Then, we can analysis and compare corresponding result

3.2.2 Duration Model with determinants

Duration model with determinants controlling in overall China,

$$\ln \frac{h_{tj}}{1-h_{tj}} = \beta_0 + \beta_1 lni_{tj} + \beta_2 INCOME_{tj} + \beta_3 RENTAL_{tj} + \beta_4 CPI_{tj} + \beta_5 RMORTGAGE_{tj} + \beta_6 BUICOM_{tj} + \beta_7 LAND_{tj} + \beta_7 PRATE_{tj} + \beta_8 LAGPRATE_{tj} + \beta_9 DECADE_{tj}$$ **Model 4**

In maximum likelihood estimation for whole Logit model, Null hypothesis is:

H_0: $\beta_1 = \beta_2 \ldots = \beta_9 = 0$

(Constant hazard rate mean there is no duration dependence in Chinese house price, Moreover, neither the fundamental factors can affect the hazard rate)

Alternative hypothesis:

H_1: $\beta_1 .. \beta_2 \ldots \beta_9$

Not all of the covariate coefficients are zero.

Duration model with determinants controlling in coastal regions:

$$ln \frac{h_{t'j}}{1-h_{t'j}} = \beta_0 + \beta_1 lni_{t'j} + \beta_2 INCOME_{t'j} + \beta_3 RENT_{t'j} + \beta_4 CPI_{t'j} + RMORTGAGE_{t'j} + \beta_6 BUICOM_{t'j} \beta_7 LAND_{t'j} PRATE_{t'j} + \beta_8 LAGPRATE_{t'j} + \beta_9 DECADE_{t'j}$$ **Model 5**

Null hypothesis ： No duration dependence in contraction of coastal house market, Moreover, neither the fundamental factors can affect the hazard rate.

Duration model with determinants controlling in inland region:

$$ln\frac{h_{t''j}}{1-h_{t''j}} = \beta_0 + \beta_1 lni_{t''j} + \beta_2 INCOME_{t''j} + \beta_3 RENT_{t''j} + \beta_4 CPI_{t''j} +$$

$$\beta_5 RMORTGAGE_{t''j} + \beta_6 BUICOM_{t''j} + \beta_7 LAND_{t''j} +$$

$$\beta_7 PRATE_{t''j} + \beta_8 LAGPRATE_{t''j} + \beta_9 DECADE_{t''j}$$ **Model 6**

Null hypothesis ： No duration dependence in contraction of interior provinces house market, Moreover, neither the fundamental factors can affect the hazard rate.

As I have stated, we cannot precisely know the effect on the probability by change the independent variable through regression coefficients β, however, we can estimate the partial effect by calculating through the sample mean of *X*.

To examine impact of these macro fundamental factors in different price phase, we test each model twice in order to investigate fundamental factors’ influence in real estate price expansion and recession.

CHAPTER IV

EMPIRICAL RESULT

4.1 Duration statistic description

Table 5 duration and price change rate in all regions

		duration			price		
		N	mean	max	mean	max	sd
Exp	overall	16.06700	4.60700	20	0.03947	1.23783	0.08811
	coast	16.33333	5.04081	20	0.03160	0.76044	0.05956
	inland	15.95238	4.38507	12	0.04363	1.23783	0.09974
Con	overall	10.70000	2.70000	10	0.03242	0.43395	0.05060
	coast	9.545455	2.81904	8	0.02272	0.31764	0.03504
	inland	10.78571	2.82450	10	0.03623	0.43395	0.05509

Note: Exp means expansion and Con means contraction

As we can see from the Table 5, as a whole, the average duration in Chinese real estate market is 4.607 months in expansion. The length of expansion is longer than contraction which is 2.7 months, as well as, price change rate mean 3.9% per month is larger than contraction 3.2% per month. Expansion has a considerable greater amount of runs than contraction. And then expansions have comparatively more real estate price fluctuation than contraction, with the standard deviation 0.088 lager than 0.05 in contraction.

From the region perspective, coastal provinces (cities)[3] and inland provinces have several points in common. Firstly, they have approximately the same number of runs not only expansion but also contraction. For contraction, the length of duration in coast is almost equal with inland provinces, about 2.8 months per contraction. Nevertheless, house price expansion of coastal provinces has about average one more month than interior provinces. The maximum price change amplitude has lager gap between coast and inland in price expansion than contraction.

In addition, we can survey the duration in variable panels. Beijing and Zhejiang has longest duration compared with other provinces in Table 6 and Table 7. October, 2005 to February, 2007, house price in Beijing rose incessantly. Likewise, in Zhejiang, from March 2009 to October, 2010, house price went up continually for 20 months. Coastal cities or provinces have relatively longer duration than others in price expansion. Nevertheless, then number of expansion in various panels has no notable disparity, most of them are in the range from 14-17. In Zhejiang, the mean of duration in expansion is 8.72 months, which is longest duration in our dataset. The appearance arises in part from: Zhejiang is the seminary of Chinese house flippers and speculators, they can get vaster fund from private lending to buy real estate.

[3] In following content, we use provinces to present provinces(cities)

Table 6 Expansion statistic descriptive

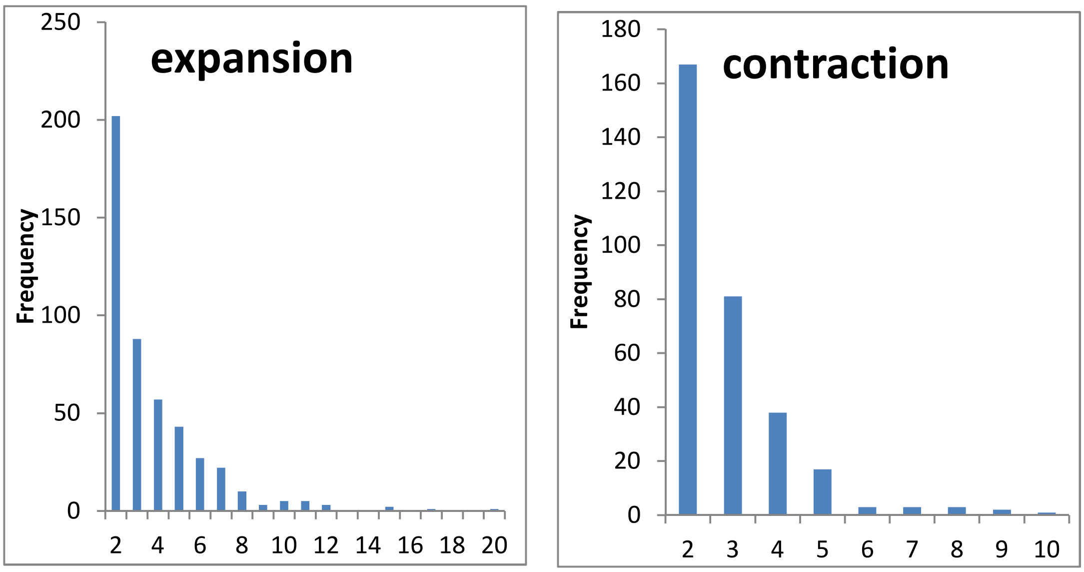
	duration			price			
	N	mean	max	mean	max	min	sd
Beijing	14	4.4286	17	0.04	0.3223	0	0.0595
Tianjin	16	5.125	12	0.0271	0.2218	0	0.032
Hebei	19	4.0526	4	0.041	0.3968	0	0.0734
Liaoning	15	3.7333	7	0.0624	0.3553	0	0.1098
Shandong	21	4.5714	8	0.0274	0.2271	0	0.0451
Shanghai	15	5.8	15	0.0256	0.2692	0	0.0423
Jiangsu	20	4.65	11	0.0202	0.1382	0	0.0298
Zhejiang	11	8.7273	20	0.0202	0.2237	0	0.0291
Fujian	15	5	10	0.0269	0.2394	0	0.043
Guangdong	19	4.1579	7	0.0288	0.2843	0	0.0543
Hainan	16	4.4375	6	0.0823	0.7604	0	0.1365
Guangxi	17	4.5294	11	0.0228	0.1475	0	0.0258
Jilin	6	2.5	3	0.1389	0.9649	0	0.2718
Heilongjiang	14	4.5	6	0.0464	0.3828	0	0.0835
Anhui	17	5.3529	12	0.0278	0.219	0	0.0431
Jiangxi	14	5.7143	12	0.0311	0.1552	0	0.0327
Hubei	13	4.3846	6	0.0432	0.1762	0	0.0494
Hunan	15	4.2	7	0.0473	0.3846	0	0.0857
Chongqing	21	4.2381	8	0.0315	0.188	0	0.0388
Sichuan	17	5.2941	10	0.0256	0.1957	0	0.0408
Guizhou	14	5.9286	10	0.0309	0.2405	0	0.045
Yunnan	20	4.05	8	0.0302	0.1684	0	0.0394
Henan	16	4.3125	8	0.0402	0.3879	0	0.0761
Shaanxi	20	4	9	0.0367	0.1844	0	0.0433
Shanxi	17	4.1765	7	0.0834	0.7107	0	0.1636
Inner Mongolia	16	3.6875	9	0.0713	1.2378	0	0.1944
Gansu	16	5.125	11	0.0748	1.1116	0	0.2066
Qinghai	15	3.2	6	0.0441	0.8613	0.00012	0.1333
Ningxia	15	4.0667	6	0.0378	0.182	0	0.0475
Xinjiang	18	4.2778	10	0.0494	0.616	0	0.1102

