The Determinants of House Prices in Chinese Cities

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Abstract

House prices in China have risen to unprecedented levels during the last decade. This can be attributed to either equivalent changes in fundamentals such as the income or the population growth rate, to the governmental stimulus program introduced shortly after the financial crisis, to the lack of alternative investment possibilities or to speculative motives of investors.

The investigation of the fundamental determinants of house prices in China makes up the main issue of this paper. Several empirical attempts to quantify the fundamental determinants of house prices will be conducted using various econometric approaches. These include static regression analysis, the development of an error correction model and the construction of a dynamic OLS model. The analyses were made using a panel data set based on data from 70 medium-sized and large Chinese cities ranging from 1998 to 2011. Even though the models fail to fully predict the development of the house prices in all cities, they explain a large portion of the variance. The results suggest real estate overvaluations during the years 2002-2003 for Shanghai and during the years 2006-2008 for Shenzhen. However there are no signs for large overvaluations in more rural medium-sized cities such as Hefei or Xining. Since 2009 prices have stabilized and seem now to be rather in line with the underlying fundamentals.

Nevertheless this paper concludes that there are structural problems in the Chinese housing market leading to high property prices, which require the central government to ease its policies with respect to a higher interest rate, an increase of home ownership costs and an opening of the financial market leaving the people with more investment possibilities. These measures would guarantee a stable housing market in the future.

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1. Introduction

Since the bursting of the US housing bubble in 2008 which triggered a global recession, house prices and their development have become a matter of particular concern for both economists and politicians. The Chinese housing market - to most extent spared by the global crisis - has experienced dramatic persistent increases in house prices during the last decade. These rises in prices have attained global interest and generated the question whether there is a bubble in China's housing market. Even though the house prices in China vary to a great extent among different regions, already the average national sales prices increased by 5.7% in the year 2009 (Yan et al., 2011) and economically booming cities like Beijing, Shanghai or Shenzhen have experienced much higher increases. The following figure 1 shows the annual growth rates of the house prices in Beijing, Shanghai and Shenzhen from 2000 to 2011 to get a first impression of the development of the house prices in these cities.

Figure 1: House Price Growth Rates for Beijing, Shanghai and Shenzhen

Source: Own demonstration, data based on the China Statistical Yearbooks, 2000-2011.

The growth rates in figure 1 above are based on the data of the house price index which are provided by the China Statistical Yearbooks. This house price index HPI is measured by taking the previous year as a baseline (year-on-year approach, the value from the preceding year $= 100$) and provides the possibility to observe the development of the house price

increases. The growth rates that are shown above can be calculated from the house price index. However data for the actual levels of house prices are not publicly available and a comparison of the actual house price levels is therefore not possible.

The enormous increase in house prices can be attributed either to a commensurate increase in GDP and changes in other fundamentals as proposed for instance by Rothman (2011) or to the adoption of radical governmental stimulus programs that were supposed to antagonize the potentially harmful effects of the financial crisis on the Chinese economy (Dreger and Zhang, 2010). Other explanations for the rising prices include low property taxes, the general governmental encouragement of home ownership or the unavailability of alternative investment possibilities (Ahuja et al., 2010). Wang et al. (2010) on the other side constitute these high increases of prices mainly to the deeper integration within the world market of China. As the question of whether the Chinese house prices have developed according to economic fundamentals is still inconclusive and highly controversial among economists, this field of study offers many interesting research possibilities that I want to explore in this paper. However not only the evaluation of the Chinese housing market is of great interest but also the elaboration of general possibilities on how to assess a housing market is one of the most interesting topics in today's economics. Even though research has been widely conducted in the field of real estate in general, research on the Chinese market is rather limited. Most of the available literature covers the US market, whereas only little is provided for China. This might be partly because of the insufficient data situation. Therefore this paper is trying to fill a gap in existing literature by applying different econometric approaches.

The main aim of this paper is to determine whether the house prices in Chinese cities are consistent with the development of the economic fundamentals. For that I will explain different methods for the assessment of the stability of a housing market and I will develop econometric models to see whether the house prices have developed according to their underlying fundamentals. The focus of this work lies on China as the Chinese market exhibits several idiosyncratic characteristics that have to be taken into account. Therefore a deeper understanding of the existing practices in the Chinese real estate market will be provided.
The econometric analysis is mainly based on Ahuja et al. (2010) who developed a dynamic OLS model to evaluate the Chinese housing market, and on Quigley (1999) who conducted several simpler regression analyses on the US market. The formal aspects of this work are primarily based on the papers by Dreger and Zhang (2010), Glindro et al. (2008), Rothman (2011) and Wu et al. (2010) whereas the data are taken from the China Statistical Yearbooks, China Data Online and the World Bank.
The main findings of this paper can be summarized as follows:

- After the tremendous increases in house prices during the last decade the government

successfully stabilized house prices in all 70 observed cities after 2009. But even though house prices do not grow anymore, they have remained on high levels.

- The static regression analysis reveals highly significant impacts of the included fundamentals, i.e. of the population growth rate, the development of the Shanghai Stock Exchange Index, the consumer price index, the GDP, the savings, the investments in fixed assets, the construction activity (measured in number of completed floor space in m^2) and of the unemployment rate on the house price index.

- Furthermore a co-integrating relationship between the house price index and the GDP, the savings, the investments in fixed assets and the construction activity has been detected. The developed error correction model (ECM) shows a long-run equilibrium between the house prices and the included regressors and explains the short-run changes in house prices based on changes in the co-integrated variables. The error correction mechanism reveals a highly significant adjustment coefficient of -0.4 implying that an economic disequilibrium in the market will resolve after 2.5 years.

- The subsequently developed dynamic OLS model - including as well a short-run and a long-run equilibrium model - controls for endogeneity, autocorrelation and heteroskedasticity and still shows basically the same results as the previous ECM.

- The two dynamic models show an overvaluation of certain cities in the coastal areas, but almost no deviations in the rural parts of the country (except for Urumqi). To be more concrete Shanghai shows an overvaluation of around 12% in 2002-2003 and the houses in Shenzhen were overvalued by around 7% in the years 2007-2009.

- A comparison between the predictions of the developed models and the actual development of the house prices shows that the dynamic OLS model captures the long-run relationship between the house prices and the included fundamentals best. However the model still fails to fully predict the short-run behaviour of the house prices. This leaves two options: either is the model not well enough developed or there are other factors determining the house prices in the short run. This includes other not in the analysis included fundamentals or the existence of speculative behaviour in the market. As the $RMSE$ statistic shows good results for the predictive power of the models, the second option is more likely. The answer to this question however is open to further research and cannot be answered in this paper.

The remaining part of the paper is structured as follows: Section 2 provides a deeper literature review on the topic and identifies the gap in existing literature that this paper

aims to close. The subsequent section 3 lays out the recent developments in the Chinese housing market, i.e. the different reforms, the influencing policies and their impacts will be discussed in more detail. Then in section 4 the idiosyncratic characteristics of the Chinese housing market will be explained. This includes a historical overview on the development of the property market and an explanation of the roles of the government, the state-owned enterprises and the banks. These demonstrations facilitate the understanding of the underlying processes and help therefore to deepen the understanding of the Chinese economy and its real estate market. In section 5 general possibilities of the assessment of a housing market will be discussed. This includes the definition and interpretation of different ratios and measurements that help to evaluate the situation of a property market. Then in section 6 the econometric models will be developed in order to evaluate whether the price increases in the Chinese housing market are based on underlying fundamentals. This part includes both simple regression analysis and the development of an ECM and a DOLS. Section 7 discusses the structural problems in the market and the herewith implied policy implications, and finally section 8 concludes.

2. Literature Review

The main task of this thesis is to answer the following questions: What determines the house prices and their development in China, respectively in its different cities? What are the recent price changes based on and what are the institutional influences on the housing market? There have been many studies focusing on the same questions in the US market in recent years, however studies on China's house prices are still very rare. In this section I will review the existing literature on what this work will be built on and specify the new insights this thesis will provide.

In order to understand the determinants of the house prices it is important to gain insights into the institutional framework of the Chinese housing market. Glindro et al. (2008) describe in their paper the determinants of house prices in nine asian economies including China and give a good overview on how the Chinese housing market has evolved over the last decade. They argue that in general there is a trend in encouraging house ownership from a governmental side, however property-rights problems are very acute in China, also in the real estate sector. The Chinese government is highly involved in regulating the housing market in terms of the tenure system (only leasehold system is allowed), foreign ownership restrictions (especially after the strong increases of house prices the government introduced strong restrictions in order to ease the overheating property market) and taxation policies (the government imposed taxes for the same reason as before). In addition Rothman (2011)

provides more information in order to be able to understand the Chinese housing framework. He points out that 89% of home buyers are owner-occupiers which supports Glindro et al. (2008) arguing that house ownership is encouraged and that this is one of the main reasons for the increasing demand for housing. This number however is challenged by Zhang and Cheng (2011) who argue that there is indeed highly speculative behaviour in the Chinese property market as 50% of home buyers are multiple home owners. Rothman (2011) also declares that the Chinese housing market is not overheating but is rather in line with the high income growth over all social classes over the last decade. Rothman sees the communist party as the only risk for the housing market, as they might go too far with their regulations (as described before), and suppress a healthy development of the real estate market. However this is not supported by Wu at al. (2010) who conducted an empirical analysis on the Chinese housing market and concluded that there is indeed a risk for a mispricing in several Chinese cities and that the willingness of the Chinese government (in contrast to the US government during the subprime crisis) to precociously intervene should be appreciated. Many economists share this view, such as Zhang and Cheng (2011), Ning and Hoon (2012) or Leung et al. (2010). Leung et al. (2010) also give policy advice with respect to the interest rate that is supposed to be higher. This is also one of the main policy advices provided by Ahuja et al. (2010) as will be discussed later on.

However the question whether governmental interference is desirable or not depends on how the situation of the housing market is assessed. The research on the Chinese housing market is relatively new and has its main reason in the increasing house price index around 2002-2008. One of the main questions is whether the Chinese house prices are (were) overvalued, and whether there is or was the risk of an emerging housing bubble. However it is difficult to assess the existence of a housing bubble, but one can address the fundamental determinants of house prices and draw conclusions from that analysis. As there are many possible ways to conduct an empirical analysis on the price determinants of houses the results differ as well widely. Existing literature shows that the house price index can be explained empirically by underlying fundamentals such as the GDP, the interest rate, the unemployment rate or the population growth rate. However the empirical methods can be very different. The previously mentioned paper by Wu et al. (2010) conducts an analysis using data from the land auctions in Beijing. The authors conclude that real constant quality land prices have increased by 800% since 2003 and that state-owned enterprises have played an important role in that development. According to Wu et al. (2010) the situation on the Chinese real estate market is rather serious as supply highly outweighs demand (in terms of usage), however due to expectations of high price increases, prices are still high. This conclusion clearly implies a large speculative motive behind the tremendous price increases. The argument of

an overvaluation is also supported by Dreger and Zhang (2010). Dreger and Zhang conduct a panel co-integration analysis similar to the one that will be conducted in this work. They conclude that the overvaluation is approximately 25% off the equilibrium path value that is implied by the fundamental values in 2009. Another paper by Liu (2011) addresses the question of overvaluation also empirically. Liu (2011) conducts a regime-switching model that tests for the existence of a housing bubble in China. He concludes that there is evidence for a speculative bubble in some Chinese cities between 2003 and 2007. Also an empirical approach on the determinants of house prices is provided by Ahuja et al. (2010) who conduct a dynamic OLS regression analysis showing the impact of different fundamentals on the house prices in Chinese cities. They conclude that real income per capita, real mortgage interest rate, wealth levels (as represented by the market capitalization of the Shanghai Composite stock exchange index), past land prices and the degree of urbanization can partly explain significant long-term house price trajectories. In their paper Ahuja et al. develop also a second analysis based on an asset pricing approach where they calculate benchmark prices. The authors conclude - opposite to Wu et al. (2010) - that there are little deviations of the actual prices from these benchmarks. In addition they assess the increasing prices to be not persistent and the governmental measures to be working. However Ahuja et al. (2010) also point out that there are long-run structural problems that have to be solved as for instance the lack of alternative investments for the Chinese people or the low real interest rate.

In general a lot of information regarding house price assessments, perceptions and bubble evaluations is provided by previous research conducted on the US market. Especially the research by Shiller (2004 and 2007), Mayer (2011) and by Himmelberg et al. (2005) provide valuable insights about the mechanisms in the housing market that I will use here in my thesis. However one has to keep in mind that the data situation in China is not comparable to the one in the United States. Therefore many analyses are impossible to be carried out simply because of the insufficient data availability.

A second approach pursued by some researchers when discussing whether the Chinese real estate market exhibits overvaluations, includes speculative behaviour. Wang (2012) develops several dynamic models based on the ratio of net mortgage loans to net speculative gains, and concludes in his work that the Chinese property market is full of speculative behaviour. However there is no conclusive answer from all researchers; Hu et al. (2006) for instance develop a model including fundamental and non-fundamental components of house prices and find little evidence for the existence of speculative behaviour. Nevertheless these approaches dealing with speculative behaviour are not subject to this work and leave a spot for further research. However it is interesting to see that the question whether the Chinese property market is in equilibrium or not is not conclusive in any aspect.

So to summarize this study examines the Chinese housing market and assesses the fundamental determinants of house prices. The papers by Ahuja et al. (2010) and Dreger and Zhang (2010) are very closely related to this one as they conduct empirical analyses similar to the one presented here. However this paper differs substantially from those papers as it provides additional valuable insights as follows:

1. The included independent variables are not all the same as those used by Ahuja et al. (2010) or Dreger and Zhang (2010). I am going to use more variables in my analysis and will therefore provide a more detailed picture of the house price determinants.

2. This study will in addition to the development of an empirical model also forecast the house price index development and compare it to the actual values on city-level in order to check for a potential overvaluation of the house prices.

3. In order to get a preferably detailed analysis it is important to understand the institutional framework behind the housing market and the Chinese laws and regulations. This paper will provide detailed information about the Chinese real estate market throughout the whole paper.

4. A focus of this work is also to get a detailed understanding of the Chinese system with respect to the real estate market, i.e. I will explain the roles of the government, the SOEs and the banks with respect to the property market. This part seems extremely important to me as many of the Chinese phenomena can only be understood and analyzed with a certain understanding of the characteristics of the market.

5. In addition I will explain and lay out several real estate ratios in my analysis that are valuable indicators for the assessment of a property market. These measurements will be explained and can be used universally for any property market.

As can be seen from the previous points this paper adds to the existing literature and provides interesting new insights about the Chinese housing market.

3. Recent Developments in the Chinese Housing Market

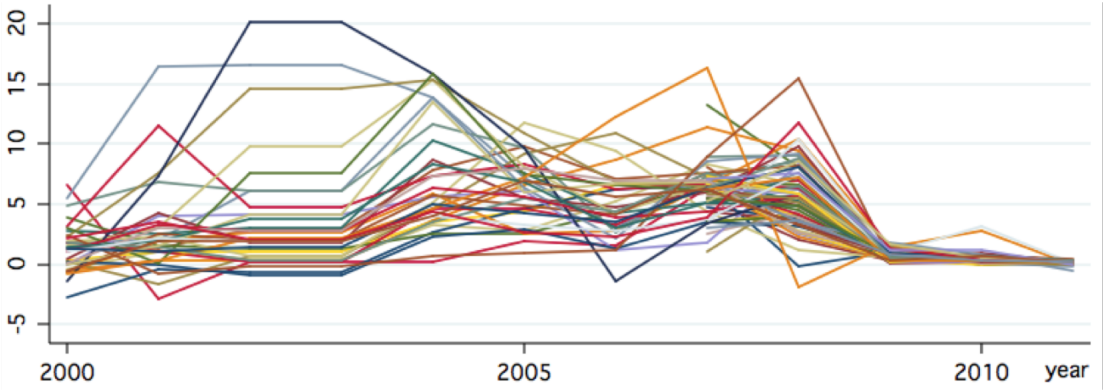
For many economists the Chinese real estate market seemed to be driven by a bubble in recent years. Reasons for that become obvious when observing the house price development during the last decade. The Chinese property market itself is relatively new, being established in 1998 when market-driven reforms in the real estate sector took off. Therefore the data situation is still rather limited. The China Statistical Yearbooks provide data for the house

price indices of 35 large Chinese cities from 1998 to 2009. In 2009 the data collection was expanded and includes now data of 70 large and medium-sized Chinese cities. The indices are provided on an annual basis until 2009, after that they are provided on a monthly basis. The house price index is calculated with respect to the previous year, i.e. only the growth rates of the house prices are reported and not the price levels themselves.

General Development:

The following figure 2 shows the development of the house price growth rates of the 70 large and medium-sized Chinese cities over the available time period. I am aware that the individual city-specific developments cannot be clearly seen on this picture, however it provides an interesting first overview on how the whole market has evolved over time. Again - it is important to notice that these values are the growth rates and the actual levels of the house prices cannot be seen (as the data are not available).

Figure 2: House Price Growth Rates for 70 large and medium-sized Chinese Cities



Source: Own demonstration, data based on the China Statistical Yearbooks, 2000-2011.