Table 7 Contraction statistic descriptive

	duration			price			
	N	mean	max	mean	max	min	sd
Beijing	10	2.7	4	0.0317	0.2283	0	0.0472
Tianjin	9	2.7778	5	0.0195	0.1184	0	0.0273
Hebei	12	2.5833	4	0.0357	0.1996	0	0.053
Liaoning	13	3.7692	10	0.0329	0.2351	0.000142	0.0432
Shandong	8	2.25	3	0.0289	0.1103	0	0.0306
Shanghai	8	2.75	4	0.0259	0.2252	0	0.0487
Jiangsu	6	2.3333	3	0.008	0.027	0.002146	0.0065
Zhejiang	7	2.5714	5	0.0103	0.0441	0	0.0127
Fujian	9	3.1111	6	0.0154	0.0559	0	0.0138
Guangdong	13	2.8462	7	0.0146	0.0816	0	0.0164
Hainan	10	3.6	8	0.0256	0.1537	0	0.0294
Guangxi	12	2.5	3	0.0177	0.0756	0	0.0213
Jilin	18	3.1667	9	0.0562	0.3687	0	0.0706
Heilongjiang	11	4.0909	9	0.0187	0.0664	0	0.0177
Anhui	8	2.375	4	0.0181	0.0767	0	0.0205
Jiangxi	12	2.25	4	0.0181	0.1352	0	0.0313
Hubei	11	3.3636	6	0.0216	0.103	0	0.0267
Hunan	14	2.7857	5	0.028	0.1382	0	0.0346
Chongqing	9	2.5556	5	0.0181	0.0808	0	0.0203
Sichuan	8	2.375	5	0.0283	0.1932	0	0.0431
Guizhou	7	2.7143	6	0.0256	0.131	0	0.0332
Yunnan	11	2.7273	4	0.0241	0.1545	0	0.0377
Henan	15	2.3333	4	0.0212	0.1379	8.99E-05	0.0293
Shaanxi	9	2.8889	5	0.0374	0.1441	0	0.0402
Shanxi	12	3.6667	8	0.0482	0.3237	0	0.0701
Inner Mongolia	13	2.7692	5	0.0579	0.38	0	0.0766
Gansu	10	2.7	7	0.0731	0.3662	0	0.0963
Qinghai	12	2.3333	5	0.057	0.434	0	0.0838
Ningxia	10	2.8	5	0.0177	0.0824	0	0.0207
Xinjiang	14	2.2143	3	0.0614	0.2851	0	0.0709

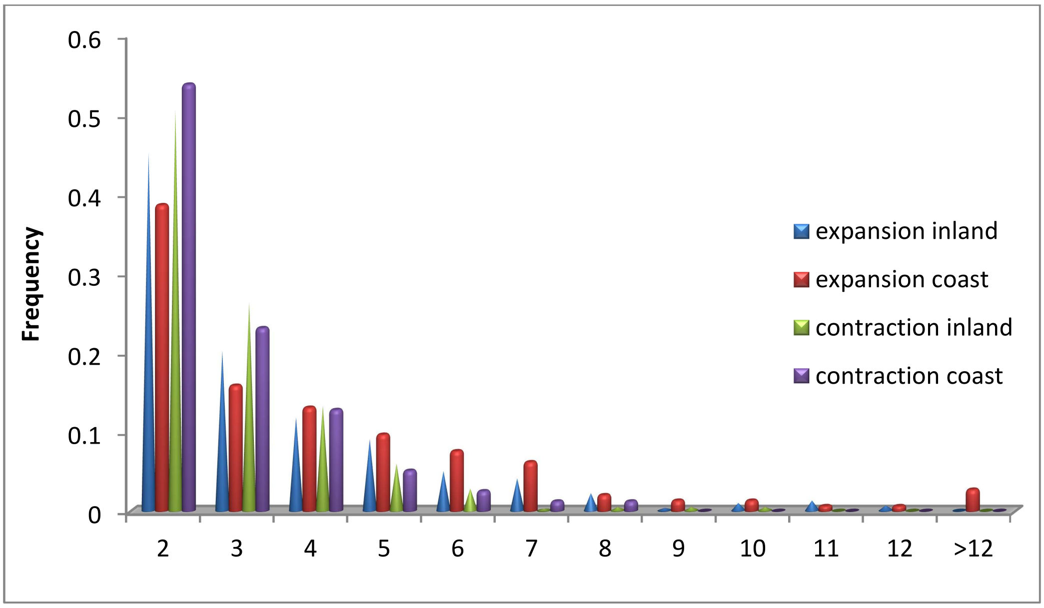
In contraction, the number of runs is concentrating distribution in 8-12. Jiangsu answer Zhejiang has fairly less contraction. The longest contractions are in both Jilin and Heilongjiang with 9 months duration. These two provinces are geographically adjacent and economic structure is similar, they are heavy industry cluster provinces, otherwise, Heilongjiang has the largest contraction length with 4.09 months. The duration in contraction is in a range from 2.5-3.5 months.

Figure 6 duration frequency distribution in overall China



As is shown in Figure 6, we can check the frequency of duration counts with different length in Chinese real estate market. In expansion, the main range of duration length is 2-7 months. Not same with expansion .the most common duration length is 2-5 months, shorter than recession. In whole Chinese, general duration distribution trends in expansion and recession are coincidence. In contraction, after survived for 5 months, there was a sharp fall in the number of runs which can survive in sixth month. Not same with contraction, the plunge in expansion comes after the seventh month. Even so, there is a small high tide of duration counts whose length is 10-12 months.

Figure 7 duration frequency distribution in coast and inland



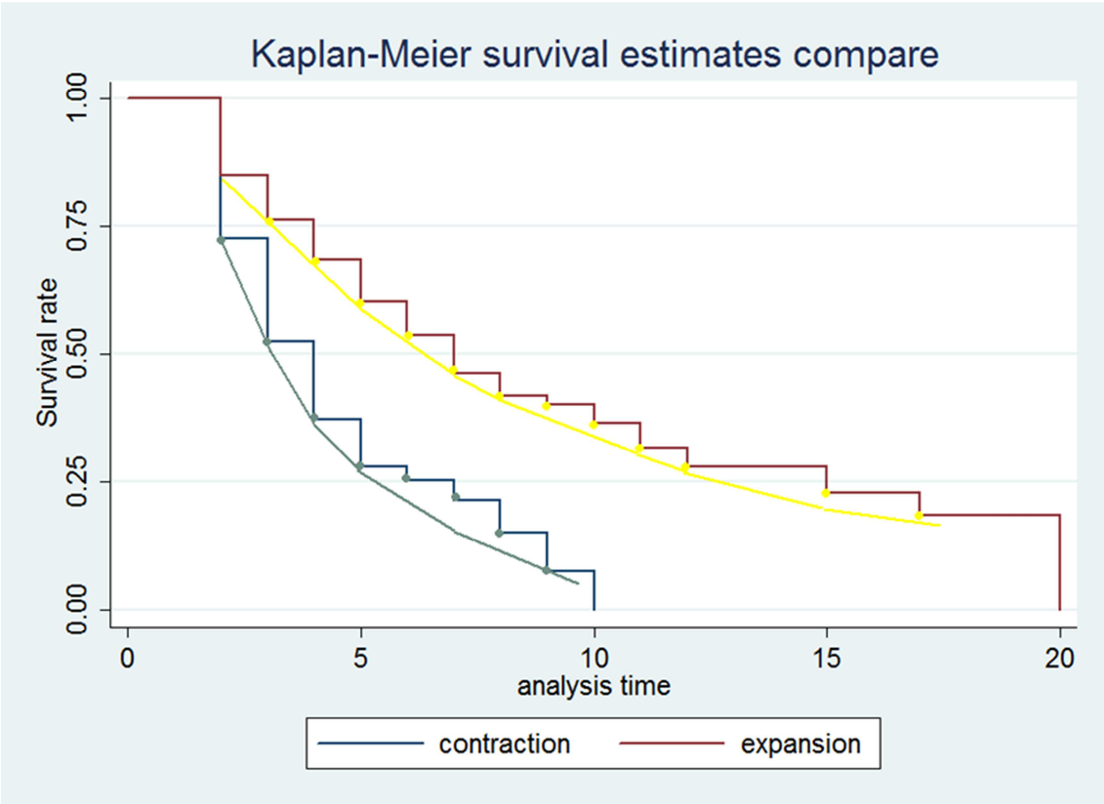
Concurrently, the durations in various regions and disparate phases are compared in Figure 7(the bars present proportion of duration counts with different age). It can be seen from Figure 7, the proportion of expansions which have length le than 5 month is diminishing synchronously both in coast and inland, after fifth month, the frequency of expansion counts in coast drops more moderately than inland. On the other hand, inland provinces have higher proportion than coast provinces below 5 months survival time. For longer survival time, coastal provinces indicate higher proportion in real estate price expansion. Anyway, the high frequency of survival time distributes 2-7 month in coastal expansion.

For contraction, the survival time in coast and inland keeps essentially consistent before sixth month. After seventh month, a few of contractions can survive in inland provinces. In spite of these is part of contraction survives more than 7 months in coast, the proportion is smaller than the same lever of expansion in coastal region.

4.2 Kaplan-Meier survival estimates compare

We can also depict the survival curve roughly in boom and bust of real estate market. It's estimated using Kaplan-Meier estimate, which is nonparametric estimate way used in either large or small sample. The slope of survival curve present the hazard rate, frankly speaking, the steeper slope the smaller survival rate.

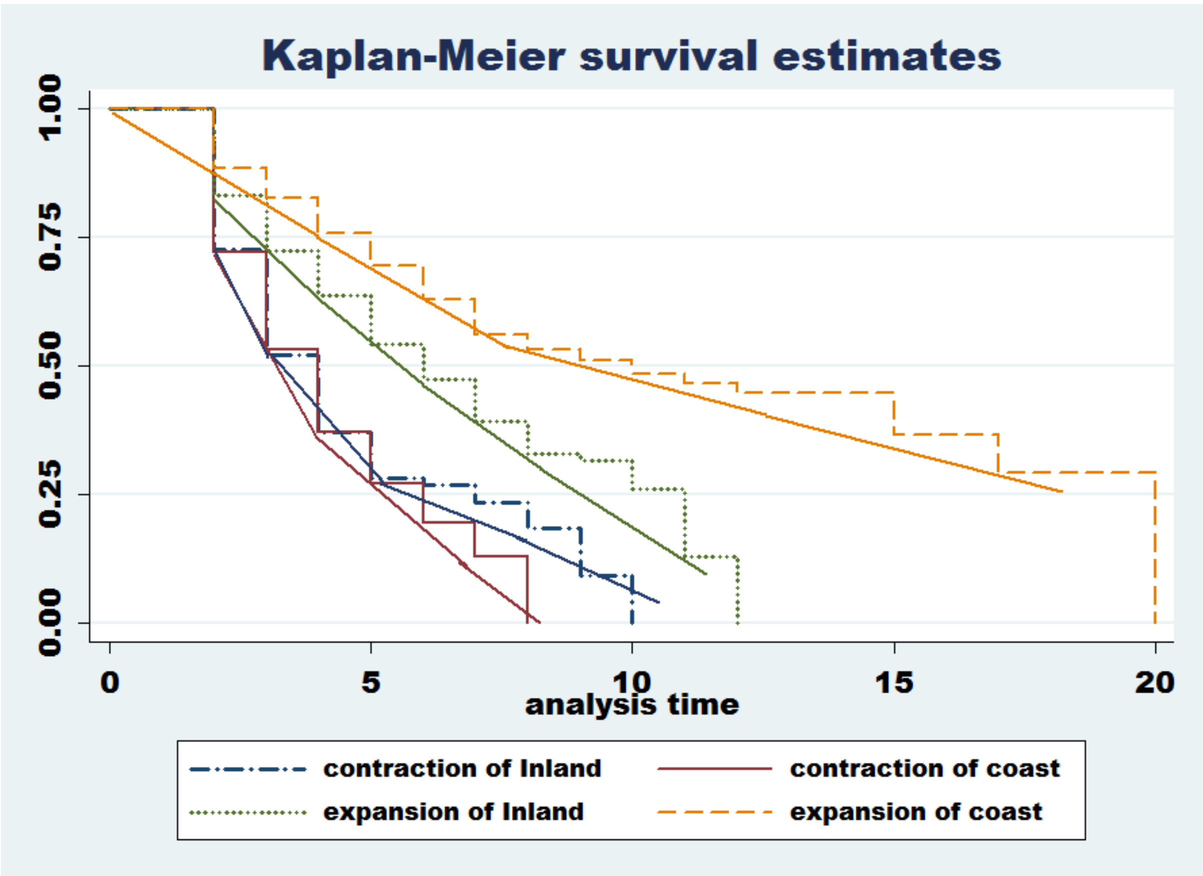
Figure 8 Kaplan-Meier survival estimates compare of expansion and contraction in overall China



In Figure 8, the yellow curve presents the relationship between survival time and survival rate. Both of the survival curves in expansion and recession are downward. That means the survival rate falls by the survival time, in short, price lengths lasted longer, they are more likely to ends. On the other hand, the survival curve of contraction is steeper than expansion, this fact indicates the likelihood of a contraction will ends in next month is larger than an expansion when they have lasted for equal time.

Survival rate is compared in Figure 9. It is apparent from Figure 9 that survival curve of inland is steeper than coastal provinces in house price upturns. This fact expresses that after survived for same time, booms in interior provinces are more likely to end than coast. Contrary to expansion, the situation in recession is more intricate. In the inchoate time survival curve, the curve path of coast and interior practically overlap. However after survived for 5 months, the survival curve of inland is more steady. That denotes that hazard rate of coast increases faster, compared with interior, by longer survival time. More precise results will be set out in the next section. From survival rate's point of view, in real estate price contraction, inland contraction is more likely to survive than coast after has survived for 5 months.

Figure 9 Kaplan-Meier survival estimates compare of expansion and contraction in coast and inland



Our test results are mainly composed of basic duration test with and without controls for fundamental house price determinates in various time buckets. Basic duration dependence test result includes overall, coastal provinces and interior provinces in expansion and contraction phases. All regional duration tests with fundamental factors are contained in this paper. Econometrics tests process is shown in appendix A. In order to illustrate more straightforward, we output the Odds ratio and interpret detail of Odds ratio in Appendix A as well.

4.3 Duration dependence and hazard model test result

4.3.1 Duration dependence test result

Table 8 duration dependence test result in expansion and contraction of each region

	Expansion			Contraction		
Regions	coefficient	Marginal Effect		coefficient	Marginal Effect	
		MEN	AME		MEN	AME
overall	1.09828	0.21868	0.20741	2.50349	0.35223	0.36222
coast	0.83329	0.17566	0.16737	2.42108	0.35149	0.35579
inland	1.26263	0.24406	0.23116	2.53326	0.35234	0.36449

Note: all coefficients'-value of Wald tests are 0.00000 at 1% significant level

It is clear from Table 8 positive duration dependence appears in expansion of Chinese real estate market. The positive coefficient describes that an additional one percent length in current expansion enhances the hazard rate. Frankly speaking, shorter expansion duration phases are more likely to survive, likelihood of expansion phase ending is pushed up by the length of current expansion. The result is consistent with Wang, L., and Wang, H.W (2005)'s result. After calculating, we get the marginal effect at means (MEN) and average marginal effect (AME) of duration on the hazard rate. There is no obvious difference between MEN and AME. However, AME in contraction is greater than MEN, by contrast, all AMEs in expansion are smaller than MEN, and we explain marginal effect within AMEs, as many researches' preference. The mathematical difference between marginal effect at mean and average marginal effect is presented in Appendix B.

The possibility of an expansion ends goes up medially about 20.7% by this expansion lasts for one more percent. In accordance with expansion, Contraction demonstrates powerful evidence of significant positive duration dependence according the result in Table 5.

Calculation result for marginal effect is about 0.36， The length of a run increases by 1%, the average growth in probability of a run will termination for the sample under consideration is about 36%. AME in contraction is almost two times as much as expansions. This result illustrates that the probability of a contraction ending is larger than expansion when they already have survived for same duration.

Positive duration dependence occurred in two regions both expansion and recession at 1% statistic significant level. As analyses show that, for coastal provinces and inland, older age reduce the likelihood an expansion or contraction survives in the next month. In contraction, marginal effect of duration in coastal provinces is similar, approximately equal 0.35. The possibility of a contraction will exit is pushed up by 35% with lasting one more percent current length , however expansion is more like to survive than contraction in inland with lasting one more percent. Coast bear resemblance to inland, the marginal effect of duration in boom is smaller than contraction. Marginal effect of duration in expansion of coastal provinces is 0.175. Likewise, marginal effect in contraction of inland doubles expansion. Notwithstanding, the expansion of coast is more likely to survive by increasing one percent previous survive time, compared to interior provinces, which has 24.4% growth in hazard rate. Anyway, all the results of duration dependence tests are consist with Kaplan-Meier survival estimates.