Interesting to see is the large variance of the single city-specific house price developments in the years 2000-2009 and the strong fast convergence after that, when the government set the goal to stabilize the property market. House prices have been steadily increasing as the growth rates were almost always positive and they have remained still in 2010 at high levels, even though prices have stabilized and do not increase anymore. The large variance in the earlier periods can be explained through city characteristics. Those cities with very high price growth rates are the economically booming cities on the east coast like Shanghai, Beijing, Shenzhen or Guangzhou, whereas the more rural and medium-sized cities experienced moderate or even no price increases from 2000 until 2003. From 2003 on it can be clearly seen that all property prices in the different cities increased in line with each other. Reasons for that are mainly the booming economy in general, the encouragement of house ownership and other governmental policies, and potentially speculative motives in the

market (Ahuja et al., 2010 or Wu et al., 2010). Shen et al. (2005) argue that already at that point of time there was a serious threat of a bubble in some cities (Beijing and Shanghai). After the strong increases of housing prices in 2004/05 the central government - afraid of an overheating of the property market - implemented a series of policies targeted to slow down the development in the housing sector. These policies included extra tax burdens, purchasing limitations, restrictions on loans (Yang, 2008) and a tightening of monetary policy (Ma, 2010). These measurements led to a decrease of house price growth rates in 2006/07 as can be seen in the previous figure.

During the global economic slowdown due to the financial crisis in 2007/2008 the central government introduced a fiscal stimulus package of 4 trillion RMB including massive credit expansion in order to prevent the economy from slowing down (Ma, 2010). As an example the stock of loans increased by more than 50% in 2008 providing home mortgage loans for private individuals but also credits for housing development companies (Dreger and Zhang, 2010). During that period (2007 to 2009) house prices rose to unprecedented levels. Experts were discussing whether the increases in house prices were mainly the result of a speculative bubble based on the policy measures described before or a genuine increase in demand for housing. However the Chinese central government - again alarmed by the skyrocketing prices and its potentially harmful implications on the economy - took actions in 2009 to slow down the development by increasing the nominal interest rates, rising the down-payment requirements and putting restrictions on further home purchases (Dreger and Zhang, 2010). As a result house price indices in most (all) cities have stopped rising, however the levels are in many cities still at record levels. This convergence can also be seen in the previous graph after the year 2009. According to the data there is no more large variance in the house price developments throughout the country and property prices have stopped rising in all cities.

City-Specific Development:

The previous analysis only provides a first insight of the overall real estate development. For further analysis we have to observe the development of the house prices on a city-level. As China is a large country it differs widely in its different regions and one has to be aware that Shanghai - even though it epitomizes China for most westerners - is not representative for the whole Chinese market. In order to give a better overview on the real estate market I will divide the 70 cities into four different groups according to their maximum house price growth rates. The first group contains all cities that have experienced very high house price increases of over 15% per year, the second group contains those cities with high house price increases with growth rates between 10% and 15% a year, the third group includes cities with medium house price increases (growth rates between 5% and 10% per year) and the last group covers those cities with low house price increases (growth rates of less than 5%).

- **Cities with a peak house price growth rate of more than 15% per year:**

  Nanjing, Ningbo, Qingdao, Shanghai, Shenyang, Shenzhen and Urumqi.

- **Cities with a peak house price growth rate between 10% and 15% per year:**

  Beihai, Beijing, Chongqing, Dalian, Haikou, Hohhot, Jinan, Nanchang, Sanya, Tianjin and Yinchuan.

- **Cities with a peak house price growth rate between 5% and 10% per year:**

  Baotou, Bengbu, Changchun, Changde, Changsha, Chengdu, Dali, Fuzhou, Ganzhou, Guangzhou, Guiyang, Hangzhou, Hefei, Huizhou, Jilin, Jinhua, Jiujiang, Lanzhou, Luzhou, Mudanjiang, Nanchong, Nanning, Pingdingshan, Qinhuangdao, Quanzhou, Shaoguan, Shijiazhuang, Taiyuan, Tangshan, Wenzhou, Wuhan, Wuxi, Xi'an, Xiamen, Xiangfan, Xining, Xuzhou, Yangzhou, Yantai, Yichang, Yueyang, Zhanjiang and Zhengzhou.

- **Cities with a peak house price growth rate between 0% and 5% per year:**

  Anqing, Dandong, Guilin, Jining, Jinzhou, Kunming, Luoyang and Zunyi.

It can be seen that there is a strong distribution of various levels of house price growth rates among these cities. Most of the cities had peak increases between 5 and 10%, a few had lower peak increases and 18 cities had more, from these only 7 had peak increases of more than 15%. The next figure 3 shows the distribution of the cities in the whole country. In addition table 8 in the appendix (on page 65) provides a list with all included cities and their corresponding provinces for information purposes. We can see that those cities with very high increases are mostly in the coastal areas (all except Urumqi in Xinjiang province), those with high increases are generally more in the eastern region, those with medium increases are regularly distributed over the inhabited area and those with low increases are mainly in the central inner part of the country. China is divided into 23 provinces, 5 autonomous regions and 4 municipalities that are under control of the central government. Their level of economic development is a result of discriminating policies from the central government and geographic characteristics. Therefore regional disparities in terms of economic welfare as well as in terms of industrialization are large in China. The geographical distribution in terms of house prices of the cities is consistent with the corresponding economic development, i.e. those cities with very high house price growth rates are those that have also experienced the highest economic growth rates and vice versa.

In the remaining part of this paper I will focus on specific cities that seem interesting for various reasons. When dealing with the real estate market the Chinese distinguish between

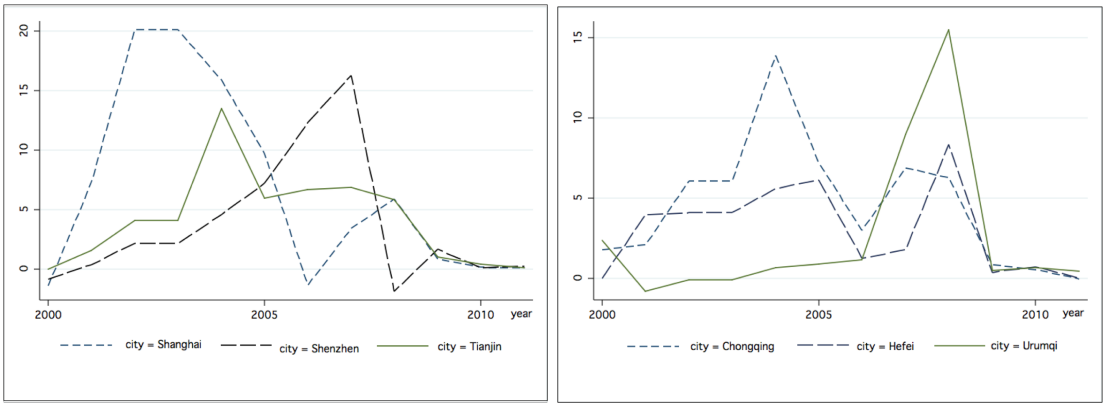
Figure 3: Location of the Cities with Booming Property Markets in China

Source: Own demonstration, map based on 'China Tourist Maps'.

655 cities which are again divided into several groups according to the development of their property market industry. These groups are called First-Tier, Second-Tier and Third-Tier Cities and they are grouped according to several characteristics such as GDP, population size or completed floor space (Jones Lang LaSalle, 2009). The First-Tier Cities include Shanghai, Beijing, Shenzhen and Guangzhou, which have the highest developed levels of real estate industry. The Second-Tier Cities include all cities that fulfill certain criteria regarding the population size, the GDP and the general development of the real estate industry. This group includes for example Tianjin or Nanjing. The Third-Tier Cities include those that do not fulfill one or two of the previous criteria. For further analysis I will pick one city from each of the three groups. For the First-Tier representative city I am choosing Shanghai (Shanghai Municipality on the East coast), for the Second-Tier city I will choose Tianjin (Tianjin Province in the Norht-East) as representative and for the Third-Tier city I choose Hefei (Anhui Province in Eastern Central China) to be representative. The reason for my choice

is that these cities are economically strong in their group and therefore represent where the other cities in their group might head to (Jones Lang LaSalle, 2009). However these groups are not made with respect to their location but only with respect to the development of their real estate industry. However as I said before the geographical location is meaningful for the house price development. Therefore it seems reasonable to take the geographical component as well into account. I will therefore add three more cities that seem representative for their geographical location. I will include Shenzhen (Guangdong Province in the South), Urumqi (Xinjiang Province in the North-West) and Chongqing (Chongqing Municipality in Central China) to represent the southern, north-western and central parts of China. In addition it is worth mentioning that those cities all experienced significant increases in house prices. The following graphs in figure 4 show the development of the house price growth rates for those cities. On the left side are Shanghai, Tianjin (First-Tier and leading Second-Tier cities) and Shenzhen and on the right graph we can see Chongqing, Urumqi and Hefei (leading Third-Tier city). We can see that all the cities exhibit a similar development as described previously in the overall development. The differences however may be due to region-specific policies and geographical characteristics.

Figure 4: House Price Growth Rates for various Chinese Cities



(a) House Price Growth Rates for Shanghai, Shenzhen and Tianjin

(b) House Price Growth Rates for Chongqing, Hefei and Urumqi

Source: Own demonstration, data based on the China Statistical Yearbooks, 2000-2011.

Compared to the previous figure 2 it is now possible to track the house price growth rates for the single cities. We can see that the amplitudes of the price increases are different for all cities, however there is a general trend for increases from 2004 to 2007, followed by a general decline due to the financial crisis in 2007 and then again a general increase due to the fiscal stimulus package. The strong increases are then followed by an abrupt fall in 2009

due to governmental measures. Interesting are mainly two things: first of all the strong variance in house price growth rates among the cities followed by the abrupt stabilization after the year 2009, and secondly the amplitudes of the price increases. If we bear in mind that property prices have been increasing every year and there have been no negative growth rates, prices must be at very high levels. The question of what drives house prices will be further discussed in the following sections. The next chapter 4 will first focus on the institutional drivers behind the housing market in China whereas the fundamental drivers will be addressed in section 6.

4. The Chinese Housing Market and its Characteristics

4.1. Historical Outline

The development of the Chinese commercial housing market started only in 1998 when the communist party disbanded their governmental work units (danwei) that had so far provided public housing for all workers. Back then over 80% of the urban housing was owned by the state (compared to for instance only 28% of state-owned housing in eastern Europe) and the companies (which were also all state-owned) were responsible to provide housing for their employees (Rothman, 2011 or Lin, 1991). However today over 80% of the real estate in Chinese urban areas are privately owned, which is one of the highest home ownership rates in the world (Rothman, 2011). The market liberalization in the 1990's included reforms in almost all sectors and many workers got laid-off during the process of privatization. For compensation purposes the government sold the previously state-owned apartments to the workers far below the market price and ordered the companies to pay out wages in cash to compensate for the previously free public housing (Rothman, 2011). The value of the houses as well as the newly received wages provided the liquidity for China's new property market. In line with the implemented property market reforms a commercial housing sector emerged with profitable construction companies and other associated industries like furnishing or housing agencies. This flourishing new sector generated a motor for GDP growth and became an important source for employment. In addition the government strongly promoted investments in the property market and fostered home ownerships as banks were now allowed to give mortgages to private individuals. Since then the housing market is an important part of the Chinese economy that accounts for a significant share of GDP (10% according to Dreger and Zhang, 2010) and a total of 16% of total investments in 2009 (Dreger and Zhang, 2010). The new housings in turn led to higher living standards across the country and the living space per capita increased from 4 square meters in the late 1970s to 28.3 square meters today (Dreger and Zhang, 2010 and Rothman, 2011). Most of the urban Chinese families

bought a second apartment when their income started rising and began to rent out their former old apartments to rural migrants. In order to understand the way the Chinese property market works today I will briefly give an overview on the current situation: Still today all land is owned by the Chinese government which represents therefore a monopolistic supplier of land. However the land can be let by the local government; the maximum leasehold periods are 70 years for residential housing, 50 years for industrial use and 40 years for commercial housing. The process of the land allocation is conducted through an auction system which works as follows: Local governments are in charge of the land. They decide which land will become available and they distribute it to construction firms through an auction where the highest bidder gets the award of the contract. So the local government leases the land to the construction company which then in turn builds houses on it and then sells these houses to private individuals. It is not allowed to individually build a house as a private person. However the individuals have the right to live in the apartment or rent it for 70 years. What will happen then is unclear up to now (Wu et al., 2010).

4.2. The Role and the Responsibilities of the Government

The government - the local as well as the central - plays a superior role in the Chinese economy. Most of the industrial sectors are still highly influenced or even controlled by the communist party and the financial sector is completely in governmental hands. However one has to distinguish between the local and the national (central) government. Whereas the central authorities mostly issue policies, control large companies, set economic goals and act as supervisors, the local officials are responsible for the conduction and - if they wish - an intensification of the imposed central policies. However in the case of land, the local authorities act as the monopolistic supplier of land and their influence on the housing market is therefore unmistakable. As China has one of the most centralized governments in the world, the local authorities are not allowed to tax, borrow or issue bonds (Rothman, 2011). All these money raising possibilities are solely entitled to the central government, which in turn provides the locals with financial resources. However one of the possibilities of the local governments to raise their income is land leasing which is completely under local control. This system leads to certain structural problems as the local and the central authorities do not share the same goals towards the supply of land (Li and Ma, 2009). The central government is concerned about food supply for the whole population which depends on the available agricultural land. However the local governments would like to lease as much land as possible in order to increase their revenues (Li and Ma, 2009). As China has only about 10% of arable land (compared to for instance 25% in Europe) this shortage can lead to serious dependencies from food imports. Nevertheless today land leasing earnings have

become one of the major sources of income for local governments as the local government has the ability to sell land use rights and to implement policies. This has led to problems regarding corruption and misgovernment, as no one controls the system of land leasing. For most local governments income from land auctions has become essential for surviving as many of them suffer from high levels of debt. For instance in Beijing the income from land amounts to 46% of total income of the local government (Dreger and Zhang, 2010).
When coming back to the main topic of this paper - namely the determinants of house prices - one has to keep these implications in mind. As the local authorities have the goal to increase their revenues as much as possible they are interested in possibly high leasing rates. This adds to the high house prices as the construction companies have to be compensated for their lease rates. When the Chinese central government realized that prices were skyrocketing they encouraged several state-owned enterprises (SOEs) to engage in the housing market (so that they could control it better). However SOEs are financially less restricted as they can get high loans from the (state-owned) banks - which private firms cannot. The local governments in turn know that the SOEs involved in the housing market have better access to capital and therefore they sell them the land to a higher price. To close the loop it is the case that SOEs often get the specific order from the central government to win an auction and as local officials know that, they can artificially increase the bids. The impact of SOE activity in the real estate market is substantial, the exact estimations of the impacts of SOE bids on land lease prices however differ widely among economists (compare for instance with the article on cnbc.com). This point will be undermined with some numbers in the following section. Besides the encouragement of SOEs to get engaged in the housing market the central government imposed multiple rules and regulations in order to cool down the overheating property market when prices were skyrocketing. As the government can control almost all policies without further restrictions its influence on the property market is very large. The following measurements are examples of typical governmental interferences that have led to strong price relaxations on the Chinese real estate market (Ahuja et al., 2010):

- In 2007 when property prices were largely increasing the government increased the VAT (value added tax) on land transactions, raised the minimum down-payment ratio (to 40%) and increased the minimum mortgage rate in order to cool down the market.
- In 2008 - again due to the high real estate prices - taxes on both capital gains and personal income were set up and the government issued a law that forbid banks to give loans for land purchases. With these measurements demand for house purchases decreased and therefore also prices stagnated.
- Again in 2009 the initial payment for land purchases (down-payment ratio) was raised

to a minimum of 50% in order to decrease demand for housing.

- And in 2010 the central government again raised the minimum down-payment ratios for several mortgages, restricted the mortgage-lending to non-residents and increased the land supply for residential properties.

These policies are very typical for the Chinese government and show with what measures they try to control the market. In addition there are often city-specific regulations about how many property units a household can buy. And regarding foreign home ownership the Chinese government adjusts rules from time to time in order to keep the housing market at a regular path. These are only some of the policies issued, but they seem to be the most often used policies and the most popular among Chinese politicians.
However these measurements only treat the symptoms of the high housing prices and not the underlying structural reasons. This topic however will be discussed in section 7.