In real estate expansion, house price growth generates wealth effect, house owner’s wealth increase. For seeking profit, People who have houses not only for living could sell part of their real estates to get more disposable income and then, re-investment in real estate market, their will push the real estate demand as well as house price.

Besides, Chinese traditional parents generally are used to buy house for their children, for this kind of consumers, they may have rigid house demand and purchasing power for one house. When real estate price keeps rising, higher price panic in future makes them to buy a house. On the other hand, their current residence allows them to obtain more mortgage loan, since the value of their current residence is higher. Under this situation, house price may go up continuously since house demand growth. Lastly, People who has neither the house nor purchasing power, or who has capacity to buy a house before not now just can give up their house purchasing plan, in this way, house price may decrease since house demand fall.

In real estate contraction, house price decline gives a chance to consumers, who have no house or want to improve their residential environment. They could pay for the house when real estate price is lower. These kinds of activities enhance the house demand and real estate price. For developers and speculators, it’s not a good idea to sell stored real estate in recession. In fact, the house supply may has no apparent change.

Despite the fact that both coast and inland have positive duration dependence, the marginal effect of duration in inland is larger than coast in expansion. Income gap between coast and eastern may lead to this result. In inland, proportion of people who has no house and low-income is larger than coast. Consequently, real estate expansion is more like to end in inland than coast. In real estate contraction, there are not many factors as expansion to affect the house price, so the discrepancy between coast and inland is not large as expansion. However, marginal effect in inland still is greater than coast. Because of primary real estate price dominators’ proportion is larger in interior area.

4.3.2 Duration dependence test result with determinants

4.3.2.1 Overall Hazard model test result

Table 9 overall hazard model test result in expansion and contraction[4]

Overall Expansion				Overall Contraction		
Independent	Coefficient	Marginal Effect		Coefficient	Marginal Effect	
		MEN	AME		MEN	AME
lni	1.762*** (0.000)	0.263	0.237	14.809*** (0.009)	0.486	0.546
cpi	0.115* (0.065)	0.021	0.019	0.797* (0.069)	0.008	0.009
prate	4.451*** (0.006)	0.552	0.498	-10.111 (0.153)	-0.045	-0.050
land	-0.033 (0.117)	-0.003	-0.003	-0.121* (0.095)	-0.001	-0.002
rental	0.108* (0.090)	0.019	0.017	0.237 (0.342)	0.001	0.001
buicom	-4.00E-05*** (0.000)	-4.90E-06	-4.41E-06	-2.20E-05 (0.518)	-1.02E-07	-1.14E-07
rmortgage	-1.390 (0.57)	-0.24	-0.221	7.483 (0.563)	-0.126	-0.142
rincome	-0.137 (0.943)	0.001	0.001	-2.405 (0.876)	0.077	0.087
lagprate	-0.944 (0.315)	-0.154	-0.139	3.349 (0.29)	0.026	0.029
decade	-0.702*** (0.004)	-0.118	-0.106	1.523 (0.111)	0.021	0.023

Note: value in parentheses below coefficients is P-value of Wald test for independent variables and *- significant at the 1 % level, ** - significant at the 5 % level, * - significant at the 10 % level.**

Table 9 reports the empirical relationship between economic fundamental factors and hazard rate in expansion phases. To compare marginal effect at means and average marginal effect of each fundamental factor, we report both of MEN and AMM marginal effects at means are very similar to average marginal effects in our model, MEM is popular but many think that AME is superior[5].

[4] The sign of incomes' marginal effect is opposite with coefficient since the null hypothesizes are di fferent when we calculate marginal effect by STATA. More detail in http://www.stata.com/statalist/archive/2 008-10/msg01122.html and Appendix B

[5] Marginal Effects: Discrete and Continuous Change [Online]. Source: http://www.google.com.hk/url?sa =t&rct=j&q=marginal+effect+MEM+is+popular+i.e.&source=web&cd=1&cad=rja&ved=0CCEQFjAA&url=http% 3A%2F%2Fnd.edu%2F~rwilliam%2Fxsoc73994%2FMargins02.pdf&ei=dieVUKrLN8vIrQfH2oHABA&usg=AF QjCNFv59ekU11h5k5EOSrmZByG-Bk4yw

So we explain the marginal effect only base on AME result. As same as the fact that there is significant positive duration dependence in our countrywide model in Table 9, after we add the fundamental factors, duration variable has lager effect on hazard rate. In expansion, once the duration increase by 1%, the probability of this expansion will end in next period will increase about 24%, marginal effect in contraction phases is more than twice of expansion, the probability of a contraction ends is pushed up 54% with one percent growth in duration. The independent variables mostly performed as expected sign above besides consumer price index, mortgage rate and Completed Building Construction Area, Income per capita and Mortgage rate have no significant influence on hazard rate in expansion.

Land price and rental have weekly significant effect on hazard rate at 10% significant level. Strongly evidence shows real estate price, consumer price index and Completed Building Construction has significant effect on the hazard rate, but the sign is mixed. One percent Positive changes in house price associated with a 49.8% rise in the likelihood that a boom ends. Land price has negative effect on hazard rate, in other words, land price climbing leads to the continuation probability of this expansion increase. Contrary to what would be expected, completed building also has slight negative effect on hazard rate, higher growth in completed building tend to decrease the possibility that a real estate price expansion will end and land price has a negative impact on hazard rate in real estate price expansion. It is worthwhile to pay attention. Nevertheless, the coefficients present a correlation between macroeconomic variables and real estate price, not a causal relation.

More completed building, smaller likelihood the house price expansion will end, and this situation may imply the real estate price may be in initial stage of the expansion, the conclusion is accordance with Duan, X.W (2010). Sway with 1% inflation, the possibility of an expansion ends will climb by 1.93%. Semblable influence of rental is presented on the hazard rate.

Different from expansion, contraction demonstrates that less fundamental factors have significant influence on hazard rate, but still present positive duration dependence, keeps consistent with the previous result. It means that longer length he higher probability the recession exit.

House price, rental price, mortgage rate, income, completed building area and decade variable, none of them has significant effect on hazard rate in contraction.

Significant determinants are consumer price index and land price at 10% significant level in contractions6.The result falls into chime with Yan, L (2011) and Chen, C., and Fu, Y (2009). Consumer price index has correspondingly weaker impact on the probability of a price bust exits by comparison, with 0.9% positive marginal effect. Besides, land price goes up by 1%, hazard rate of recession will fall about 0.2%. Compared with expansion, both CPI and land price drive the hazard rate more powerfully. In real estate price recession, few independent variables are significant.

What's worth mentioning is the opposite performance of CPI in expansion and contraction. There are three ways that CPI can affect house price. Firstly, CPI increase, consumers' purchasing-power decrease, people who have capacity to buy house reduce, house demand goes down.

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[6] One possible reason for the defective of variables significant is the less number of observations available for real estate price contraction.

Secondly, once inflation comes, central bank will enhance interest rate, for developers and speculators, specifically developers, bank is their major capital source as private lending sector can't afford their huge fund demand, and investment cost soars, speculative demand falls, real estate price decrease. Finally, consumers who have enough saving to buy house will choose house as hedging tool, in spite of incremental deposit interest rate, the income effect of inflation is larger than income effect of interest rate, so these kind of consumers could buy a house to keep value rather than saving. These various ways have complicatedly superposed influence on real estate price.

In expansion, inflation decreases the house price. We can explain this through income effect induced by inflation. CPI growth may reduce the real income, for equally amount of currency, however, real purchasing-power reduction, namely, income effect of inflation. Finally, house demand decrease results in real estate price fall, therefore, expansion may end, inflation has positive effect on hazard rate. In contraction, income effect is smaller than substitution effect consumers choose real estate rather than saving their wealth.

In Chinese real estate contraction, most of real estate developers generally keep land unused, hold on to their real estate of flats. They have less aspiration to sell their commodity house in contraction since they are not able to pursue the profit maximization. In particular, even the land price increase in house contraction, the location or construction condition limit, real estate developer wouldn't buy the land, consequently, house cost may not be changed, and so is the house price.

Sun, R (2009) reported that 5 years above long mortgage rate is irrelevant with real estate price, reduction or growth of mortgage rate isn’t a signal that consumer can really own the real estate loans since financial institution may keep their quondam loan provision or credit policy.

It seems unexpected that per capita income doesn’t affect the hazard rate, in this case, house price, neither real estate price upturns or bust. Base on Chinese realities of situation, house price-to-income ratio with rang six to seven is considered reasonable. However, after 2003, there is a holistic upward trend in the number of Chinese house price-to-income ratio and this ratio keeps above the upper limit of rational rang.

In 2009, house price-to-income ratio reached 8.1, became the highest ratio in recent years. Real estate price has already broken from per capita income years ago. As an illustration, famous Chinese northeast heavy industry city, Harbin, Commodity building Selling Price is 5553 RMB/Sqm, house price-to-income ratio is 8.9 in 2011.

Currently, completed house vacancy area in is about 20 million square meters. Generally speaking, we need about 7 million effective populations to consume these vacancy building.

Nevertheless, in fact, the population is 6 million and only 5% of this people possess purchasing power for potential house demand, in other words, only three hundred thousand consumers could buy house in Harbin, house supply is far larger than house demand. However, first quarter of 2012，real estate price still increased by 0.1%. This fact goes to prove that income isn’t an important determinant for nowaday main real estate consumer. People can loan from private landing sector, buy a house and resell in suitable timing with price much higher than purchase price.

The loan interest in private landing sector usually is higher than bank loan interest, even though, the profit from reselling is respectable. Reseller can not only pay back the high loan interest but also get revenue which may be 5-10 times as much as their yearly income.

Decade variable exhibits strikingly significant. This fact presents, to some extent, government policy partially dominates expansion in real estate market, but not in house price recession.

The primary result in our above research is that positive duration dependence displays in Chinese real estate price expansions, as well as recession. In addition, duration dependence in recession is much more conspicuous than house price expansions. Reasonable interpretation is presented in following paragraph.

In recent years, real estate industry becomes pillar industry in Chinese economic development. It plays an important role in driving the development of other economic industries, such as construction industry, financial sector and so on. Accordingly, real estate industry stagnancy leads to overall economic slowdown.

To maintain economic growth, Chinese government will adopt applicable policy to excite real estate market as soon as possible.

For example, December, 2008，after 4 months continuously house price fall, General Office of the State Council of the People’s Republic of China introduced policies such as abolished urban real estate tax and supported to real estate developer financing in order to stimulate real estate market. From then on, real estate market started to rebound.

At the end of 2009, Chinese real estate price reached 4695 RMB/Sq m, roughly 1000 RMB/Sq m increasing in whole year. It's apparent in Figure 1, after we included house price determinants variables in hazard model, great change have taken place in duration dependence of contraction, marginal effect of duration jumped from 0.559 to 2.96. At the same time, the change in expansion is comparatively small.

In next section, several detailed results of hazard rate are given with special regard to Chinese coast area and inland area.

4.3.2.2 Hazard model test results in Coast and Inland

Table 10 hazard model test result in expansion and contraction of Coast and Inland

	Expansion				Contraction			
	Coast		Inland		Coast		Inland	
Independent	Coef.	AME	Coef.	AME	Coef	AME	Coef.	AME
lni	2.057*** (0.000)	0.167	1.754*** (0.000)	0.252	4.117** (0.015)	0.665	15.531** (0.02)	0.390
cpi	0.240* (0.073)	0.026	0.073 (0.329)	0.011	0.003 (0.99)	-0.016	0.945*** (0.062)	0.011
prate	8.633*** (0.002)	0.934	2.430 (0.294)	0.219	1.005 (0.789)	0.155	-11.343 (0.191)	0.268
land	-0.019 (0.56)	0.002	-0.025 (0.401)	-0.004	-0.061 (0.218)	-0.002	-0.099 (0.32)	-0.007
rental	0.174 (0.223)	0.03	0.092 (0.212)	0.012	0.185 (0.533)	0.026	0.276 (0.344)	0.009
buicom	-1.4E-05 (0.19)	8.06E-07	-9.1E-05*** (0)	-1.34E-05	-1.3E-05 (0.435)	-3.7E-07	-6.8E-05 (0.318)	-1.38E-05
rmortgage	-10.14* (0.052)	-.209	1.407 (0.635)	0.27008	6.699 (0.475)	0.778	15.248 (0.342)	0.644
rincome	4.380 (0.311)	0.647	-1.447 (0.526)	-0.2047	-10.530 (0.299)	-0.777	1.385 (0.934)	0.186
lagprate	-5.74** (0.046)	-.115	-0.355 (0.762)	0.01476	0.822 (0.758)	0.018	4.014 (-0.253)	-0.371
decade	-1.31*** (0.008)	-0.160	-0.482 (0.107)	-0.069	0.389 (0.719)	0.041	1.767* (0.087)	0.067

Note: value in parentheses is P-value for coefficient. Since the shortage of coast contraction data, we treat a month which has negative or zero following negative price change rate as price contraction as well. We calculate the AME of mortgage and lag of price with length instead of lni since some dispute and limitation and *- significant at the 1 % level, ** - significant at the 5 % level, * - significant at the 10 % level.**

In this section, we only give the average marginal effect. It's apparent from the Table 10 that there are significant positive duration dependence in coastal provinces and inland, simultaneously, in real estate price booms and busts. Expansion and contraction differ in the terms of duration variable's coefficient significant. The coefficients of duration variable in price contraction are less significant than price expansion not only in coastal (0.015) but also inlands (0.02).

Notwithstanding the possibility of expansion ends in next period of coastal provinces is 16.8% higher with one more percent lasting, which is broadly larger to interior provinces' hazard rate growing by 25%. Marginal effect of coastal contraction is notably different with inland provinces and lager than expansion respectively. Coast provinces have almost 4 times growth in hazard rate, length of a bust run goes up by 1%, hazard rate will soar by 66%, and by comparison, inlands have correspondingly small change in hazard rate in real estate recession with 39% increase in hazard rate by lasting one more percent length.

Consumer price index has significant positive effect on hazard rate of house price upturns in coastal developed areas at 10% significant level. Besides, the significant coefficients' signs are consistent with overall hazard model. One percent rising in inflation forced the likelihood of expansion ends by 2.6 %. The result is in accordance with Luo, G.Q., and Zhao, T (2010). It is undeniable that Chinese coastal average residents' income level is higher than inland area. Furthermore, higher-level income groups mainly centralize in eastern area. In coastal expansion, real estate is regards as speculative tool, thousands of real estate speculators buy the real estate through bank loan and private lending, thereafter high inflation, and the loan interest rate must be elevated, speculative cost goes up, in addition, they can't sell off their stored house immediately, and real estate demand falls, house price may drop. Whereas, inflation doesn't drive price growth in house price expansion inland area. Because of CPI can influent real estate price through diverse paths. When overall inflation takes place, rich consumer may choose to buy real estate to hedging and house demand is dilated, and real estate price goes up.

Conversely, households who have comparatively common revenue, their real income is diminished as high inflation, they could have no capacity to buy house, especially in house price boom. Contrary to real estate price expansion, CPI has no remarkable impact on the probability that a contraction ends in coast, however, CPI goes up for one percent, the survive rate of contraction will significant fall by 1.1% in inland. For inland consumer, house market contraction with high inflation, unquestionably, real estate is a suitable choice to keep value. On the other hand, coast consumers have more choice to store capital, so inflation in coast could not lead to remarkable real estate price shock.

Neither real estate price change rate nor lag of real estate price change rate has significant impact on hazard rate in contraction no matter coast and inland. Uniquely, in expansion of coast, price change rate enhance the probability that real estate price stops rising. Nevertheless, the likelihood of expansion continues in next period ascends by 11.5% with one unit growth in lag price change rate. Yao, Z., Sun, H.P., and Feng, C.C (2011) manifested same result. In economic developed area, the lag price can guide the expected price in next period, in house price upturns, consumers or speculators will expect higher house price, this kind of expectation stimulates them to purchase house, and consequently, real estate expansions survive.

It's wonderful that all coefficients of land price index and rental index in various regions and phases are insignificant at 10% significant level. Furthermore, the signs keep coincide with overall test result, and no difference in expansion and contraction, as well as coast and inland. As a matter of fact, lack of data could conduct to this insignificant result since we use quarterly data and the observations are less after we divided the data into two regions.

Nevertheless, Dong, Z.Y., Guan, H., Ming, Y (2010) believe that land price has no conspicuous economic influence on real estate price. It isn't the ruling supply factor which controls house price. In addition, this result verifies that there is tremendous profit margin in Chinese real estate industry.

From real estate price phases perspective, completed Building construction area displays similar features with overall models. It is statistic significant in expansion rather than recession. Nevertheless, P-value of coast's coefficient in expansion is 0.19， very weakly significant at 10% significant level .Coefficient of inland completed Building construction area in expansion is strongly significant at 0.01 significant level, meanwhile, marginal effect of completed Building construction area is slight compared to other significant independent variable. Anyway, the more completed Building construction area, expansion is likely to survive. All of the coefficients' sign are negative. In house price upturns, under the situation that holistic shortage in house supply, enhancive house supply may fabricate an illusion that real estate sale is exuberant. This illusion results in panic buying, since consumers want to avoid house price rising and house supply shortage in the future, these activities keep on house price soaring.