4.3. The Role of the State-Owned-Enterprises SOEs in the Market

State-owned enterprises (SOEs) still play an important role in the Chinese economy. Even though many sectors have been privatized since 1978 the Chinese central government declared certain sectors for strategic, which have therefore to be under governmental control. There are three different possibilities of how a SOE can be structured (Szamosszegi and Kyle, 2011). First there are companies that are fully owned by the state. When talking about 'the state' this refers to the 'State-owned Assets and Supervision and Administration Commission (SASAC)' that is the organization through which the Chinese state controls its assets and companies. Then secondly there are SOEs that control other companies that are not officially SOEs, however they are controlled by them. And thirdly there are entities that are indirectly controlled by SOE subsidiaries in- and outside China (Szamosszegi and Kyle, 2011). In addition there are urban collective enterprises and township and village enterprises (TVEs) that also belong to the government but are not officially considered as SOEs. It is unknown what proportion of the Chinese economy makes up for SOEs. Szamosszegi and Kyle (2011) argue that approximately 50% of the GDP in China is controlled by the state. A study conducted by McKinsey (2009) estimates that this number is similar in some African countries (around 50%) but significantly lower (15%) in European and other Asian countries. A more accurate distinction between the countries however is not provided.
SOE industries are not built randomly. The SASAC has announced several industries to be strategically important and these sectors will stay under complete state control. The strategic sectors include national defense, electric power and grid, petroleum and petrochemicals, telecommunications, coal, civil aviation and shipping. In other so-called pillar industries the

government will remain the major player with a majority of control. The pillar industries include for instance steel, machinery and equipment, car production and construction industry. However 'state-owned' means not only that the state owns the companies, but also that it provides them with special treatment, less risk and better conditions. The relations between politicians and SOE managers are very close and for a company, being a SOE exhibits several advantages. So do SOEs benefit from preferred access to bank capital, below-market interest rates on loans from state-owned banks (this will be explained in more detail in the next chapter), favorable tax treatment, policies that create a favorable competitive environment for SOEs relative to other firms and large capital injections when needed. And in addition SOEs also seem to dominate China's expanding government procurement market (Szamosszegi and Kyle, 2011). As mentioned before construction is considered as being a pillar industry in the Chinese market and therefore we can find here again the link to the housing market. The reason for that is that the real estate market is a very important part accounting for economic growth, and therefore the national government wants to keep the market stable and under control - which is mostly done through the SOEs. As already pointed out before the government encouraged SOEs that did not count construction to their core business to engage also in construction in order to strengthen the governmental position in the market. The exact impact of the SOEs on the prices is controversial. However Wu et al. (2010) state that the prices of land (in Beijing) were 27% higher when a SOE wins a land auction that is strongly associated with the national government. In addition Deng et al. (2011) state that in 2009 the land auction prices increased by 100% when SOEs became more active buyers due to the governmental demand. This means that the intention of the national government - to calm down the property market - had the opposite effect and led to costly resource misallocations (Deng et al., 2011).

4.4. The Role of the Banks in the Market

Banks play an important role in the property market, since there cannot be any transaction in the housing market without the direct support of the banks (Wang, 2012). Bank lending is the most important form of financing in China as most companies are denied access to capital from other outside sources. China's financial sector is still tightly controlled by the government and the banking sector is dominated by the 'big four' state-owned banks (The Bank of China (BoC), the Agricultural Bank of China (ABC), the People's Construction Bank of China (PCBC) and the Industrial and Commercial Bank of China (ICBC)). However the competition between these banks is very low as the government sets the interest rates and guarantees them a certain profit. These state banks tend to favour SOEs at the expense of private firms (Szamosszegi and Kyle, 2011) which on one side makes state-owned companies

more competitive as they have easier access to capital and leads on the other side to an under-supply of capital in the private sector.
When the property market began to take off in 1998, banks were allowed to give loans to construction companies and to private individuals. This increased their exposure substantially. For instance Deng and Fei (2008) argue that the ratio of mortgage loan balances to total bank loans increased from 0.5% in 1998 to more than 10% in 2004. However such numbers on the exposure of banks are delicate. On one side Rothman (2011) argues that because the banks are not allowed to offer subprime mortgages or option adjustable-rate mortgages to private individuals and because securitisation and home-equity loans are rare, that generally the whole market is more traditional and safer. This seems not only true for China, but for the whole Asian market. Warnock and Cacdac Warnock (2008) estimate the depth of the Asian mortgage market (mortgages in % of GDP) to be approximately 15%, compared to 50% in Europe and 68% in the US. On the other side Weng (2012) argues that the banks played an important role in encouraging speculative behaviour as they had the goal imposed by the government in the 1990's to increase loans by 15% per year. Reasons for that were that the prices in the property market were rather low in the beginning of the privatization process and that the government wanted to boost the economic growth process with a high price strategy in the housing market. As the banks had to meet these goals they were forced to give loans to speculators and this in turn led to speculative behaviour and a larger exposure of the banks. So the role of the banks is extremely important, not because they make up for a big share of GDP but because they are one of the most important tools through which the government can control the market - including the property market.

5. Real Estate Indicators for the Assessment of a Property Market

When discussing the determinants of house prices the main question in most cases is whether there is an overvaluation of the house prices, i.e. whether the market is in equilibrium according to its fundamentals. But why is it so important to catch the early signs of an overvaluation in the property market?
The housing market is an important part of an economy as private property serves on one side as a consumption good and on the other side also as an investment good. In China housing is the most important private property of the people and mostly a household's largest individual investment is its own property. As an example Liu and Huang (2004) estimate that the house equity value is approximately 47.9% of the wealth of the Chinese people. This value is similar to the number estimated by Bostic et al. (2008) who argue that the

home equity value was more than 50% of the wealth of US Americans before the crisis. This number however is probably considerably lower today after the burst of the housing bubble. However this is a high value and therefore changes in house prices are supposed to have higher effects on private wealth than changes in financial investments for instance (Glindro et al., 2008). Due to that a housing bubble is not only considered an economic problem, but also one affecting the people's livelihood and therefore social stability (Dreger and Zhang, 2010). As individuals are strongly affected by changes on the property market, it is therefore important for policymakers to carefully observe potential mispricings of housing.

But what determines the fair price of a property? In the long run the price of a house should be the present discounted value of future rents plus the resale value of the house. This value is determined by the demand and the supply of housing possibilities, which in turn depend on fundamentals such as the income, the interest rate or the population growth rate. However in the short run property prices can deviate from their long-term values due to economic cycles (booms or recessions). Later in chapter 6 I will develop an econometric model that captures exactly these imbalances between the long-run prices and the short-run deviations. Such a model can tell us whether the housing market is in equilibrium or not. However there are also less complicated methods that can be used to detect potential overvaluations in the property market. As econometric analysis is complex and time-consuming economists have attempted to identify potential bubbles or property mispricings with appropriate indicators (EDinformatics, 2007). The following sections explain these indicators and point out from what fundamental values they depend on. The main problem is that these indicators never give us a full picture of what is going on in the market because they only depend on one fundamental each. Therefore the indicators cannot tell us exactly whether the house prices are in line with all fundamentals or whether the prices are off the equilibrium path, however they can give us a first impression on where the price development is heading to and whether there is a risk of a mispricing.

The indicators expose two different aspects: the valuation component and the leverage (debt) component. The first aspect measures how expensive houses are with respect to the income and the other aspect measures how indebted households become from buying the property, which includes also the bank exposure. In this part I will describe several of these indicators which show how the situation of a housing market can be assessed. I will implement these indicators with respect to China, i.e. the Chinese cities we picked before as key markets, i.e. as representatives for their property industry development and their geographical location (Shanghai, Shenzhen, Tianjin, Chongqing, Hefei and Urumqi). However these indicators are universally applicable and can be used in every market for the evaluation of real estate.

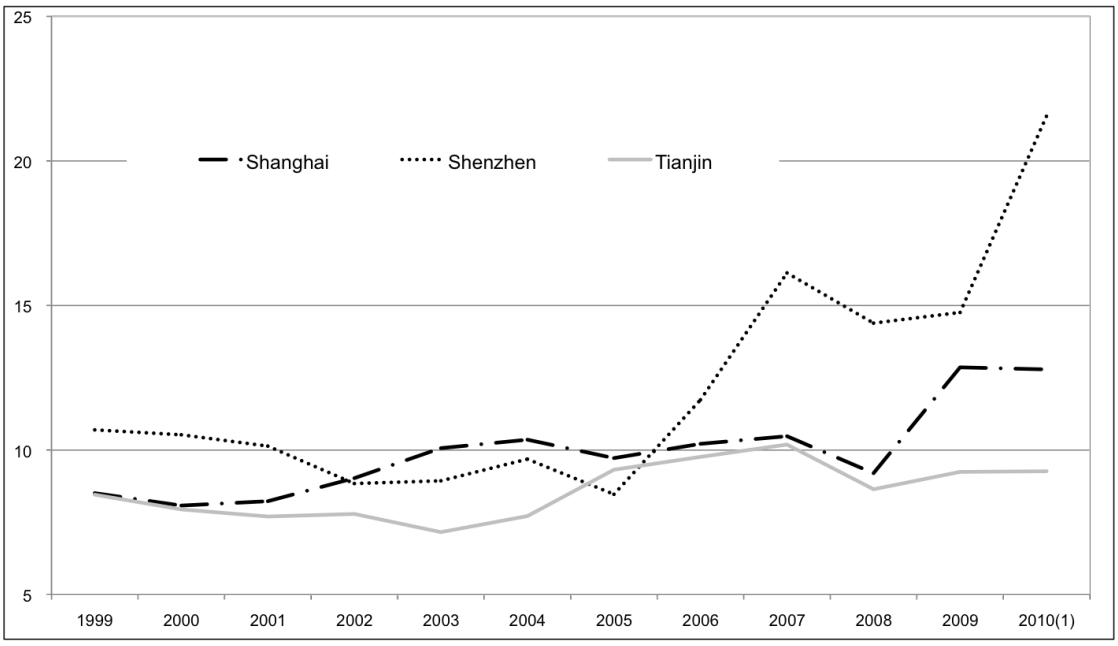
5.1. Housing Affordability Measures

Housing affordability measures depend on one of the most important fundamentals, namely on the income. They - simply spoken - evaluate whether housing is affordable for the citizens.

Price-to-Income Ratio:

The price-to-income ratio is the basic affordability measure. It is the ratio of the average house price over the average income. This indicator measures whether housing is affordable for the 'average' citizen. If house prices start increasing substantially property becomes unaffordable, which is an indicator of overpriced real estate. Wu et al. (2010) provide data on the development of the price-to-income ratio for Shanghai, Shenzhen and Tianjin as can be seen in the following figure 5. We can detect a clear increase of the ratio in all three cities and mostly for Shenzhen. This would imply a potential real estate overvaluation during that period of time. The reason for that is that the underlying fundamental value - the income - did not increase in line with the prices. However as we pointed out before, this is only one part of the whole story. In order to be able to tell whether there is a bubble it is necessary to check what other measures say.

Figure 5: Price-to-Income Ratios for Shanghai, Shenzhen and Tianjin



Source: Wu et al. (2010).

5.2. Housing Debt Measures

Housing debt measures estimate how indebted average households become when buying real estate. These measurements capture on one side the interest rate (if mortgages are used to buy the property) but on the other side also the exposure of the banks to the property market. In addition they include the expectations of the buyers, i.e. they can eventually tell whether there might be speculative behaviour in the market.

Housing-Debt-to-Income Ratio:

The housing-debt-to-income ratio is the ratio of mortgage payments to available income. When the ratio increases, the owners will depend more and more on an increasing property value in order to be able to service their debt. This development can quickly become dangerous for the economy when the house prices start decreasing and the home owners are unable to pay back their mortgages. In China however the usage of mortgages is relatively new and uncommon. According to Rothman (2011) there is an extremely low leverage among real estate buyers as 33% (in 2007) of all buyers paid all cash and for those who do use mortgages, the leverage is relatively low, i.e. the buyer's equity stake is high and this can absorb large decreases in prices if house prices start to fall. According to Rothman (2011) the average cash down-payment was 44% in 2011 and he argues that subprime mortgages and option adjustable-rate mortgages are not allowed in China.

Housing-Debt-to-Equity Ratio:

The housing-debt-to-equity ratio is also called loan-to-value ratio (LTV) and explains the financial leverage. If the ratio is exactly 1, we have 100% leverage and a ratio of more than 1 means a negative asset. As mentioned before the average cash down-payment was 44% in 2011 which implies a relatively low LTV of 56%. When prices then decrease by 10%, the LTV will increase to 62%, which is still low. The situation becomes critical with an LTV of 100%, however if prices were to fall by 33% (like in the US during the recent crisis), this would imply a LTV of 84%, which is high, but still bearable because it's lower than 100%, so the banks are not at risk. So based on these data we can say that the Chinese home buyers are not highly indebted for property investments.

This ratio is also extremely useful in estimating the risk exposure of the banks. If the LTV becomes larger than 100%, there is a risk for the banks. Before that the private investors have to bear the costs of a price decrease themselves.

5.3. Housing Ownership and Rent Measures

Home ownership measures can be used to assess whether the market is driven by speculative investors' demand (where a small fraction of people (the investors) makes up for a large

portion of the the demand) or by a substantial increase in fundamental demand.

Ownership Ratio:

The ownership ratio is the proportion of households who have their own property and do not rent. As the government encouraged home ownership through various channels, the rate in China is high compared to other economies. According to Rothman (2011) the overall home ownership rate in China was 82% in 2007 (compared to for instance 68% in the US). According to Rothman (2011) not only the wealthier Chinese belong to the home owner fraction but also the poorer citizens as can be seen in the following table 1:

Table 1: Home Ownership Rate & Floor Area for different Income Groups, China, 2007

Income Group	**Homeownership Rate**	**Average Floor Area (m^2)**
Lowest 10%	72.9%	67.8
2nd 10%	77.6%	72.2
3rd 20%	80.5%	77.5
4th 20%	83.5%	83.6
5th 20%	86.0%	89.6
6th 10%	86.2%	96.3
Highest 10%	87.4%	107.3
National Average 10%	82.3%	84.5

Source: Rothman (2011) and Man (2011).

According to Rothman (2011) the extraordinarily high home ownership rate is one of the main reasons why house prices in China are not mispriced, because the prices seem to be mainly driven by a genuine increase in demand from new home owners (the demand for living space is steadily increasing as also the floor space demanded increases) and not by speculators. Rothman estimates the fraction of speculative investors to be 10%, however this number is not clearly funded and other papers state much higher numbers (for instance Zhang and Cheng (2011) state that 50% of the property is bought from investors). Important to mention is that a high home ownership ratio is only a sign for a steady demand, given that the LTV is still low. Otherwise there could be a dangerous situation like in the US market before the crisis where many households got deeply indebted to afford a house even though they basically could not afford it and were speculating on a increasing price in the future. So it is important to take several measures into account when assessing the risk in the market.

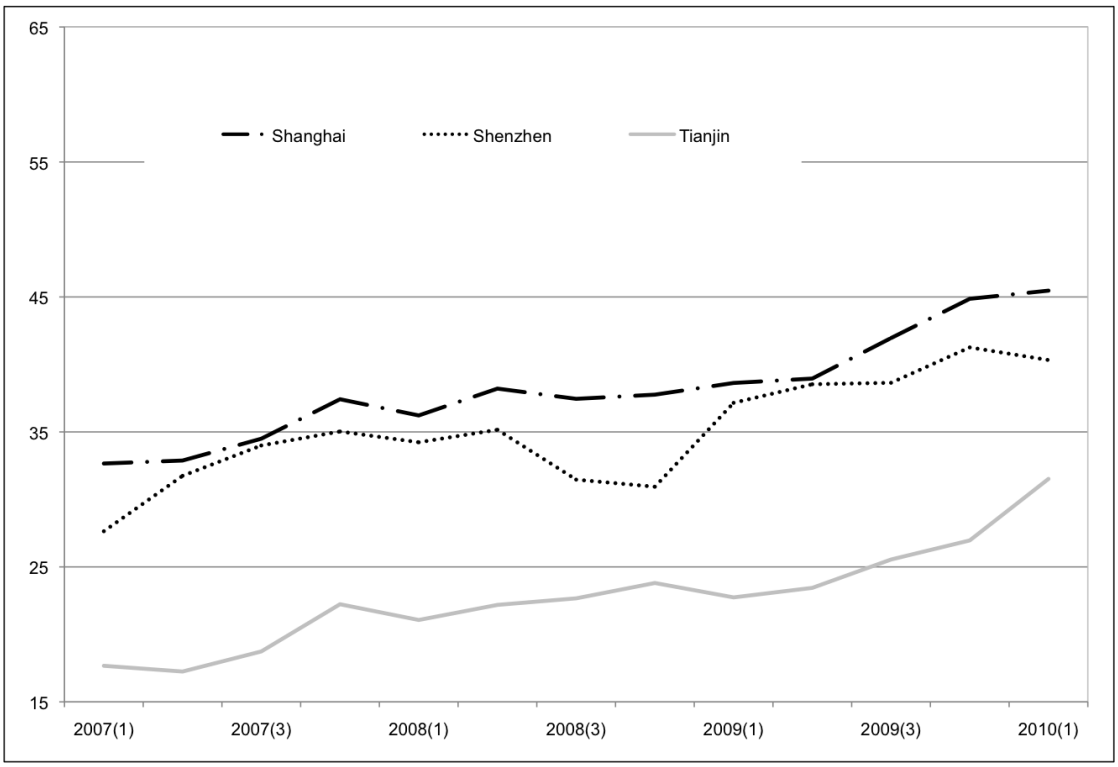
Price-to-Rent Ratio:

The price-to-rent ratio is defined as the house price divided by the sum of the annual rents:

$$\frac{P}{R} = \frac{HousePrice}{12 * MonthlyRent}$$

This value measures how much the buyers pay for the property for every unit of received rent. Rents are very closely related to supply and demand and are therefore supposed to be rather stable. If price-to-rent ratios start increasing and rents stay constant, this can be a reliable signal for the onset of a bubble. Wu et al. (2010) provide price-to-rent ratio data for Shanghai, Shenzhen and Tianjin. We see in figure 6 a stable increase of the price-to-rent ratios for all three cites which would support the idea of an overvaluation of real estate.