We get more systematic result in Table 9, mortgage rate reveals negative influence on hazard rate in expansion of coastal provinces. Elevated mortgage rate continues house price rising in coastal house price upturns. The marginal effect is-0.209, means that one unit increase in mortgage change rate, the probability of this run ends goes down by 20.9%, mortgage rate play an important role in duration of expansion in coastal provinces. Moreover, none of other coefficients is statistic significant.

In eastern house expansions, mortgage rate is an important considerable cost factor for real estate speculators. They can't get house off their hands in short-run. The higher cost they bear the higher exit price. As I have said that coastal speculators control the real estate price principally in expansion, for above reason, increasing mortgage rate elevates the survive rate. For real estate developer, mortgage rate growth enhances development cost, since bank loan almost be their only development capital source, private lending sector can't furnish such huge development capital.

Average income per capita isn't a factor that affects the hazard rate of Chinese real estate price phases in any field. The conclusion is totally in accord with overall model.

Decade variable, which represents government real estate policies, indicates fixed significant in various situation. For house price booms, government policy can drive the real estate price efficiently in coastal economic developed area. On the other hand, government regulative effects are less notable with 0.107 P-value at 10% significant level. However, contrary to expansion, government policies are remarkable efficient in inland provinces, not in coast province in contraction. A lot of previous researches have proved out that house demand in Chinese coast (eastern) is more likely speculativeness demand. On the contrary house demand in western and central China[7] are rigid demand. House price recession in inland is an indicator of income constraint. Government policy can ameliorate this circumstance, for instance, reducing down-payment gives more changes to these consumers who have only constrictive budget. Moreover, lower mortgage rate also can relieve monthly repayment pressure for Middle-income and low-income groups. Government promotion policies perform feebly in eastern China. They can't enhance the house demand through monetary policy.

The reason of less purchasing of real estate isn't lack of fund, it's more likely to market saturation or consumer put their fund into other higher yield and less risky channels since financial sector in Chinese coast is highly mature and investment

[7] Inland means central China and western China area in this thesis

channels are multitudinous. It is worth mentioning that government policies have slightly significant on hazard rate in inland expansions, we can treat it as a semaphore that exorbitant house price which included by speculative practice has already diffused into inland area bit by bit.

The results strongly support to real estate price, mortgage rate and the lag of house price has significant impact on hazard rate in expansion of coast, nevertheless the signs are opposite. CPI has positive impact on the likelihood of expansion ends in coast and recession ends in inland. Completed building construction area has significant effect only in expansion, in other words, more completed building results in that house price climbs constantly. What’s more, rental index, income and land price have no relationship with hazard rate, in this case, also house price. Government policy is efficient to control price leap in coast and promote real estate market.

On the whole, variables which are significant in overall model be significant in either coast or inland model. For coast provinces, the significant variables are duration, consumer price index, current house price, mortgage rate, lag of current price which indicates consumer price expected and decade variable which predict government policy. In addition, all of macro price determinants occur only in real estate expansion. On the side of inland region, statistic significant variables distribute in different real estate phase. Completed Building construction area is significant in boom and CPI and decade variable show significant in real estate price recession. Concluding these results, we can say that positive duration dependence occurs countrywide, as well as each region. The overall result roughly reflects the duration dependence in Chinese real estate market. Further, the factors which impact survival possibility of house price phases are intricate in separate region and disparate phase.

CHAPTER V

CONCLUSION

5.1 Summary

The study has gone some way towards understanding duration dependence and the determinants of hazard rate in Chinese real estate market. What's more, duration dependence in dissimilar regions is discussed in our research.

In the first place, we concentrate on the primary duration dependence analysis. I collected 113 months of house price data in 30 provinces which is divided into coast and inland regions in China. Survival model is utilized in each regions as well as overall China. Strongly evidence of positive duration dependence is found for both expansion and recession in overall China, Chinese coast and inland's real estate market, more clearly, not only real estate price expansion but also the recession are more likely to end as they get longer. The finding in real estate expansion is consistent with the result of Bracke, P (2011), which analyzed the house market in 19 OECD countries and Rose Cunningham and Kolet, I (2007), focused on house cycle in Canada and American. Likewise, the duration dependence in real estate price contraction is stronger than expansion. There are no obvious diversity in survival rate of contraction in coast and inland area once a contraction lasts one more month. However, expansion in inland is more likely to end than coastal province with one more month lasting. Secondly, quarterly dataset is applied to analyze that how macro price determinants affect hazard rate in all regions and different price phase. By the way, Positive duration dependence still displays in each model.

In regard of price phases, hazard rate in expansion is more impressionable than contraction. CPI, current real estate price, house price expectation, land price, completed building construction area, mortgage rate and government policy do a fairly good job of explaining the transition of housing market out of expansion phases. However, only CPI, land price and Government policy can explain the transition of housing market out of contraction Phases. Nationwide speaking, CPI has positive effect on hazard rate both on expansion and contraction. In this case, CPI may decrease house price in boom and increase house price in bust. Land price growth dwindles hazard rate, namely improve survival rate in contraction. Rental raising and house price increase enhance the likelihood of an expansion ends in next period. Government policy is more powerful for upturns than downturns.

As viewed from regions, hazard rate in coastal expansion is comparatively more sensitive to house price determinants than interior expansion. Situation in contraction is inverse that hazard rate in coast is less sensitive to fundamental factors than inland. CPI, current price can significant push up the probability of a coastal expansion ends in next period. By comparison, mortgage rate and price expectation increase the probability house price will climb continuously in coastal expansion. Government macro-control can adjust the price in expansion. For inland provinces, completed building construction area growth maintains house price increase. Government policy would affect transition from price expansion to recession. Additionally, inflation can prevent house price from reducing, and government macro-control also has effect on hazard in interior real estate price recession.

5.2 Policy suggestion

These consequences in our conclusion are meaningful for policy maker and consumer. They are useful indicators in forecasting the length of Chinese real estate price spell and helpful in regulating house price efficiently.

Based on our conclusion, Chinese government should implement distinct policy to adjust real estate market in diverse price stage and distinct regions. In expansion, control price soar should focused on regulate speculative demand such as levy house transfer tax, stricter homebuying restrictions standardized private lending process in coastal provinces. For interior provinces, government should guide the rational purchasing and avoid unquestioning investment in real estate market. In contraction, more liberal migrant policy is necessary, in order to irritate rigid house demand in coast economic developed area. Finally, for inland consumers, appropriate house purchase subsidies and lower down payment will work in contraction.

5.3 Limitation

The first shortage is data collecting. National bureau of statistic of China publishes some economic data less accurately, some time series has same value in contiguous months or quarters. Beside, some economic indexes as land price and per capita income; we can just collect quarterly data. Lack of observations may due to our result bias. Anyway, obtaining highly precise data always is a problem in Chinese economic researches.

Subsequently, our model had several challenges to settle the time lag effect in economic variables. There are a lot of independent variables in our model when we test the influence of price determinants on hazard rate. Generally speaking, time series economic model include lag of independent variables to examine the non-contemporaneous effect (dynamic models). Basically, we can add the first order lag variables in the equitation. However, fewer observations and more variables reduce the degree of freedom, which can make our result inaccurate. As such, the model should be considered plain for best efforts being made at this time and future results may prove more precise.

Thirdly, In terms of future researches, it would be worth to examine the effect of diverse duration on hazard rate, and separate size of the price change into several levels and input other economic variables such as real estate investment, building selling area and so on. This kind of model may measure the relationship between duration and hazard rate, as well as, forecast a price peak or trough more precise.

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APPENDICES

Appendix A

Table 11 results of unit root test for main variables

Variables description	Variables name	P-value of Fisher-type unit-root test for panel data H_0: All panels contain unit roots , variable is non-stationary
Consumer Price Index	cpi	0.0002
Commodity building Selling Price per square meter	price	1.0000
Price change rate	prate	0.0000
Chinese Land Price Index	land	0.0004
The napierian logarithm of a phase's length	lni	0.0000
Phases dummy variables (expansion =1)	expansion	0.0000
Chinese rental price index	rental	0.0000
individual housing common reserve fund rate on loan	mortgage	0.9998
Change rate in individual housing common reserve fund rate on loan	rrmortgage	0.0205
Completed Building Construction Area	builcom	0.0000
Change rate in Completed Building Construction Area	rbuilcom	0.0000
Average Income per Capita	income	1.0000
Change rate in Average Income per Capita	rincome	0.0000

Ho: All panels contain unit roots

Ha: At least one panel is stationary

As we can see from above table, house price, per capita income and mortgage rate is non-stationary series, however, the change rate of these variables is significant stationary series.

Table 12 Autoregression test for panel data

	Expansion		Contraction	
	F	Prob > F	F	Prob > F
overall	3.158	0.0868	0.248	0.6236
coast	4.622	0.0638	3.322	0.1182
inland	0.89	0.3578	0.007	0.9357

Wooldridge test for autocorrelation in panel data. We test Autoregression just in first three models, since they are monthly panel model which with relatively few cross-section and long time-series.[8]

H_0: no first order autocorrelation.

We cannot reject the any null hypothesis in table1 at 1%significant level, so we treat panel data has no first order autocorrelation.

Table 13 overall odds ratio in in expansion and contraction

	Expansion		Contraction	
	OR	P>z	OR	P>z
overall	2.99901	0	12.22504	0
coast	2.300876	0	11.25803	0
inland	3.534696	0	12.59448	0

Interpretation: Calculation in Table 13, yellow cell denotes that increasing the duration variables by one percent, the odds (i.e. divide hazard rate by survival rate) increase by 2.99901 times. Since the change direction consistent with hazard rate, the growth of a run's length higher the probability of this run will terminate in the following month in overall expansion. Following interpretation is similar.

[8] EVIEWS 7 guide : 564

Table 14 odds ratio on and contraction of Coast and Inland

	Expansion						Contraction					
	overall		coast		inland		overall		coast		inland	
	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z
lni	5.828588	0	7.826955	0	5.782074	0	2702340	0.009	61.41481	0.015	5564635	0.02
cpi	1.12285	0.065	1.271518	0.073	1.076554	0.329	2.220419	0.069	1.003223	0.99	2.573112	0.062
prate	85.75909	0.006	5615.773	0.002	11.36786	0.294	4.06E-05	0.153	2.732201	0.789	1.19E-05	0.191
land	0.967025	0.117	0.981097	0.56	0.974471	0.401	0.885543	0.095	0.940154	0.218	0.905482	0.32
rental	1.114225	0.09	1.190412	0.223	1.097128	0.212	1.26792	0.342	1.204333	0.533	1.318587	0.344
buicom	0.99996	0	0.999986	0.19	0.99991	0	0.999979	0.518	0.999987	0.435	0.999932	0.318
rmortgage	0.248926	0.57	3.92E-05	0.052	4.087524	0.635	1778.866	0.563	811.8	0.475	4192629	0.342
rincome	0.871456	0.943	79.85364	0.311	0.235075	0.526	0.090193	0.876	2.66E-05	0.299	3.99553	0.934
lagprate	0.388861	0.315	0.0032	0.046	0.700742	0.762	28.47477	0.29	2.276493	0.758	55.37147	0.253
decade	0.495483	0.004	0.269625	0.008	0.61737	0.107	4.587115	0.111	1.476569	0.719	5.854108	0.087

Note: OR is an initial of odds ratio

There are three kinds of results of panel logit Hausman test, unlucky, all of three results appear in our tests. Here, I just enumerate one of result to interpretation for each type.

Table 15 Hausman test result for overall expansion

	coefficient			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	fe	re	difference	S.E.
lni	1.762775	1.387287	0.375488	0.08009
cpi	0.11587	0.113025	0.002845	0.017283
prate	4.451542	2.908049	1.543493	0.829707
land	-0.03353	-0.02037	-0.01316	0.011065
rental	0.108159	0.102286	0.005874	0.018116
buicom	-4E-05	-2.6E-05	-1.4E-05	7.08E-06
rmortgage	-1.3906	-1.29308	-0.09753	0.505427
rincome	-0.13759	0.008311	-0.1459	0.426726
lagprate	-0.94453	-0.81316	-0.13138	.
decade	-0.70222	-0.62225	-0.07998	0.050362

b = consistent under Ho and Ha; obtained from xtlogit

B = inconsistent under Ha, efficient under Ho; obtained from xtlogit

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 51.85

Prob>chi2 = 0.0000

Null hypothesis: both fixed-effect model and random-effect model are adequate

Alternative hypothesis: the fixed effects estimation is suitable and the random-effect model is not.

Under the above result, our initial hypothesis that the individual-level effects are adequately modeled by a random-effects model is resoundingly rejected. So we choose fixed model.

Table 16 Hausman test result for coastal expansion

	coefficient			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
lni	2.057574	1.257654	0.799919	0.38296
cpi	0.240212	0.198638	0.041574	0.062738
prate	8.633335	7.016491	1.616844	1.12385
land	-0.01908	0.015353	-0.03444	0.022216
rental	0.174299	0.243405	-0.06911	0.089361
buicom	-1.4E-05	6.05E-06	-2E-05	9.02E-06
rmortgage	-10.1476	-9.36257	-0.78502	1.707577
rincome	4.380195	4.858202	-0.47801	1.621799
lagprate	-5.7446	-7.58309	1.838487	0.785402
decade	-1.31073	-1.20215	-0.10858	0.197214

b = consistent under Ho and Ha; obtained from xtlogit

B = inconsistent under Ha, efficient under Ho; obtained from xtlogit

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 1.01 Prob>chi2 = 0.9994

(V_b-V_B is not positive definite)

Null hypothesis: both fixed-effect model and random-effect model are adequate

Alternative hypothesis: the fixed effects estimation is suitable and the random-effect model is not.

On examining the output from Hausman, we see that there is no evidence that the IIA assumption has been violated. We should choose fixed effect model.[9]

(i.e. IIA means outcome categories for the model have the property of independence of irrelevant alternatives. Stated simply, this assumption requires that the inclusion or exclusion of categories does not affect the relative risks associated with the repressors in the remaining categories.)

[9] Stata 12 manuals, Hausman — Hausman specification test,642

Table 17 Hausman test result for overall contraction

	coefficient			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
lni	14.80963	8.736668	6.072961	5.29578
cpi	0.797696	0.1454655	0.65223	0.407505
prate	-10.1118	-0.8115794	-9.3002	6.020694
land	-0.12155	-0.0335401	-0.08801	0.061189
rental	0.237378	0.0195095	0.217868	0.218406
buicom	-2.2E-05	-1.82E-06	-2E-05	3.05E-05
rmortgage	7.483731	-2.278546	9.762277	11.26155
rincome	-2.40581	1.397012	-3.80282	12.80188
lagprate	3.349019	0.4699277	2.879091	2.233936
decade	1.523251	0.3781467	1.145105	0.772821

b = consistent under Ho and Ha; obtained from xtlogit

B = inconsistent under Ha, efficient under Ho; obtained from xtlogit

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= -0.66 chi2<0 ==> model fitted on these data fails to meet the asymptotic assumptions of the Hausman test; see suest for a generalized test.

Null hypothesis: both fixed-effect model and random-effect model are adequate

Alternative hypothesis: the fixed effects estimation is suitable and the random-effect model is not.

Here the χ^2 statistic is actually negative. We might interpret this result as strong evidence that we cannot reject the null hypothesis. Such a result is not an unusual outcome for the Hausman test, particularly when the sample is relatively small — there are only 45 uninsured individuals in this dataset.

Table 18 contemporaneous correlation of overall expansion

	lni	cpi	prate	land	rental	buicom	rmortgage	rincome	lagprate	decade
lni	1									
cpi	0.0147	1								
prate	0.1011	0.0156	1							
land	0.0195	0.2395	0.1965	1						
rental	0.0268	0.141	0.017	0.2231	1					
buicom	-0.0424	0.0252	-0.0171	0.0662	0.0319	1				
rmortgage	-0.0225	0.589	0.1058	0.2221	0.0401	0.0047	1			
rincome	0.0813	0.1085	0.0322	0.0693	0.0445	-0.0052	0.1521	1		
lagprate	0.1036	0.1226	0.3597	0.2208	0.1752	0.0077	0.1428	0.0468	1	
decade	0.13	0.0586	0.0425	0.0199	0.2608	0.1063	-0.2186	0.0613	0.0882	1

Table 19 contemporaneous correlation of overall contraction

	lni	cpi	prate	land	rental	buicom	rmortgage	rincome	lagprate	decade
lni	1									
cpi	0.0421	1								
prate	0.1204	0.1334	1							
land	0.0941	0.097	0.2776	1						
rental	0.062	0.0405	0.146	0.1948	1					
buicom	0.1296	0.0349	0.1715	0.3982	0.166	1				
rmortgage	0.0822	0.5005	0.1233	0.1543	-0.0044	0.0223	1			
rincome	0.0632	-0.0847	0.0482	0.0116	-0.0322	0.0575	0.0492	1		
lagprate	-0.0091	0.0162	0.5122	0.2734	0.0763	0.0794	0.0927	0.0755	1	
decade	0.0339	0.22	0.1734	0.1255	0.2253	0.1909	0.0346	-0.0212	0.0478	1