Figure 6: Price-to-Rent Ratios for Shanghai, Shenzhen and Tianjin



Source: Wu et al. (2010).

Number of Vacant Flats:

Another meaningful real estate indicator is the number of vacant flats because it measures the lacking demand for living space. A high rate of vacant flats implies speculative behaviour in the market because buyers refrain from a rent (because the demand is too low, everyone buys an apartment and no one rents one) because they expect the prices to rise in the future

so that they will be compensated later on. So even without a rent the buyers expect the final pay-off of the property to be higher than the price and the maintenance costs. This is a clear sign for speculative behaviour. Haila (1999) argues that even when the housing market took off in the late 1990's, already 40% of the buildings in Shanghai were vacant. However there are still today no reliable data available on the number of vacant flats in China. However when travelling, empty houses and 'ghost cities' are evident in all parts of China.

5.4. Sum Up

As could be seen in this section there is a mixed perception of the Chinese housing market. On one side there is indeed evidence for real estate overvaluations. For instance the price-to-income ratios and the price-to-rent ratios imply a certain mispricing. However there are also arguments supporting the Chinese property market development like to low LTV or the high home ownership ratio. In order to be able to answer the question whether the house prices have developed according to the fundamentals and whether property prices are in equilibrium we need stronger econometric analysis. This will be provided in the upcoming section.

6. Can Fundamentals explain the House Prices?

In this chapter thorough econometric regression analysis will be conducted in order to answer the question if economic fundamentals can explain and forecast property prices. In the first subsection I will describe the data and their economic intuition. In the second subsection the static regression analysis will be carried out. Following that the third part includes a dynamic regression analysis with the development of an error correction model. The fourth section includes important robustness checks and ideas on how to improve the model. Then section five incorporates these adjustments in a dynamic OLS model. Following that in section six forecasts based on the dynamic OLS model will be analyzed as this model has the highest predictive power, and subsection seven includes a conclusion of the econometric analysis.

6.1. The Data

The empirical analysis is based on an unbalanced panel data set covering 70 Chinese cities over a period from 1998 to 2011. However it is worth mentioning that I will downsize the data set in the dynamic models to 35 cities over a period from 1998 to 2011 because of missing values. The data are collected from different sources, i.e. from the China Statistical Yearbooks, China Data Online and the World Bank.

- **House Price Index HPI:** The house price index data are collected from the China Statistical Yearbooks which provide indices from 1998 to 2007 for 35 large Chinese cities. Then from 2008 on there are data for 70 large and medium-sized Chinese cities as the data collection was expanded to 70 cities. The data are collected on an annual basis from 1998 to 2008 whereas they are collected on a monthly basis from 2009 on. The monthly indices will be converged to an annual value as there are only annual values from 1998 to 2008. The house price index is calculated as follows: It takes the previous annual value as 100 and calculates then the percentage increase or decrease over the following year (year-on-year approach, y-o-y), therefore the base line is always the preceding year and we have basically only the growth rates of the house prices in the different cities and not the property price levels themselves.

  Intuition: The house price index shows the development of the house prices in specific Chinese cities and serves in my analysis as the dependent variable. As there are no data publicly available on the levels of house prices, I will use the index only. These data have also been used by other researchers (for instance by Ahuja et al., 2010).

- **Population Growth Rate POP:** The data for the population growth rates are as well collected from the China Statistical Yearbooks. I am going to use the annual natural population growth rate (in one tenth of a percent) which is not provided for the cities but only for the provinces. However due to the difficult data situation (there are no data on the population growth rates on a city-level, and even if there were, they would be strongly biased as the Chinese government does not include the rural population migrating to the cities in their statistics due to the Hukou-system), I am going to use the provincial data, again from 1998 to 2011, as proxies for the data on city-level.

  Intuition: The population growth rate is supposed to be one of the key drivers behind genuine increases in house prices. As a larger population leads to a higher demand for housing, prices are expected to increase ceteris paribus due to higher demand. Therefore we would expect the relationship to be positive. The population size or growth rate is often used as an explanatory variable as also for instance by Glindro et al., (2008) who also found a positive relationship between these two variables.

- **Gross Domestic Product GDP:** One of the most important variables in my analysis is the income. I am going to use the per capita annual income of urban households (in CNY) in my analysis that is provided as well by the China Statistical Yearbooks on provincial annual level from 1998 to 2011. For variance reasons the income can also be substituted with the Gross Domestic Product GDP per capita that is also collected on an annual provincial level from the China Statistical Yearbooks (however only on

provincial level). I will have to check which one of the two variables fits the model better and then decide which one to include.

Intuition: When the people's income increases, their demand for housing also increases as housing is a normal good. Therefore the relationship is supposed to exhibit a positive sign. Again this theory is supported by various research papers (i.e. Ahuja et al., 2010 or Glindro et al., 2008).

- **Consumer Price Index CPI:** In order to control for a general price increase I will include the consumer price index CPI in my analysis. I am going to use the general CPI provided by the China Statistical Yearbooks, again on provincial annual level as proxy for the inexistent city-level data. The CPI is always calculated as the change to the previous year (y-o-y approach) like the house price index.

  Intuition: The consumer price index captures the general price increase due to monetary policies or other inflationary mechanisms. As housing is one of the largest expenditures of the population we expect the house prices to be in line with a general price increase. So we expect the relationship to be positive. To support the relationship between the CPI and the house prices, Leung et al. (2010) argue that housing was the second largest contributor to the increase in Chinese inflation during 2002 to 2004.

- **Savings SAV:** The data collected for the savings are provided by China Data Online. They are defined as the outstanding amount of savings deposit of urban and rural residents at year-end (in 100 million CNY), covering a timeline from 1998 to 2011. Again they are collected on a provincial level and will be used as proxies for the city-level data, as the city-level data are not publicly available or inexistent.

  Intuition: The relationship between the house prices and the savings is ambiguous. On one side models of life-cycle saving behavior can suggest that increasing real estate prices will reduce the savings of those in possession of a house, but on the other side higher house prices will increase savings among those who want to buy a property in the future (income being equal). Kennedy and Andersen (1994) already described an ambiguous relationship between the savings and the house prices in their paper, arguing that the relationship can be negative or positive depending on the country and its characteristics and institutions.

- **Investments in Fixed Assets INV:** The total investment in fixed assets is provided on provincial level from 1998 to 2011 by the China Statistical Yearbooks. The numbers are collected in 100 million CNY. The data are collected on an annual level and will serve as proxies for city-level data as city-level data are not available.

Intuition: For the intuition we can argue that high investments in fixed assets in general will also lead to high investments in housing, as housing is a fixed asset. When investment in fixed assets (housings) increases, the supply of housing in general increases and therefore prices are supposed to decrease ceteris paribus due to a higher supply. Therefore we would expect the relationship to be negative. Ma (2010) argues for instance in his paper that the Chinese government set up a stimulus package in order to cool down the property market and that this money was mainly invested in fixed asset investment in order to increase supply and therefore decrease prices.

- **Construction Activity CON:** The construction activity is captured as the number of total completed floor space of buildings in 10'000 sq.m. These data are as well provided on an annual provincial level from the China Statistical Yearbooks and range from 1998 to 2011. Again the provincial data will be used as proxies for the city-data which are not available.

  Intuition: Regarding the intuition we can argue that a higher number of completed floor space (high construction activity) leads to a higher supply, and therefore to a lower price (other things being equal). Therefore we would expect the relationship to be negative. Quigley (1999) uses a similar measure, namely the number of construction permits. However the argument is the same.

- **Unemployment EMP:** The data for the unemployment are collected from two different sources. One is the number of urban registered unemployees at year-end on provincial level provided by China Data Online and the second one is the unemployment rate on provincial level again from the China Statistical Yearbooks. The timeline is here again 1998 to 2011. I will decide on which data I am going to use later on based on the statistical fit in the econometric analysis.

  Intuition: The intuition behind the unemployment and the house prices is easy to understand. More unemployed people lead to a lower income and therefore to a lower demand for housing. Therefore we would expect the relationship to be negative. Quigley (1999) as well includes the fraction of employed people as an independent variable in his analysis, which leads to the opposite effect as expected here.

- **Shanghai Stock Exchange SSE Index:** These data are collected from the homepage of the SSE and are broken down into annual data from 1998 to 2011. Apparently these data are national and neither on provincial nor on city-level.

  Intuition: The intuition behind the relationship between the Stock Exchange and the house prices lies in the fact that investing in the Stock Exchange and investing

in housing is complementary. This means that if the value for the Stock Exchange increases people are more likely to invest their money there, as their return on equity is increasing on the stock market. If people invest more money on the stock market, this money won't be spent on the housing market and therefore demand for housing decreases. Therefore we expect a negative relationship. Also Ahuja et al. (2010) include the stock price index in their analysis, however - against economic theory - they find a positive coefficient. However the lack of alternative investment possibilities in China is supposed to be one of the key drivers behind the large house price increases, therefore from an economic point of view these two investment possibilities should be regarded as complementary and therefore the relationship should be negative.

- **Geographical Location of the Cities GEO:** In addition I will include a dummy variable for coastal provinces that is supposed to capture the influence of the geographical component on house prices. The dummy will be 1 for all cities that are located in a province that has a border to the sea and zero for those which do not.

  Intuition: It could be assumed that those cities in the eastern part experienced higher house price increases due to the strong economic developments of the recent years which are based on the unequal economic treatment of the different provinces since 1979. Therefore we would expect the relationship to be positive.

6.2. Static Regression Analysis

Development of the Model:
The analysis conducted in this part of the thesis is based on one of the simplest equilibrium in economics, namely on the equalization of supply and demand. I will define the demand for housing as a function $Q^d = d()$ depending on the population growth rate POP, the development of the Shanghai Stock Exchange Index SSE, the GDP, the geographical attractiveness of the city GEO, the savings of the population SAV and the employment situation EMP. i stands for the city whereas t captures the time period.

$$Q^d_{i,t} = d(POP_{i,t}, SSE_t, GDP_{i,t}, GEO_{i,t}, SAV_{i,t}, EMP_{i,t}) \tag{1}$$

For the supply side I define a function $Q^s = s()$ which includes the following variables: the investment in fixed assets INV and the construction activity variable CON. Again i captures the respective city and t the time period.

$$Q^s_{i,t} = s(INV_{i,t}, CON_{i,t}) \tag{2}$$

In addition to the variables included in (1) and in (2) the consumer price index CPI is included as well representing the overall price increase independently of supply and demand. By substituting (2) into (1) and solving for $P_{i,t}$ we get the following relationship:

$$P_{i,t} = P_{i,t}(POP_{i,t}, SSE_t, CPI_{i,t}, GDP_{i,t}, GEO_{i,t}, SAV_{i,t}, INV_{i,t}, CON_{i,t}, EMP_{i,t}) \tag{3}$$

Equation (3) will be estimated with an unbalanced panel data set covering a total of 70 cities, i.e. 35 large Chinese cities from 1998 to 2011 and 35 medium-sized Chinese cities from 2008 to 2011.

Preliminary Analysis:

This analysis here will be conducted with the OLS (ordinary least squares) method. This method requires that the underlying stochastic processes of the variables are stationary (i.e. that the variables exhibit constant means and variances over time). If the stochastic processes are not stationary, OLS produces unreliably significant coefficients ('Spurious Regression') and the t- and F-tests are invalid and cannot be used for inference. Therefore before conducting regression analysis we have to test all included variables for a unit root. For a panel data set this can be done with the Levin-Lin-Chu or the Fisher-type test.[1] These tests check whether the data exhibit stationarity. If the regressors are I(1) in levels (non-stationary), i.e. I(0) (stationary) in first differences or growth rates, the growth rates can be used in the OLS estimation. The results show that the population growth rate, the unemployment rate, the Stock Exchange Index and the consumer price index are already stationary as the data are not collected in levels. However the data for the GDP, the savings, the investments in fixed assets and the construction activity are non-stationary in levels but stationary in growth rates. Therefore I will use the growth rates of these variables in the analysis.

Linear Regression Analysis:

The two most widely used methods for estimating panel data models are the fixed effects model FE and the random effects model RE. The fixed effects model FE corrects for unobserved heterogeneity, i.e. for city-specific characteristics that are unobservable but remain constant over time for each observation. It is assumed that these individual characteristical effects are correlated with the independent variables. A fixed effects model is set up by creating a dummy variable for each city capturing its characteristics. The random effects

[1] These tests can be conducted in STATA using the 'levinlin' or the 'xtfisher' commands.

model RE on the other side assumes that the individual characteristics are uncorrelated with the independent variables. If this assumption holds the random effects estimators are more efficient than the fixed effects estimators. On the other side if this assumption does not hold, the random effects model RE becomes inconsistent and the fixed effects model should be conducted. Which of the two models is more appropriate depends on the situation. In general fixed effects models are said to be less restrictive and are thus more likely to show the data realistically. However with a random effects model one can calculate the effects of stable covariates (i.e. race or gender) that is not possible with a fixed effects model. In this panel data set here we can test which model fits the data better with the Hausman specification test which tests for the consistency of the estimators of both models, i.e. whether the individual unobservable characteristics are correlated with the regressors or not (i.e. whether the unique errors are correlated with the regressors).[2] In this example the test suggests the implementation of a FE model.

The following table 2 shows the results of regressing the house price index HPI on each variable alone and the last column shows the regression including all variables. I will use the GDP per capita and the unemployment rate representing the income component and the employment situation as these variables fit the model best.

When regressing the house price index on the geographical location of a city, we cannot use fixed effects as GEO is a dummy variable and therefore time invariant (that is why this variable has been dropped in the overall FE model). Therefore I used a random effects model in the case where the HPI is regressed only on the geographical location. The coefficients are all highly significant except the savings when used as the only regressor and the investments in fixed assets in the overall model. The R^2 is relatively low when including only one independent variable (from 0.0011 for the savings to 0.1857 for the CPI), however the whole model shows a R^2 of 0.4480 which is considerable for a macroeconomic regression. The signs of the coefficients are as expected positive for the CPI, the GDP and the geographical location of the city, as expected negative for the Stock Exchange Index and as expected ambiguous for the savings. However the investments in fixed assets, the construction activity and the unemployment rate exhibit a positive relationship even though we would have expected a negative coefficient and the population growth rate shows a negative sign even though a positive one was expected. The reason for that might be that during the time when China's house prices increased the One-Child Policy was already established and on provincial level the population growth rate was decreasing (even though positive). However due to rural migration into the cities the population growth rates in the cities are supposed to be increasing. As we only used provincial data, this might have influenced the results.

[2] The test can be conducted in STATA using the 'hausman fixed random' command.

Table 2: Static Linear Regression Analysis - Results

VAR	I	II	III	IV	V	VI	VII	VIII	IX	X
Population	-.9886***									-.6899***
Growth	(.2714)									(.2572)
Stock		-.1129**								-.0068**
Exchange		(.0385)								(.0034)
Consumer			.6190***							.4706***
Price Index			(.0608)							(.0790)
GDP				22.53***						15.34***
				(2.7628)						(3.9646)
Geographical					1.0117***					dropped
Location					(0.3024)					-
Savings						1.8510				-11.01***
						(2.6018)				(3.3654)
Invest. in							8.6439***			.9325
Fixed Assets							(1.769)			(1.909)
Construction								2.4717**		3.2298***
Acitivty								(1.0890)		(.9292)
Unemployment									3.2208***	2.4849***
Rate									(.5802)	(.5512)
Constant	109.66***	103.09***	40.33***	100.24***	102.85***	105.87***	101.59***	103.40***	91.87***	49.53***
	(1.4425)	(.1630)	(6.2312)	(.4505)	(.1980)	(.3573)	(.4600)	(.2095)	(2.1843)	(8.7162)
R^2(within)	.0366	.0162	.1857	.1278	.0187	.0011	.0500	.0112	.0745	0.4480
R^2(between)	.0245	.1904	.1145	.0256	.0187	.0062	.0223	.0371	.0028	0.0052
R^2(overall)	.0277	.0185	.1166	.0682	.0187	.0022	.0173	.0171	.0143	0.1751
No of Obs.	420	595	525	525	595	545	525	525	454	384

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 1998-2011.
*signifcant at 10% level, **significant at 5% level, ***significant at 1% level

Therefore we would need data on a city-level to better explain the relationship between the house prices and the population growth rate. The sign for the savings is ambiguous, but the statistically significant value in the overall model is negative implying that higher savings lead to lower house prices. The signs for the construction activity and the investments in fixed assets might here be positive because the market in China did not react to a higher supply, and prices were increasing anyway because of other reasons such as speculation.