Table 20 contemporaneous correlation of coastal expansion

	lni	cpi	prate	land	rental	buicom	rmortgage	rincome	lagprate	decade
lni	1									
cpi	0.1178	1								
prate	0.1389	-0.0105	1							
land	-0.082	0.269	0.3143	1						
rental	-0.0886	0.1617	0.0899	0.2029	1					
buicom	-0.2201	0.0852	-0.0734	0.1066	0.0346	1				
rmortgage	0.0895	0.6016	0.1302	0.3071	0.0937	0.0126	1			
rincome	0.0941	0.1468	0.064	0.0286	0.0301	-0.0024	0.1611	1		
lagprate	0.138	0.1096	0.5928	0.2676	0.1015	-0.0398	0.162	0.0929	1	
decade	0.1207	0.1053	0.0247	-0.0059	0.2626	0.1273	-0.2577	0.0238	0.0676	1

Table 21 contemporaneous correlation of coastal contraction

	lni	cpi	prate	land	rental	buicom	rmortgage	rincome	lagprate	decade
lni	1									
cpi	0.2075	1								
prate	0.1555	-0.1104	1							
land	0.1851	0.2735	0.3969	1						
rental	0.3306	0.1866	0.3269	0.2547	1					
buicom	0.3175	0.1258	0.2651	0.5338	0.1209	1				
rmortgage	0.1574	0.6141	0.0428	0.28	0.183	0.0179	1			
rincome	0.0148	0.0454	0.0593	0.0657	0.1466	-0.0533	0.3043	1		
lagprate	-0.0225	-0.0031	0.6276	0.4736	0.3316	0.0932	0.0022	0.0209	1	
decade	0.2553	0.2492	0.0059	0.1797	0.1816	0.1959	0.0599	-0.2338	-0.1095	1

Table 22 contemporaneous correlation of interior expansion

	lni	cpi	prate	land	rental	buicom	rmortgage	rincome	lagprate	decade
lni	1									
cpi	-0.011	1								
prate	0.0446	0.0383	1							
land	0.0063	0.2662	0.0714	1						
rental	0.0493	0.1441	-0.0436	0.2157	1					
buicom	0.1232	-0.0144	0.0156	-0.0877	0.0025	1				
rmortgage	-0.098	0.5884	0.091	0.157	0.0043	-0.0122	1			
rincome	0.0921	0.0902	0.0244	0.1144	0.0555	0.0015	0.1507	1		
lagprate	0.0578	0.138	0.239	0.181	0.1954	0.0257	0.1337	0.0374	1	
decade	0.1573	0.0319	0.0573	0.0458	0.2638	0.1165	-0.1975	0.0798	0.1034	1

Table 23 contemporaneous correlation of interior contraction

	lni	cpi	prate	land	rental	buicom	rmortgage	rincome	lagprate	decade
lni	1									
cpi	-0.0089	1								
prate	0.1125	0.2272	1							
land	0.0898	0.0455	0.1294	1						
rental	0.0006	0.0167	0.0233	0.1126	1					
buicom	0.0789	0.0457	0.0975	-0.0494	0.169	1				
rmortgage	0.0539	0.4588	0.1639	0.1052	-0.0663	0.0837	1			
rincome	0.0687	-0.103	0.0323	0.0106	-0.0516	0.1448	0.0259	1		
lagprate	0.0014	0.0342	0.4599	0.0854	-0.0676	0.0074	0.1434	0.0829	1	
decade	-0.0269	0.2149	0.2308	0.1152	0.2449	0.281	0.0267	-0.0061	0.1039	1

All results are estimated by STATA 12

Appendix B

Cameron, A.C., and Trivedi, P.K (2009) said "An ME [marginal effect], or partial effect, most often measures the effect on the conditional mean of y of a change in one of the regressor". In binary regression equation, the marginal effect is the slope of the probability curve relating x_p to probability of dependent equals 1, holding all other variables constant. In order to help understand marginal effect at mean and average marginal effect, we show the calculation review both MEN and AME. The following section follows the exposition in Bartus, T (2005)

1. Definition of AME and MEM

Consider the single-equation regression model

$$E(y) = F(\beta x)$$

Where βx denotes the linear combination of parameters and variables and $F(.)$ is the cumulative distribution function that maps the values of βx to the [0,1] interval.

Following the standard interpretation of linear statistical models, marginal effects should measure the change in the expected value of y as one independent variable increases by unity while all other variables are kept constant. Then the AME of the *i*th explanatory variable is

$$\mathrm{AME}_i = \frac{1}{n}\sum_{k=1}^{n}\{F(\beta x^k + \beta_i) - F(\beta x^k)\} \qquad (1)$$

And the MEM is

$$\mathrm{MEM}_i = F(\beta \bar{x} + \beta_i) - F(\beta \bar{x}) \qquad (2)$$

For continuous variables, (1) and (2) are rarely applied. Instead, researchers estimate the effect of an infinitely small change. Let $f(.)$be the derivative of $F(.)$ with respect to βx. Consider a continuous variable x_i.

The AME of the ith continuous variable, AME_i is given by

$$\text{AME}_i = \beta_i \frac{1}{n} \sum_{k=1}^{n} f(\beta x^k) \quad (3)$$

Where βx^k denotes the value of the linear combination of parameters and variables for the kth observation. Let $\bar{x}$ be a vector containing the means of the explanatory variables. The MEM for x_i is defined as

$$\text{MEM}_i = \beta_i f(\beta \bar{x}) \quad (4)$$

There are also separate formulas to estimate marginal effects for dummy variables. The well-known formula for AME is

$$\text{AME}_i = \frac{1}{n} \sum_{k=1}^{n} \{F(\beta x^k | x_i^k = 1) - F(\beta x^k | x_i^k = 0)\} \quad (5)$$

In a similar fashion, one can define the MEM for dummy variables as

$$\text{MEM}_i = F(\beta \bar{x} | \bar{x} = 1) - F(\beta \bar{x} | \bar{x} = 0) \quad (6)$$

Above is the formulation of marginal effect at mean and average marginal effect.

2. Similarities and differences between MEM and AME

In this subsection, I show the conditions under which MEM cannot be considered as a good approximation of AME. Although it was argued that MEM is a good approximation of AME (Greene 1997, 876), there is some evidence that MEMs and AMEs can be different, even in considerably large samples (Bockarjova and Hazans,2000).

Our exposition will focus on marginal effects for continuous variables. Using (3) and (4), the difference between the AME and the MEM can be written as

$$\text{AME}_i - \text{MEM}_i = \beta_i \frac{1}{n} \sum_{k=1}^{n} \{f(\beta x^k) - f(\beta \bar{x})\} \quad (7)$$

Using a second-order Taylor series expansion around $\bar{x}$, $f(\beta x^k) - F(\beta \bar{x})$ can be approximated as

$$f(\beta x^k) - f(\beta \bar{x}) f'(\beta \bar{x})(\beta x^k - \beta \bar{x}) + \frac{1}{2} f''(\beta \bar{x})(\beta x^k - \beta \bar{x})^2 \quad (8)$$

Where $f'(.)$ and $f''(.)$ are the first and second derivatives of $f(.)$ with respect to βx

Substituting (8) into (7) yields

$$\text{AME}_i - \text{MEM}_i \approx \beta_i \frac{1}{n}\sum_{k=1}^{n}\left\{f(\beta x^k) - f(\beta\bar{x})f'(\beta\bar{x})(\beta x^k - \beta\bar{x}) + \frac{1}{2}f''(\beta\bar{x})(\beta x^k - \beta\bar{x})^2\right\}$$

Note that the difference between AME and MEM does not depend on the first term of the Taylor expansion because the sample sum of $x_i^k - \bar{x}_i$ is zero. Thus the absolute difference between AME and MEM reduces to

$$\text{AME}_i - \text{MEM}_i \approx \frac{1}{2}f''(\beta\bar{x})\,Var(\beta x)$$

Where $Var(\beta x)$ denotes the sample variance of the linear prediction. The relative difference between AME and MEM is

$$\frac{\text{AME}_i - \text{MEM}_i}{\text{MEM}_i} \approx \frac{1}{2}\frac{f''(\beta\bar{x})}{f(\beta\bar{x})}\,Var(\beta x)$$

In other words, the relative difference between AME and MEM is proportional to the value of the second derivative of the density function evaluated at the sample means and the sample variance of the linear prediction.

Another point we should pay attention is the result of marginal effect.

Many people expect the marginal effect to be less than one because we learn in calculus class that the derivative is the approximate change in y for a one-unit change in x. Because y is between 0 and 1, the change in y obviously cannot be greater than 1. The issue comes from the word approximately. Remember the derivative at a point is the slope of the tangent line of the curve at that point. The approximation of a curve by a tangent line is good close to the point where the tangent is drawn, but if the slope of the curve is changing quickly, this approximation is not very good further away from the point, at this time the marginal effect may be greater than one[10].

[10] http://www.stata.com/support/faqs/statistics/marginal-effect-greater-than-1/

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