Drawbacks of the Linear Regression Analysis:

The ordinary least squares (OLS) regression analysis performed in this section exhibits important limitations as it fails to capture both long-run as well as short-run effects of one variable on another. Often there are strong long-run relationships between economic fundamentals. However these long-run equilibrium relationships can be defective in the short run due to cyclical shocks. After cyclical deviations the variables tend to come back over time to the steady state. In economics it would be helpful to have a model that takes these developments into account, i.e. a model that can tell us whether the economic relationship is currently in equilibrium or not and how long it is going to take until the equilibrium is reached again. The static OLS regression model displays the economic relationship between the variables as deterministic and is therefore incapable of capturing dynamic adjustment-movements of the

variables between the short and the long run.
We know that in order to meet the requirements to conduct an OLS regression, stationarity of the variables is needed. As most of the variables are non-stationary in levels, so far we have used growth rates or first differences instead, which exhibit then stationarity (i.e. they are integrated at order $1 = \text{I}(1)$). On one side this eliminates successfully the problem of 'Spurious Regression', but on the other side when conducting regressions including growth rates or first differences, important information about the long-run equilibrium relationships between the variables become lost. Hence this information will be used to assess the long-run equilibrium relationship in the following model, that turns out to offer a good solution to the shortcomings of the OLS model.

6.3. Dynamic Regression Analysis - Error Correction Model

One of the most common dynamic models is the error correction model (ECM). An ECM assumes that there is a long-run stable relationship between a dependent variable Y and various independent variables X. However due to exogenous shocks this relationship can be defective at a certain point in time. Then an ECM can determine whether the actual values are off the equilibrium path, and the speed at which the dependent variable Y will return to the equilibrium after the shock. Or more precisely: it can estimate the long-run and the short-run effects of X on Y. I will now introduce this kind of model. [3]

The Idea of Co-integration:
In order to account for temporal dynamics we need to introduce the concept of co-integration. In the presence of co-integration a long-run relationship using the data in levels and a short-run adjustment process using the data in first differences can be developed.
Co-integration means that if variables that have an economically valid relationship are non-stationary in levels and exhibit the same order of integration (i.e. I(1) in our case), there exists a linear combination of these variables that forms a stationary variable, i.e. a variable with a lower order of integration (i.e. I(0) in our case). To be more concrete this means that the residual of the long-run relationship will be stationary. And given that the deviations (residuals) from the long-run relationship are stationary, then there is a strong tendency of the variables to get back to the steady state after a shock. If this is the case, the variables are said to be co-integrated. The reason for that is that co-integrated variables do not exhibit independent trends but are driven by common stochastic drifts.

[3] For this part of the analysis it is technically needed that the data do not exhibit gaps or missings. Therefore I will do all the calculations based on a data set that covers only 35 large cities in China over a period from 2000 to 2011. The reason for that is that the data for the house prices are only available for these 35 cities since 1998 and for the remaining 35 cities the data collection started only in 2008 and this time line is too short to be properly analyzed.

Using co-integrated variables in their levels has the advantage that the information that becomes lost when using first differences or growth rates will be incorporated when calculating the long-run equilibrium. In case that two variables are co-integrated we can present the dynamic adjustment process to the steady state with the error correction model. The development of such a model will be explained in this section, however it is first necessary to check whether the included variables in our model are indeed co-integrated.

Testing for Co-integration:

Engle and Granger (1987) determined a method for detecting co-integration between variables. In general we can summarize the process as follows: If two variables are non-stationary, i.e. individually I(1), they can generate a stationary I(0) residual if there is a long-run fundamental relationship between them. If this is the case - given that the first differences of the variables are then stationary I(0) - the variables are supposed to be co-integrated. The test involves basically three different steps that can be computed manually:

1. First we have to check for the order of integration of the variables, i.e. whether the included variables are random walks that are I(1) in levels and I(0) in first differences.[4]
2. Second we have to regress the dependent variable on the independent variables that supposably form a co-integration with the dependent variable.
3. Third we have to test the resulting residual for a unit root. If it has a unit root, there is no long-run relationship between the included variables and if the residual is stationary, i.e. I(0) there is a fundamental relationship and the variables are co-integrated.[5]

The results suggest that the GDP, the savings, the investments in fixed assets and the construction activity form a co-integrating relationship with the house price index. The population growth rate, the consumer price index, the Shanghai Stock Exchange Index and the unemployment rate on the other side are not I(1) in levels (as they are measured in growth rates only). The variables of the geographical location of the cities (GEO) won't be included as they are not city-specific and time invariant. The fact that the population growth rate, the consumer price index, the Shanghai Stock Exchange Index and the unemployment rate do not form a co-integrating relationship with the house price index does not mean that there is no economic relationship between these variables. It only means that as these regressors are measured in growth rates already and that there is no possibility to include them as non-stationary data in levels.

[4] As we are working with panel data this can be tested with the Levin Lin Chu test (levinlin) or the Fisher-type test (xtfisher). The advantage of the Fisher-type test is that it does not require strongly balanced data and that the individual series can have gaps, therefore I used the Fisher-type test to check for a unit root.

[5] I will use again the Levin Lin Chu and the Fisher-type test to check for a unit root of the residual.

A second possibility to check for co-integration is to use existing tests as for instance the test developed by Westerlund.[6] Most methods testing for co-integration are residual-based as the one developed by Engle and Granger above. One important shortcoming of these residual-based co-integration tests is the common-factor restriction. This means that these tests require that the parameters determining the long-run relationship and those determining the short-run relationship have to be the same. This assumption can cause significant losses of power of these tests if that is not given. In the here presented case the variables determining the long-run relationship include all previous variables whereas the short-run relationship only includes the co-integrated variables. So the common-factor restriction is not fulfilled here. As the test developed by Westerlund does not require common factors and is not based on the exploration of the residual dynamics we have to use the Westerlund test for our model. To be more concrete the Westerlund test checks whether the error-correction term is equal to zero. That means, the test checks whether there are short-run deviations that tend to resolve again. And the Westerlund test does that separately for every included variable, i.e. it checks for each variable whether it is error-correcting or not. The test results however show the same outcome as before with the Engle and Granger method.

Error Correction Model: Now that we know that there are co-integrating relationships between the regressors and the house price index we can construct the dynamic model.
First of all we have to state the long-run relationship as follows:

$$Y_t = \beta_0 + \beta_1 X_t + \epsilon_t \tag{4}$$

This relationship is the usual simple regression model integrating all co-integrated variables in levels and the others in indices or growth rates. We assume that the error term ϵ will be zero if the system is in equilibrium. If the relationship is not in equilibrium ϵ is not zero and captures the degree to which the system is out of equilibrium. If Y and X form a co-integrating relationship, deviations or shocks will be corrected over time until the equlibrium relationship is reached again.
In our case the long-run stable relationship between the house prices and the independent variables we chose before looks as follows:

$$\begin{aligned} HPI_{i,t} = \beta_0 + \beta_1 * POP_{i,t} + \beta_2 * SSE_t + \beta_3 * CPI_{i,t} + \beta_4 * GDP_{i,t} \\ +\beta_5 * SAV_{i,t} + \beta_6 * INV_{i,t} + \beta_7 * CON_{i,t} + \beta_8 * EMP_{i,t} + \epsilon_{i,t} \end{aligned} \tag{5}$$

[6] The test can be conducted in STATA using the 'xtwest' command.

The error term from the previous period ϵ_{t-1} can capture the amount of disequilibrium of the model and is defined as follows when assuming that the model is not in equilibrium:

$$\epsilon_{t-1} = Y_{t-1} - \beta_0 - \beta_1 X_{t-1} > 0 \tag{6}$$

Shocks have two effects on Y: one part of the shock will influence Y only in the following period t+1 so that ΔY_t is influenced by ϵ_{t-1}. However a shock will also bring the system out of equilibrium for longer than one period and this part will then be estimated with the error correction mechanism.
The basic form of an ECM is as follows: the first differences of Y (the changes of the house prices) at time t depend on a constant γ_0, on the changes of the co-integrated X (the first differences) at the previous time period $t-1$ and on the error correction component which is defined as the error term from the previous period:

$$\Delta Y_t = \gamma_0 + \gamma_1 \Delta X_{t-1} + \alpha(\epsilon_{t-1}) + \mu_t \tag{7}$$

and this is also equal to:

$$\Delta Y_t = \gamma_0 + \gamma_1 \Delta X_{t-1} + \alpha(Y_{t-1} - \beta_0 - \beta_1 X_{t-1}) + \mu_t \tag{8}$$

These two relationships exhibit basically three parts: γ_1 captures the short term effects of changes in X in the prior period on ΔY in the current period, β_1 estimates the long term effects of changes of X on Y which will be distributed over future time periods according to the error correction α. More specifically α captures the rate at which the system Y adjusts to the equilibrium state again after a shock. In other words, it captures the speed of the error correction, i.e. it determines how much of the disequilibrium will be eliminated in each period and is therefore also called 'adjustment-coefficient'. As a result, Y changes from period to period because of both short-run changes in X and lagged changes in Y whose impact depends on α. More specifically the short-run error correction model looks like this:

$$\begin{aligned}\Delta HPI_{i,t} = \gamma_0 + \gamma_1 \Delta GDP_{i,t-1} + \gamma_2 \Delta SAV_{i,t-1} + \gamma_3 \Delta INV_{i,t-1} + \\ \gamma_4 \Delta CON_{i,t-1} + \alpha(\epsilon_{i,t-1}) + \mu_{i,t}\end{aligned} \tag{9}$$

The results[7] of the estimated error correction model can be seen in the following table 3. We see in the second row the values for the long-run equilibrium relationship and in the fourth row the obtained coefficients for the short-run error correction mechanism.

Table 3: Long-Run Relationship and Short-Run Error Correction Regression Analysis - Results

VAR	Long-Run Equilibrium (SE)	VAR	Error Correction Model (SE)
Population Growth	-.3057***		
	(.0902)		
Stock Exchange Index	-.0020		
	(.0035)		
Consumer Price Index	.6265***		
	(.0916)		
GDP	.0000233	Δ GDP$_{t-1}$	-.000168*
	(.0000214)		(.0000983)
Savings	.00006	Δ Savings$_{t-1}$	-.0003128
	(.0000751)		(.0002391)
Investments in Fixed Assets	-.0003***	Δ Invest. in Fixed Assets$_{t-1}$	-.0002536
	(.0001)		(.0002693)
Construction Activity	.0001***	Δ Construction Activity$_{t-1}$	.0000664
	(.00004)		(.0001362)
Unemployment Rate	.3000		
	(.3922)		
Adjustment Coefficient ϵ_{t-1}			-.4020702***
			(.0420015)
Constant	41.0403***		.7235197***
	(8.7565)		(.265941)
R^2	0.2407		0.2329
No of Obs.	280		385

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2000-2011.
*signifcant at 10% level, **significant at 5% level, ***significant at 1% level
Using robust White Standard Errors

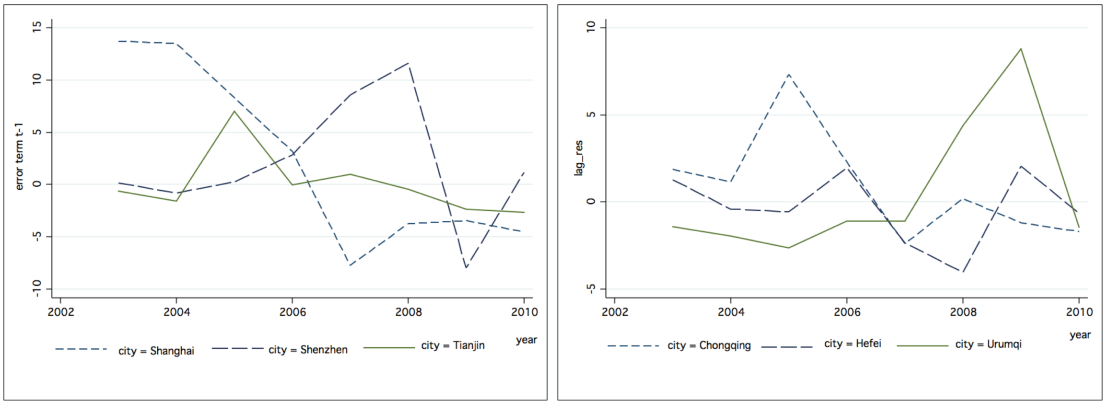
Interpretation:

We can see from the results in table 3 that in the long-run steady state the population growth rate, the Stock Exchange Index and the investments in fixed assets have a negative relationship with the house price index. The consumer price index, the GDP, the savings, the construction activity and the unemployment rate however exhibit a positive relationship with the house price index. Therefore the signs are the same as for the linear regression analysis except for the savings (where the relationship is ambiguous anyway as discussed in section 6.1) and the investments in fixed assets where a negative relationship as we have it here in the dynamic model is according to economic theory. However the significance of the coefficients is lower than in the static regression analysis as only the population growth

[7] There are two possibilities how to calculate an ECM. First there is the STATA command 'vecm' that models an error correction model for time series data, and second there is the possibility to calculate the coefficients by usual manual OLS estimation. As the 'vecm' command does not work for panel data and there is no useful panel data command available in STATA I will be going with the second method. I will in a first regression regress the HPI on all independent variables, then I will save the residual and conduct a second regression including the first differences of the variables that form a co-integration with the HPI and the residual from the previous period $t-1$.

rate, the consumer price index, the investments in fixed assets and the construction activity coefficients are significant in the long-run equilibrium results. The error correction model shows that short-run dynamic changes in house prices ΔHPI_t are negatively influenced through changes in the previous period of the GDP, the savings and the investments in fixed assets and positively influenced through changes in the construction activity in the previous period. These signs are consistent except for the GDP and again the construction activity. The coefficients are not significant though except the GDP at the 10% level. The adjustment coefficient ϵ_{t-1} however is highly significant. And the coefficient is negative, meaning that the disequilibrium is going to decrease over time. As we have annual data, we can interpret the value of 0.4 as follows: 40% of the remaining noise will be dismantled in one year and it will therefore take approximately 2.5 years in order to correct for a disequilibrium.

Figure 7: Development of the ECM Error Terms ϵ_{t-1} for various Chinese Cities



(a) Error Terms of Shanghai, Shenzhen and Tianjin (b) Error Terms of Chongqing, Hefei and Urumqi

Source: Own demonstration, data based on the China Statistical Yearbooks, 2002-2010.

Figure 7 shows the error terms ϵ_{t-1} for Shanghai, Shenzhen, Tianjin, Chongqing, Hefei and Urumqi over the chosen time period. A figure including all cities can be found in the appendix on page 61 (figure 11). We can see that the error terms were indeed not always zero implying that the market was not in equilibrium. This is especially true for the time 2004-2008. After 2009 when the government set the goal to stabilize the market, the error terms got back to a level of approximately zero implying that the market is again in the steady state. The same pattern can be seen when calculating the size of the house price disequilibrium: The following table 4 shows the size of the disequilibrium for the six cities over a period from 2000 to 2011 (the size of the disequilibrium is calculated as the percentage difference between the actual house price index and the fundamental value implied by the long-run relationship). It can be seen that often there is a slightly negative value implying that the house price index

Table 4: Size of the House Price Disequilibrium based on the Error Correction Model in various Chinese Cities

Year	Shanghai	Shenzhen	Tianjin	Chongqing	Hefei	Urumqi
2000		-3.8%		-1.0%	3.4%	-1.6%
2001	1.7%	-1.6%		-3.6%	0.28%	-1.1%
2002	13.6%	0.85%	0.04%	2.5%	1.9%	-0.76%
2003	13.4%	-.14%	-0.88%	1.8%	0.30%	-1.3%
2004	8.4%	0.87%	0.57%	7.6%	0.13%	-1.9%
2005	3.7%	3.4%	7.3%	2.9%	2.57%	-0.44%
2006	.-6.7%	8.9%	1.6%	-1.6%	-1.6%	-0.45%
2007	-2.9%	11.7%	0.21%	0.86%	-3.2%	4.8%
2008	-1.6%	1.6%	-1.7%	-0.45%	2.6%	8.9%
2009	-2.7%	-7.0%	-2.0%	-1,0%	-0.10%	-0.85%
2010	-5.7%	-2.0%	-3.6%	-4.3%	-0.60%	-1.1%
2011	-5.7%	-1.9%	-4.3%	-5.1%	- 2.1%	-2.1%

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2000-2011.
The size of the disequilibrium is calculated as the percentage difference between the actual house price index and the fundamental value implied by the long-run relationship

is even undervalued, however the large numbers are positive which shows that there have been large disequilibria in the market. For instance in Shenzhen in 2007 the house prices were overvalued by 11.73% or in Shanghai in 2002/03 the prices were overvalued by 13.5%.

6.4. Robustness Checks

In order to undermine the empirical findings it is crucial to subject the results to thorough econometric analysis. This section deals with the most common econometric problems.

Endogeneity:

In general one of the most common problems in econometrics is endogeneity, i.e. if there is correlation between a regressor and the error term. The problem is that in the presence of endogeneity OLS will produce biased and probably even inconsistent parameters. If this is the case, hypothesis testing can become misleading, the parameter estimations become invalid and are not asymptotically efficient anymore. This leads to the problem that hypothesis tests become unreliable. Reasons for the existence of endogeneity can be a measurement error, autoregression with autocorrelated errors, simultaneity or omitted variables. These problems will all be explained in the upcoming sections. Endogeneity can be treated with various approaches, however a common solution to these problems is the dynamic OLS approach proposed by Stock and Watson (1993) that will be explained in section 6.5.

Heteroskedasticity:

Heteroskedasticity means that the variance of the error terms changes over time, i.e. the error terms are not identically distributed. This violates one of the assumptions that are needed for the OLS conduction, namely the homogeneity of variance of the residuals. However even in the presence of heteroskedasticity the estimated coefficients of an OLS regression are still

unbiased. On the other side OLS is not efficient anymore and the standard errors, the t- and the F-statistics are suspect. Therefore inference tests (hypothesis testing) become unreliable. There are several methods to check for heteroskedasticity. First of all we can plot the residuals against the predicted values, if the pattern does not get narrower or wider over time, this is a sign for homoskedasticity. However we can also use certain tests that check for the existence of heteroskedasticity as for instance the Breusch-Pagan/Cook-Weisberg test that checks whether the variances of the residuals are homogeneous.[8] When conducting this test for our previous error correction model we get clear signs for the presence of heteroskedasticity which we have to deal with. There are basically two methods to fix heteroskedasticity in a model. The first one includes GLS and FGLS regressions which are weighted least squares methods. However the assumptions on the weights can be difficult. The second method involves the usual OLS combined with fixed (wider) heteroskedasticity-consistent standard errors. Famous are the White standard errors, however I will improve the model using Newey-West standard errors as they correct as well for autocorrelation. The dynamic OLS in section 6.5 includes Newey-West standard errors for this reason.

Autocorrelation:

Autocorrelation (or serial correlation) is defined as the correlation of a variable with itself over time, i.e. in most cases the correlation of the error terms with themselves. Autocorrelation of the error terms implies that the OLS estimators are still unbiased, but the standard errors are unreliable and cannot be used for inference testing. To check for autocorrelation of the error terms we can use the Wooldridge test for serial correlation in the panel data set.[9] This test basically checks whether there is autocorrelation between the first differences of the error terms of the OLS regression. When applying this test we can see that the data we are using here show indeed strong signs for autocorrelation. However there are ways to fix autocorrelation: For instance we can apply OLS anyway and use heteroskedasticity-and-autocorrelation-consistent (HAC) standard errors. As we already apply the Newey-West standard errors that correct for heteroskedasticity there is no more additional action necessary. Regarding autocorrelation in the long-run model we will add leads and lags of the first differences of the co-integrated variables in section 6.5 to control for serial correlation.

Omitted Variable Bias:

A regression model may be subject to OVB problems. This means that the model incorrectly misses some important explanatory variables. If the missing explanatory variable correlates

[8] This test can be conducted in STATA with the command estat hettest after the regression. If the p-value is very small, we would have to reject the null hypothesis of homogeneous residuals and accept the alternative hypothesis that the variance is not homogenous.

[9] This test can be conducted in STATA with the command 'xtserial'. If the resulting p-value is significant, this implies the existence of autocorrelation.

with one or more of the other regressors, the model will be biased as it 'compensates' for the omitted variable by falsely over- or underestimating the other coefficients. This problem is also known under the name 'mis-specification' of the model. In the presence of OVB, the model violates the OLS assumption that the error term is uncorrelated with the regressors, therefore the estimated coefficients will be biased and inconsistent. It is difficult to assess which variables to include in a model. The most important factor is the economic theory behind it, which cannot be tested statistically. However there is a test that performs a regression specification error test for omitted variables. This test is called Ramsey-RESET test (Ramsey Regression Equation Specification Error Test) and it checks whether there is a non-linear combination of the independent variables that can help to predict the dependent variable. If there is (i.e. the error term) then the model is probably mis-specified.[10] Our model suggests no signs for a mis-specification though, therefore the chosen variables seem to predict the house prices quite well.

Multicollinearity:

I define multicollinearity as potential linear relationships among the regressors. It is important to note that in the presence of less than perfect multicollinearity OLS is still BLUE, but not efficient anymore. So as long as the relationship is economically correct, multicollinearity does not actually bias the results. And the 'overall fit' of the regression analysis (the R^2 statistic) is not affected by the presence of multicollinearity either. The only consequence of multicollinearity is that the variances and standard errors increase, which is due to a lack of an own variance of the regressors. This means that the estimations are unbiased, but inefficient (low t-statistics). So to conclude, in case of multicollinearity it becomes more difficult to detect existing effects and to obtain significant results. There is no definitive measure to detect multicollinearity, however there are signs for it as for instance low t-statistics, i.e. insignificant coefficients (as multicollinearity leads to an increase in standard errors) accompanied by a high R^2 statistic (as multicollinearity does not affect this number), incorrect signs for estimated coefficients or when adding/deleting an independent variable the estimates of the coefficients change dramatically. But there are also two more concrete possibilities to check for multicollinearity. The first one is simply to calculate the correlations between the variables. If there is correlation, it is a sign for multicollinearity. When checking for the correlations it can be shown that there is only high correlation between the savings, the investments in fixed assets, the GDP and the construction activity, i.e. for the co-integrated

[10] This test can be conducted in STATA with the command ovtest after the regression. If the p-value is very small, we would have to reject the null hypothesis of no omitted variables and accept the alternative hypothesis that there are omitted variables. When doing this test for our model developed here we get p-values of 0.3424 for the error correction model and 0.5254 for the long-run relationship. These numbers suggest that we cannot reject the null-hypothesis of no omitted variables, i.e. our model is well specified.

variables (values between 0.6 and 0.84). Especially the savings and the investments in fixed assets exhibit a large correlation with a value of 0.84. As a second possibility we can test the data set on correlations by applying a test such as the variance inflation factor VIF test.[11] The VIF estimator is basically the inverse of the tolerance (the tolerance is here the difference between one and the correlation, in our case for the savings and investments the tolerance is 0.16) and shows the degree of correlation between the variables. Values above 10 are a sign for multicollinearity (for our case the inverse of 0.16 is 6.25 which is still in the tolerable range). A common method to correct multicollinearity is to drop one or more highly correlated independent variables. However the new problem is then that if there is an effect, dropping the variable will result in omitted variable bias, and therefore the estimates of the coefficients of the remaining variables in the equation will be biased. When conducting a regression including an interaction term and leaving the variables themselves out, it is impossible to detect the separate effects. So there is a trade-off between a potentially low significance due to multicollinearity and a potential omitted variable bias if we drop some variables. As the VIF test suggested no high signs for multicollinearity in the previous models I decide to still include all variables in the dynamic model as these co-integrating variables are important in the economic model.

6.5. Dynamic Regression Analysis - Dynamic OLS Model

According to the robustness checks conducted in the previous section there have to be certain adjustments made in our model. As mentioned before a practical solution to these problems is the dynamic OLS approach proposed by Stock and Watson (1993) that eliminates (serial) correlations and corrects for the stochastic regressor endogeneity. In addition it respecifies the model so that the hypothesis tests are again asymptotically valid. A DOLS will lead to asymptotically efficient parameter estimations because it includes also the first differences of the regressors, and leads and lags of the first differences of the independent variables in the equation to control for serial correlation. These first differences capture the endogenous feedback effects of Y on X and therefore the DOLS estimators are estimated consistently even if the independent variables are endogenous.
To be more concrete we only have to add first differences, leads and lags of the co-integrated variables (Moody, 2010). I choose to include two leads and two lags of the first differences.[12]

[11] This test can be conducted in STATA with the command VIF after the regression. As a rule of thumb we can say that values larger than 10 could be problematic, however our values for the different regressions are between 1.38 for the error correction part and 2.06 for the long-run relationship which is no problem.

[12] Appropriate tests on the number of lags are the AIC (Akaike Information Criterion) and the BIC tests. However we can also determine the number of leads and lags on the basis of the significance of the regression coefficients. This is what I have done here.

In addition I will estimate this regression using heteroskedasticity-and-autocorrelation consistent (HAC) standard errors, i.e. so-called Newey-West standard errors in order to correct for autocorrelation of the error terms and for heteroskedasticity. Therefore we can set up the long-run and the short-run relationships between the house price index and the regressors as follows in a dynamic OLS model:

$$\begin{aligned} HPI_{i,t} &= \beta_0 + \beta_1 * POP_{i,t} + \beta_2 * SSE_t + \beta_3 * CPI_{i,t} + \beta_4 * GDP_{i,t} \\ &\quad + \beta_5 * SAV_{i,t} + \beta_6 * INV_{i,t} + \beta_7 * CON_{i,t} + \beta_8 * EMP_{it} \\ &\quad + \beta_{4.0}\Delta GDP_{i,t} + \beta_{4.1}L(1)\Delta GDP_{i,t} + \beta_{4.2}L(2)\Delta GDP_{i,t} \\ &\quad \beta_{4.3}L(-1)\Delta GDP_{i,t} + \beta_{4.4}L(-2)\Delta GDP_{i,t} \\ &\quad + \beta_{5.0}\Delta SAV_{i,t} + \beta_{5.1}L(1)\Delta SAV_{i,t} + \beta_{5.2}L(2)\Delta SAV_{i,t} \\ &\quad \beta_{5.3}L(-1)\Delta SAV_{i,t} + \beta_{5.4}L(-2)\Delta SAV_{i,t} \\ &\quad + \beta_{6.0}\Delta INV_{i,t} + \beta_{6.1}L(1)\Delta INV_{i,t} + \beta_{6.2}L(2)\Delta INV_{i,t} \\ &\quad \beta_{6.3}L(-1)\Delta INV_{i,t} + \beta_{6.4}L(-2)\Delta INV_{i,t} \\ &\quad + \beta_{7.0}\Delta CON_{i,t} + \beta_{7.1}L(1)\Delta CON_{i,t} + \beta_{7.2}L(2)\Delta CON_{i,t} \\ &\quad \beta_{7.3}L(-1)\Delta CON_{i,t} + \beta_{7.4}L(-2)\Delta CON_{i,t} + \epsilon_{i,t} \end{aligned} \tag{10}$$

Equation (10) shows the long-run steady state relationship and equation (11) displays the unchanged error correction model capturing the short-run deviations from the steady state:

$$\begin{aligned} \Delta HPI_{i,t} = \gamma_0 + \gamma_1\Delta GDP_{i,t-1} + \gamma_2\Delta SAV_{i,t-1} + \gamma_3\Delta INV_{i,t-1} + \\ \gamma_4\Delta CON_{i,t-1} + \alpha(\epsilon_{i,t-1}) + \mu_{i,t} \end{aligned} \tag{11}$$

Equation (11) shows the long-run steady state of the house price index and the fundamentals. The population growth rate POP, the Stock Exchange Index SSE, the consumer price index CPI and the unemployment rate EMP are as before only included in their initial growth rates. The GDP, the savings SAV, the investments in fixed assets INV and the construction activity CON on the other side are now not only included in levels as before but also in first differences and in leads and lags of the first differences. The reason for that is that these variables are co-integrated with the house price index and exhibit therefore a stochastic trend and are therefore in danger for serial correlation and endogeneity. I will first estimate equation (10), then determine its residual for the error correction model and

integrate this new lagged residual in equation (11) which is the same as the previous short-run error correction model (equation (8)). The empirical results of the long-run equilibrium and the error correction model based on a DOLS can be seen on the following pages in tables 5 and 6.

Interpretation:

The sign of the long-run relationship between the population growth rate and the house price index is still negative as it has been throughout the analysis. The same goes for the unemployment rate which is still positive even though economic theory would suggest a negative relationship. On the other side the GDP, the consumer price index, the savings and the Stock Exchange Index estimators show again the signs expected by economic theory, i.e. positive for the first three and negative for the latter. However - and what is striking - the signs for the investments in fixed assets and for the construction activity are now finally negative as we would have expected from economic theory. This is one clear improvement of the dynamic models. The signs of the included first differences of the co-integrated variables are mixed, showing no clear support of economic theory. The significance of the estimators however has decreased compared to the previous models as only the consumer price index, the lags of the GDP and the first lag of the savings are significant. However as the variables show strong correlations, the insignificance of the results could be due to multicollinearity. The results of the short-run ECM show that the signs for the GDP and for the construction activity are not as expected but those for the savings and for the investments in fixed assets are as expected. However the coefficients for the GDP, the investments in fixed assets and the adjustment coefficient α are highly significant. Especially important is α that has to exhibit a negative sign because this implies that the disequilibrium will resolve over time. In this case a value of -.45 means that 45% of the disequilibrium will be resolved after a year. This number is slightly higher than the one implied by the previous model. This means that it takes less time (2.2 years) to resolve the economic disequilibrium. Like for the simple error correction model we can also observe the error terms $\epsilon_t - 1$ for the different cities in figure 8 to check whether they exhibit signs for a disequilibrium in the market. The figure including the graphs for all cities can be found in the appendix as well (figure 12 on page 62). The error terms show a similar development as in the previous dynamic model. So there were disequilibria in the markets for several cities, however since 2009 the markets seem to be in line again except for Urumqi, where the previous model also concluded an equilibrium again, however due to the DOLS Urumqi is still in disequilibrium.

We can again calculate the size of the disequilibria in the markets for the years 2000-2011 as before. In table 7 we see that the results are similar to the ones in the previous model, i.e. there are mispricings in Shanghai around 2002-2003, in Shenzhen in 2006-2008 and in Urumqi

Table 5: Dynamic OLS Model: Long-Run Relationship Regression Analysis - Results

VAR	Long-Run Dynamic OLS Equilibrium Relationship (SE)	Error Correction	
Population Growth Rate	-.1083324		
	(.1205486)		
Stock Exchange Index	-.0074196		
	(.00498839)		
Consumer Price Index	.3928774***		
	(.1402854)		
GDP	.0000113	ΔGDP	.0001559
	(.0000812)		(.0002791)
		ΔL(1)GDP	-.0002801
			(.000265)
		ΔL(2)GDP	-.0002257
			(.000239)
		ΔL(-1)GDP	.0008888***
			(.0002636)
		ΔL(-2)GDP	.0004247**
			(.0002107)
Savings	.0000106	ΔSavings	-.000888
	(.000443)		(.0015539)
		ΔL(1)Savings	.000568
			(.0009987)
		ΔL(2)Savings	-.0004772
			(.0005938)
		ΔL(-1)Savings	.0044547***
			(.0013301)
		ΔL(-2)Savings	-.0019015
			(.0024478)
Invest. in Fixed Assets	-.0005007	ΔInvest. in Fixed Assets	.0006571
	(.0005952)		(.0013622)
		ΔL(1)Investment	.0001943
			(.0009132)
		ΔL(2)Investment	.0001261
			(.0007173)
		ΔL(-1)Investment	.0008985
			(.0015905)
		ΔL(-2)Investment	-.0003955
			(.0021335)
Construction Activity	-.0001599	ΔConstruction Activity	.0005124
	(.0002235)		(.0004876)
		ΔL(1)Construction	.0006221*
			(.0003418)
		ΔL(2)Construction	.0003616
			(.0002293)
		ΔL(-1)Construction	.0002998
			(.0003623)
		ΔL(-2)Construction	-.0001292
			(.000228)
Unemployment Rate	.7950416		
	(.6138625)		
Constant	60.63296***		
	(14.36046)		
F(28, 216)	11.64		
No of Obs.	245		

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2000-2011.
*signifcant at 10% level, **significant at 5% level, ***significant at 1% level

Table 6: Dynamic OLS Model: Short-Run Error Correction Regression Analysis - Results

VAR	Short-Run Impact of Changes in VAR (SE)
ΔL(-1)GDP	-.0003959***
	(.0001526)
ΔL(-1)Savings	.0001165
	(.0003548)
ΔL(-1)Investment	-.0010673**
	(.0004929)
ΔL(-1)Construction	3.41e-06
	(.0001776)
$L(-1)\epsilon$	-.4523482***
	(.0746049)
Constant	1.23203***
	(.4184709)
F(5, 239)	12.04
No of Obs.	245

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2000-2011.
*signifcant at 10% level, **significant at 5% level, ***significant at 1% level

in 2008-2009. However in the other more rural cities there are no signs for overvaluations.

Table 7: Size of the House Price Disequilibrium based on the Dynamic OLS Model in various Chinese Cities

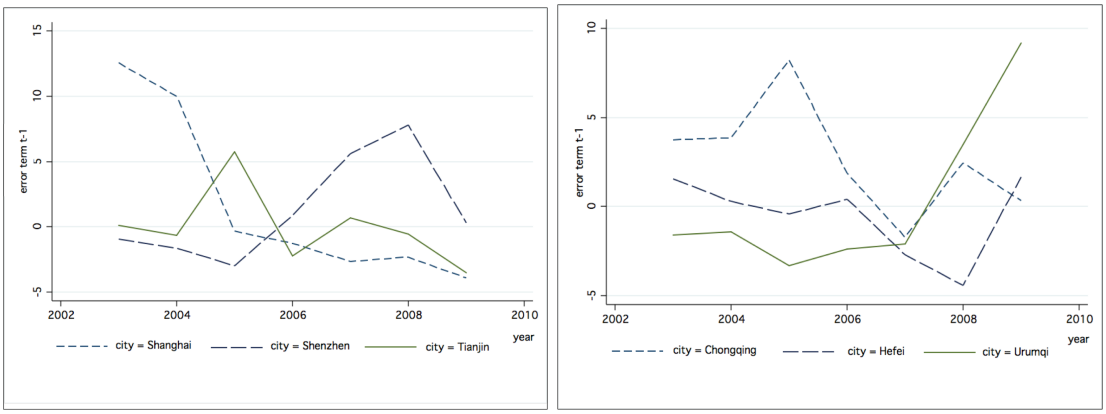
Year	Shanghai	Shenzhen	Tianjin	Chongqing	Hefei	Urumqi
2000	-7.0%	-5.8%	-2.5%		-2.4%	1.4%
2001	2.1%	0.45%	-2.3%	-1.9%	1.1%	-4.1%
2002	12.7%	-0.90%	0.10%	3.7%	1.5%	-1.6%
2003	9.1%	-1.6%	-0.60%	3.8%	0.27%	-1.4%
2004	0.3%	-2.8%	5.3%	7.8%	-0.40%	-3.1%
2005	-1.1%	0.82%	-2.1%	1.7%	0.40%	-2.3%
2006	-2.6%	5.3%	0.63%	-1.6%	-2.6%	-2.0%
2007	-2.2%	7.2%	-0.53%	2.4%	-4.2%	3.3%
2008	-3.6%	5.6%	-3.2%	0.31%	-1.6%	8.6%
2009	-2.3%	7.5%	-4.1%	1.6%	-2.9%	9.2%
2010	-1.9%	0.6%		2.3%	-4.3%	
2011	-3.2%	- 0.15%		0.33%	1.3%	

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2000-2011.
Size of the disequilibrium calculated as the actual house price index in percentage of the fundamental value implied by the long-run relationship

6.6. Model Predictions

We can use the developed models to make a prediction of the house price development in order to compare the model predictions to the actual numbers. This will on one side allow us to see a potential overvaluation of the prices and on the other side show us the predictive power of the models. For the sake of simplicity I will only lay out the prediction of the best developed model. However there are many criteria by which the models can be compared and evaluated. We can either look at the graphs and evaluate which one captures the real development best or we can use statistical measures. The most commonly used

Figure 8: Development of the DOLS Error Terms ϵ_{t-1} for various Chinese Cities



(a) Error Terms of Shanghai, Shenzhen and Tianjin (b) Error Terms of Chongqing, Hefei and Urumqi

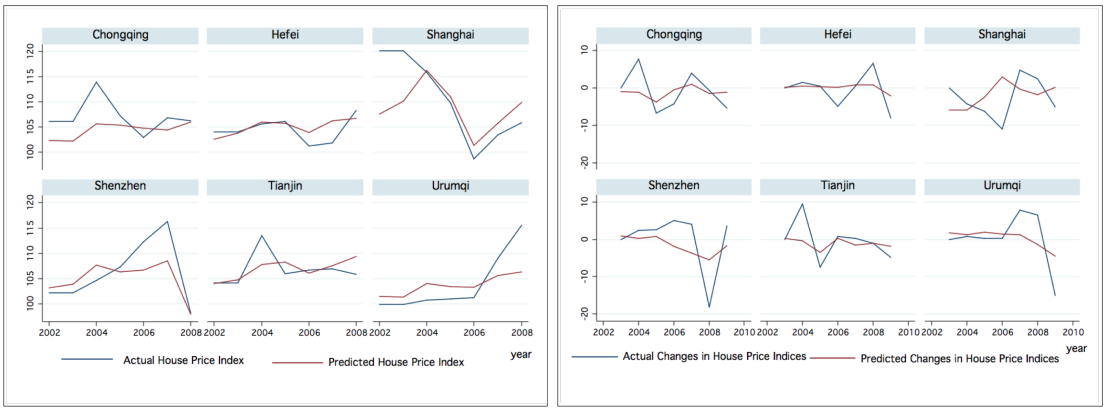
Source: Own demonstration, data based on the China Statistical Yearbooks, 2002-2010.

statistic in this context is the Root Mean Squared Error $RMSE$.[13] This number measures the differences between the predicted values of a model and the values actually observed in reality, therefore the smaller a number the better. When doing this for our models we receive a value of 3.97 for the static model, 3.54 and 3.33 for the long-run and the short-run models of the first dynamic model and 3.08 and 3.56 for the long-run and the short-run models of the second dynamic OLS model. These numbers confirm what can also be seen in the graphs (the graphs showing the predictions for all cities of all three models are in the appendix on pages 62 to 64, figures 13 to 17): the static model has the lowest predictive power and the long-run relationship of the second DOLS model has the highest accuracy. Therefore I will show the predictions of the dynamic OLS models in figure 9, but only for the six cities chosen before because they are representative for their geographical location and are leading in their group with respect to the housing industry (First-, Second- or Third-Tier cities). On the left side are the predictions for the dynamic OLS price indices in the long-run relationship, and on the right side are the predictions of the short-run changes in the house price index.

We can see that the model correctly foresees the direction of the house prices, but it still fails to predict large shocks or deviations.

[13] The RMSE can be easily conducted for every model with the 'rmse' command in STATA.

Figure 9: Predictions of the Long-Run and Short-Run House Price Index Developments based on the Dynamic OLS Model



(a) Long-Run Actual Values of the House Price Index and the Dynamic OLS Predictions

(b) Short-Run Actual Changes of the House Price Index and the Predicted Dynamic OLS Error Corrections

Source: Own demonstration, data based on the China Statistical Yearbooks, 2002-2010.

6.7. Conclusion

We can conclude that the long-run relationship between the house price index and the included fundamentals can best be explained with the third DOLS model. The short-run changes in the house prices however are still difficult to be explained as also the second error correction model based on the DOLS fails to capture the deviations or shocks from the long-run relationship. According to the DOLS model real estate was fairly overvalued in Shanghai, Shenzhen and Urumqi at different points in time. This leaves two explanations open: Either is the model still not well enough developed in order to capture the fundamentals correctly, or the development of the house price index is not according to the fundamentals, i.e. the market is not in equilibrium as there are other factors determining the house prices - like speculative behaviour for instance. This topic however is open to further research.

7. Structural Problems in the Market and Policy Implications

As we can conclude from the previous analysis, the development of the house price index cannot be fully explained by the changes in the corresponding fundamentals. Even when assuming that the dynamic OLS model, which had the highest predictive power of the here developed models, is correctly specified and includes all necessary explanatory variables, there have to be other reasons than fundamentals driving the house prices in China as they seemed to be overvalued with respect to the model predictions during different time periods.

Several factors might be responsible for the previously seen overvaluations of house prices in certain cities as Shanghai or Shenzhen. One important and often discussed factor is the existence of speculative behaviour of investors in the Chinese housing market. The empirical investigation of the existence of speculative behaviour however is complex and difficult to conduct, therefore this cannot be done in this work as it provides enough research ideas for a whole new thesis.

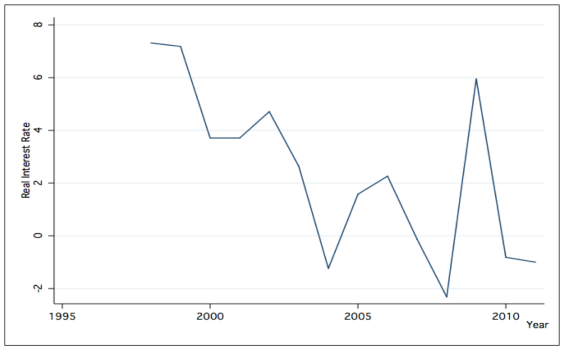
However there are problematic structures in the Chinese market that are supposed to have contributed as well substantially to the large increases in house prices. These structures seem unsustainable in the long run as they are created by the government in order to boost economic growth. On one side they fulfill their goal by providing ways to increase GDP growth rates in the short-run, but on the other side they also lead to problems in the long-run as the market is not in equilibrium and incentives are misleading. These inherently structural problems in the market will now be explained, followed by a short section on policy advices.

Problematic Structures in the Chinese Housing Market:

Structural problems related to the Chinese housing market are - among others - the following (Ahuja et al., 2010 or Chan, 1999):

- Mismanagement and Corruption: As local officials are in uncontrolled charge of the land, they artificially increased land prices through SOE-biddings to enrich themselves.
- Generally Low Home Ownership Costs: Low ownership costs imply that the additional costs coming with the home purchases are low. These additional costs include for instance low or even no property taxes and low interest and mortgage rates.
- Lack of Alternative Investment Possibilities: With an increasing wealth the Chinese want to invest the money safely. As there is no other lucrative investment option than real estate, demand is extraordinarily high leading to an unnatural price development.
- A Persistently Low Interest Rate: In order to boost economic growth the real interest rate has been kept at a low level by the government over years and has even reached negative levels during the financial crisis (compare the following figure 10). A negative real interest rate boosts the demand for hard investments that do not lose in value - like housing. In addition interest rates for mortgages are low providing incentives to buy property. We can see that especially during the years 2007/08 - when house prices increased substantially - the real interest rate reached its lowest level.
- High Savings: Due to the lack of reliable pension and social security systems savings are extraordinarily high, causing an increasing demand for safe investments as housing.

Figure 10: Development of the Real Interest Rate, China



Source: World Bank, 1998-2011.

Policy Advice:

In China governmental regulations in the housing market are applied often and mostly successfully. But even though house prices have stabilized since 2009/2010 and it seems that governmental regulatory actions have been rather successful in cooling down the market, in the long-run these regulations only cure the symptoms of the high housing prices and not the underlying structural problems. In the long-run the government will have to deal with those insufficient structures and changes will have to be implemented if the risks of a recurring price increase want to be eliminated. Therefore the following points summarize on what could be recommended for the future development (Ahuja et al., 2010 or Chan, 1999):

- Control of Corruption and a more transparent system of land allocation.
- Increase of Real Interest Rate: In order to guarantee a stable real estate market in the future the interest rate should be higher representing the actual financial value. Especially given the high GDP and productivity growth rates, real interest rates should be higher in order to make home ownership more expensive. If real interest rates were higher and reflecting the economic value more correctly, house prices were significantly higher if financed by a loan and the opportunity costs were higher as well. This would lead to a significant decrease in demand and eventually to lower house prices.
- Increase of Home Ownership Costs: As the government encouraged home ownership since the collapse of the public housing system, the costs of home ownership are disproportionally low. Even though the government implemented several policies since 2008 regarding taxes, property taxes are still remarkably low and in order to stabilize the market, higher property taxes would probably put things right.

- Opening of the Financial Market and Public Provision of alternative Investment Possibilities: Additionally and probably most important is the opening of the financial market which would offer the Chinese population a broad range of investment possibilities so that housing would not be the only available option for an asset anymore.

8. Concluding Remarks

During the last decade house prices in China have been increasing substantially. This led to a discussion whether there is a mispricing in the Chinese property market. To get clearer insights into the determination of real estate prices, the development of the house price index in 70 Chinese cities was investigated using various econometric analysis. Co-integration has been detected between the house price index and several fundamentals. Besides a static regression model and a simple error correction model a dynamic OLS model has been developed. The dynamic OLS model shows the largest predictive power and implies that there were indeed disequilibria in the housing markets of several Chinese cities. Especially the data for Shanghai, Shenzhen and Urumqi show large overvaluations of real estate (between 7% and 12%) during the years 2002-2003, 2006-2009 and 2008-2009 respectively. In the rural parts of the country however clear signs for overvaluations could not be detected.
However prices have stabilized since 2009 due to governmental interferences and the threats of a housing bubble are under control for now. But on the other side there seem to be severe structural problems in the Chinese market that can lead to artificially high house prices that are not in line with what the fundamentals would propose. These points include a persistently low real interest rate, generally low home ownership costs, high private savings and a lack of alternative investment possibilities that are the main reasons for the high demand of real estate in China. Therefore the Chinese government would be well advised to ease its policies with respect to these points. This would favour the development of a sustainable housing market in the long-run.

References

Ahuja, Ashvin, Cheung, Lillian, Han, Gaofeng, Porter, Nathan, and Wenlang Zhang, 2010. "Are House Prices Rising Too Fast in China." *IMF Working Paper,* 2010 (274).

Bostic, Raphael, Gabriel, Stuart, and Gary Painter, 2008. "Housing Wealth, Financial Wealth and Consumption: New Evidence from Micro Data." Found on August 25, 2012 on *http://www.usc.edu/schools/price/lusk/research/pdf/wp_2008-1006.pdf*

Chan, Nelson, 1999. "Land-Use Rights in Mainland China: Problems and Recommendations for Improvement." *Journal of Real Estate Literature,* 7 (1): 53-63.

Chen, Jie, and Aiyong Zhu, 2008. "The Relationship between Housing Investment and Economic Growth in China: A Panel Analysis using Quarterly Provincial Data." *Uppsala Universitet Working Paper,* 2008 (17).

China Data Online, various years. Found on April 18, 2012 on *http://chinadataonline.org/*

China Statistical Yearbooks, various years. Found on April 18, 2012 on *http://www.stats.gov.cn/english/statisticaldata/yearlydata/*

cnbc.com, 2010. "Chinese State - Owned Firms Fueling Real Estate Boom." Found on August 26, 2012 on *http://www.cnbc.com/id/38516617/Chinese_State_Owned_Firms_Fueling_Real_Estate_Boom*

Deng, Yongheng, Morck, Randall, Wu, Jing, and Bernard Yeung, 2011. "Monetary and Fiscal Stimuli, Ownership Structure and China's Housing Market." *NBER Working Paper,* 2011 (16871).

Deng, Yongheng, and P. Fei, 2008. "The Emerging Mortgage Markets in China," *in D. Ben-Shahar, C. K. Y. Leung and S. E. Ong, eds.,* Mortgage Markets Worldwide, Oxford: Blackwell Publishing: 1-33.

Dreger, Christian, and Yanqun Zhang, 2010. "Is there a Bubble in the Chinese Housing Market." *Deutsches Institut fuer Wirtschaftsforschung - Discussion Paper,* 2010 (11).

EDinformatics, 2007. "The Real Estate Bubble in the 2000's - Housing Market Indicators." Found on June 23, 2012 on *http://edinformatics.com/real_estate/real_estate_bubble.htm*

Engle, Robert, and Clive Granger, 1987. "Co-integration and Error Correction: Representation, Estimation and Testing." *Econometrica,* 55 (2): 251-276.

Glindro, Eloisa T., Subhanij, Tientip, Szeto, Jessica, and Haibin Zhu, 2008. "Determinants of House Prices in Nine Asia-Pacific Economies." *BIS Working Paper,* 2008 (263).

Haila, Anne, 1999. "Why is Shanghai Building a Giant Speculative Property Bubble." *International Journal of Urban and Regional Research,* 23 (3): 583-588.

Himmelberg, Charles, Mayer, Christopher, and Todd Sinai, 2005. "Assessing High House Prices: Bubbles, Fundamentals and Misperceptions." *Federal Reserve Bank of New York Staff Report,* 2005 (218).

Hong, Fang, and Jie Chen, 2007. "The Relationship between Home Mortgage Loan and Real Estate Market in China: Evidences and Insights from a Regional Perspective." Found on July 12, 2012 on *http://about-equity-loan.com/mortgage-home-loan-market*

Hou, Yongzhou, 2009. "Urban Housing Markets in China." *Royal Institute of Technology Stockholm,* 2009 (88).

Hu, Jianyiang, Su, Liangjun, Jin, Sainan, and Wenjun Jiang, 2006. "The Rise in House Prices in China: Bubbles or Fundamentals." *Economics Bulletin,* 3 (7): 1-8.

Jones Lang LaSalle, 2009. "China 40 - The Rising Urban Stars." *Global Foresight Series Report.*

Kennedy, Neale, and Palle Andresen, 1994. "Household Saving and Real House Prices: An international Perspective." *BIS Working Paper,* 1994 (20).

Leung, Charles Ka Yui, Chow, Kenneth K., Yiu, Matthew S., and Dickson C. Tam, 2010. "House Market in Chinese Cities: Dynamic Modeling, In-Sampling and Out-of-Sample Forecasting." *City University of Hong Kong.* Hong Kong.

Li, Tian, and Wenjun Ma, 2009. "Government Intervention in City Development in China: A Tool of Land Supply." *Land Use Policy,* 26 (2009): 599-609.

Lin, Zhiqun, 1991. "Recent Developments in Chinese Housing." *HABITAT International,* 15 (3): 19-24.

Liu, Chen, 2011. "Evaluation of the Existence of a Housing Bubble in China. " *UC San Diego,* San Diego.

Liu, H., and Y. Huang, 2004. "Prospects of Real Estate Markets in China - Challenges and Opportunities." *Institute of Real Estate Studies Tsinghua University - Working Paper,* Beijing.

Ma, Qing-Ping, 2010. "Housing Market in China's Growth Recovery and House Price Determination." *Nottingham University and Centre for Global Finance,* 2010 (6).

Man, Joyce Yanqun, 2011. "China's Housing Reform and Outcomes." *Lincoln Institute of Land Policy,* 2011 (4).

Mayer, Christopher, 2011. "Housing Bubbles: A Survey." *Annual Review of Economics,* 3 (1): 559-577.

McKinsey, 2009. "Improving Performance at State-Owned Enterprises." Found on August 19, 2012 on *http://www.mckinseyquarterly.com/Improving_performance_at_state-owned_enterprises_ 2357*

Moody, Carl, 2009. "Basic Econometrics with Stata." Found on June 19, 2012 on *http://www.scribd.com /doc/58043272/137/Dynamic-ordinary-least-squares*

Ning, Chai, and Oh Dong Hoon, 2012. "Case Studies of the Effects of Speculation on Real Estate Price Bubble Forming: Beijing and Shanghai." *Seoul National University - Eighteenth Annual Pacific Real Estate Society Conference,* Adelaide.

Peng, W., and L. Cheung, 2001. "The Property Market and the Macro-Economy." *HKMA Quarterly Bulletin,* Hong Kong.

Quigley, John M., 1999. "Real Estate Prices and Economic Cycles." *International Real Estate Review,* 2 (1): 1-20.

Rothman, Andy, 2011. "Food, Flats and the Party - Framework for understanding China." *CLSA - China Macro Strategy Working Paper.*

Shen, Yue, Hui, Eddie Chi-Man, and Hongyu Liu., 2005. "Housing Price Bubbles in Beijing and Shanghai." *Management Decision,* 43 (4): 611-627.

Shiller, Robert J., 2007. "Understanding Recent Trends in House Prices and Homeownership." *Yale University - International Center for Finance, Cowles Foundation Discussion Paper,* 2007 (1630).

Shiller, Robert J., and Karl E. Case, 2004. "Is there a bubble in the housing market?" *Yale University - Research in Economcs, Cowles Foundation Discussion Paper,* 2007 (1089).

Stock, James H., and Mark W. Watson, 1993. "A Procedure for Predicting Recessions with Leading Indicators: Econometric Issues and Recent Experience." *NBER Working Paper,* 1993 (4014).

Szamosszegi, Andrew, and Cole Kyle, 2011. "An Analysis of State-owned Enterprises and State Capitalism in China." *U.S.-China Economic and Security Review Commission Report,* 2011 (10).

Wang, Sheng, 2012. "Dynamic Speculative Behaviors and Mortgage Bubbles in the Real Estate Market of Mainland China." *Journal Of Finance and Investment Analysis,* 1 (1): 1-54.

Wang, Songtao, Yang, Zan, and Hongyu Liu, 2010. "Impact of Urban Economic Openness on Real Estate Prices: Evidence from thirty-five Cities in China." *China Economic Review,* 22 (1): 42-54.

Warnock, Francis E., and Veronica Cacdac Warnock, 2008. "Markets and Housing Finance." *Journal of Housing Economics,* 17 (3): 239-251.

World Bank, various years. Found on July 5, 2012 on *http://data.worldbank.org/*

Wu, Jing, Gyourko, Joseph, and Yongheng Deng, 2010. "Evaluating Conditions in Major Chinese Housing Markets." *NBER Working Paper,* 2010 (16189).

Yan, Yan, Wang, Yan-Ting, and Xiao-Wu Zhu, 2011. "Heterogeneous Responses of Chinese Cities' Housing Prices to Monetary Policies." *Commun. Theor. Phys.,* 56 (4): 791-796.

Yang, Qianyu, 2008. "An Empirical Analysis of the Chinese Housing Market." Found on June 19, 2012 on *http://dspace.centre.edu:8080/jspui/bitstream/123456789/193/1/yang_qianyu.pdf*

Zhang, Yun, and Yapeng Cheng, 2011. "The Analysis of China's Housing Price Based on the Demand." *Agricultural University of Hebei - Orient Academic Forum,* Hebei.

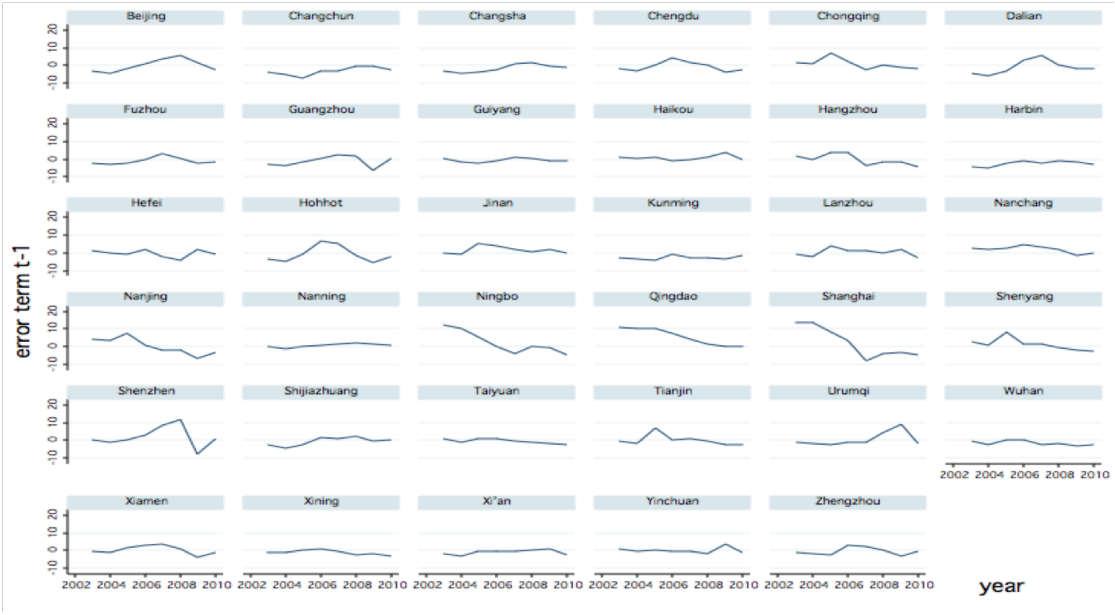
Zhou, Min, and John R. Logan, 1996. "Market Transition and the Commodification of Housing in Urban China." *International Journal of Urban and Regional Research,* 20 (3): 400-421.

A. Appendix

General Thoughts on the Data: The whole analysis conducted in this paper stands and falls by the house price data. Therefore the reliability of these data should be discussed for a moment. One would think that the clear convergence of the house price indices to a stable level in 2009 should be regarded with doubts (compare figure 2 on page 12), as there is not even one single outlier among the 70 observed cities. Especially when considering the fact that the Chinese local authorities' career depends on the fulfillment of economic targets imposed by the central government, the perfectly simultaneous alignment of all house price indices to a stable level in 2009 leaves a bad aftertaste. Therefore the question of whether the reported data reflect the reality arises. To be more concrete not only have the prices stabilized, there are no decreases in price levels observable in the data (i.e. the growth rates are never negative). But there are many articles in common journals such as the 'Economist' that have recently reported on price decreases of up to 30% in short time periods (compare the related links after this section). Also Chinese newspapers reported these events (ChinaDaily for instance). So from the common media one could come to the conclusion that house prices have fairly declined in recent times. However there is no sign for that in the official data. Why that? According to a personal discussion with Professor Kou Zonglai of the Fudan University, Shanghai the Chinese government was/is well aware of an overvaluation of the house prices and the solution pursued by the government was to stabilize the house prices (i.e. to prevent a further increase, but not to let them decrease) over the next years until the prices will be again in equilibrium with the other fundamentals. With this strategy a clash in the housing market could be prevented without negative economic impacts. The stabilization of the house prices should be reached with governmental regulations such as property taxes or other restrictions to prevent a burst of the housing bubble. The hypothetical results of this strategy can be seen in the data as the local officials report their data according to the targets imposed the the central government: We can therefore see a strong stabilization of house prices throughout the country over the last 24 months. However this is not consistent with what the media have been reporting. This leads to the conclusion of probably unreliable data, i.e. that the official data show the aspired goal of the government because local governments had the specific order to stabilize house prices.
However these are only my personal thoughts, but it seemed interesting for me to point out out these irregularities especially with regard to further research.
The following list contains several articles that contain information/news about the development of house prices and clearly illustrate that strong price decreases did take place and caused numerous riots among earlier buyers and real estate developers:

- http://www.arabianmoney.net/us-dollar/2011/10/30/riots-in-shanghai-as-property-firms-slash-house-prices/
- http://shanghaiist.com/2011/10/26/is_the_bubble_finally_bursting_shan.php
- http://globaleconomicanalysis.blogspot.ch/2011/10/shanghai-homeowners-smash-showroom-in.html
- http://www.chinadaily.com.cn/business/2012-05/08/content_15234978.htm
- http://articles.latimes.com/2011/dec/13/business/la-fi-china-housing-bubble-20111213
- http://www.npr.org/2011/12/13/143623874/after-boom-chinas-property-market-heads-lower
- http://www.businessweek.com/news/2011-10-24/shanghai-homeowners-protest-developer-s-price-cuts-daily-says.html

Figure 11: Error Terms of the Error Correction Model for 35 large Chinese Cities

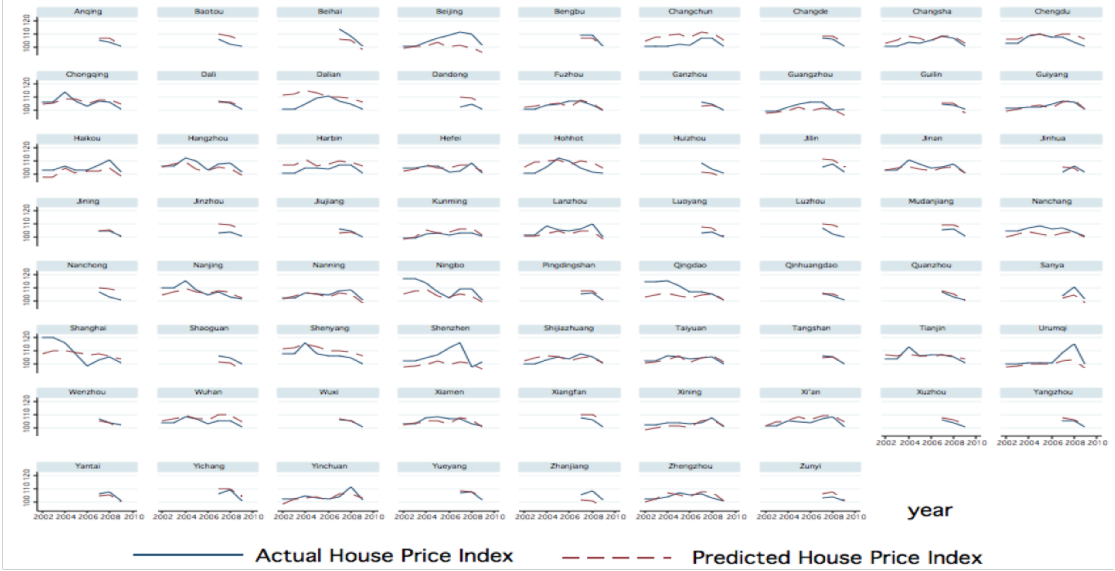


Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2002-2010.

Figure 12: Error Terms of the Dynamic OLS Model for 35 large Chinese Cities

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2002-2010.

Figure 13: Comparison between the Actual Values of the House Price Index and the Predictions made with the Static Regression Model for 70 Cities

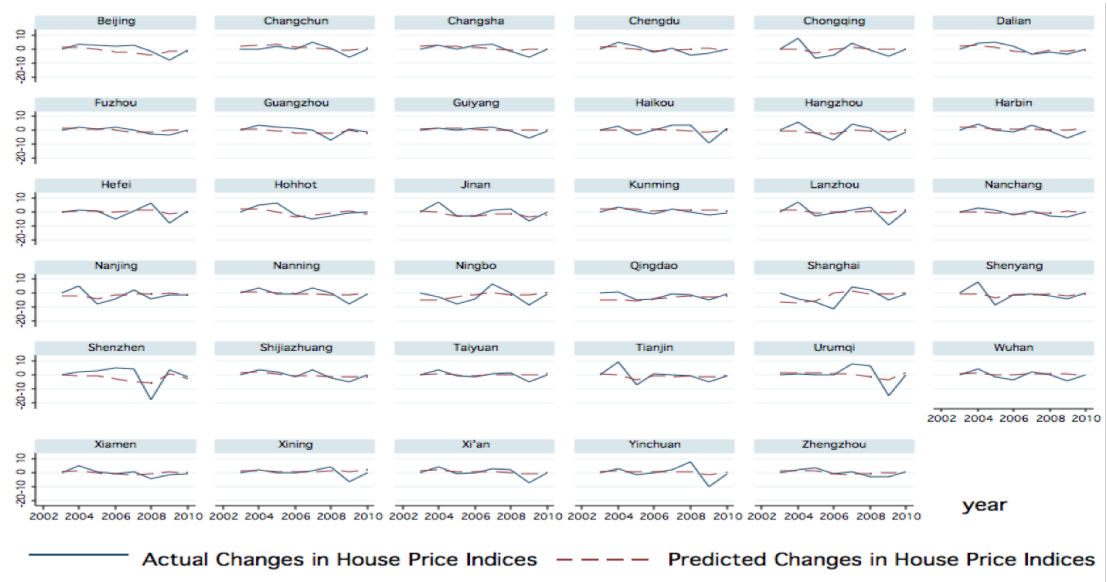


Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2002-2010.

Figure 14: Comparison between the Actual Values of the House Price Index and the Predictions made with the Long-Run Error Correction Model for 35 Cities

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2002-2010.

Figure 15: Comparison between the Actual Changes of the House Price Index and the Predictions made with the Short-Run Error Correction Model for 35 Cities

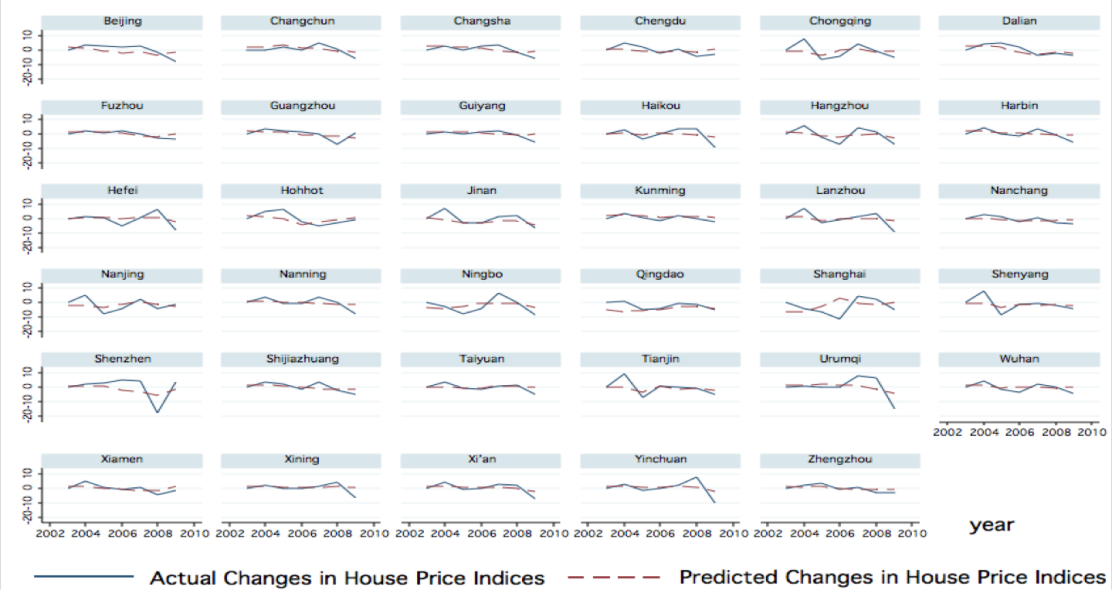


Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2002-2010.

Figure 16: Comparison between the Actual Values of the House Price Index and the Predictions made with the Long-Run Dynamic OLS Model for 35 Cities

Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2002-2010.

Figure 17: Comparison between the Actual Changes of the House Price Index and the Predictions made with the Short-Run Dynamic OLS Model for 35 Cities



Source: Own demonstration, data based on the China Statistical Yearbooks and China Data Online, 2002-2010.

Table 8: List of Chinese Cities included in the Econometric Analyses (* Provincial Capital)

City	**Province**	**City**	**Province**
Beijing*	Beijing	Tianjin*	Tianjin
Shijiazhuang*	Hebei	Taiyuan*	Shanxi
Hohhot*	Inner Mongolia	Shenyang*	Liaoning
Dalian	Liaoning	Changchun*	Jilin
Harbin*	Heilongjiang	Shanghai*	Shanghai
Nanjing*	Jiangsu	Hangzhou*	Zhejiang
Ningbo	Zhejiang	Hefei*	Anhui
Fuzhou*	Fujian	Xiamen	Fujian
Nanchang*	Jiangxi	Jinan*	Shandong
Qingdao	Shandong	Zhengzhou*	Henan
Wuhan*	Hubei	Changsha*	Hunan
Guangzhou*	Guangdong	Shenzhen	Guangdong
Nanning*	Guangxi	Haikou*	Hainan
Chongqing*	Chongqing	Chengdu*	Sichuan
Guiyang*	Guizhou	Kunming*	Yunnan
Xin*	Shaanxi	Lanzhou*	Gansu
Xining*	Qinghai	Yinchuan*	Ningxia
Urumqi*	Xinjiang	Tangshan	Hebei
Qinhuangdao	Hebei	Baotou	Inner Mongolia
Dandong	Liaoning	Jinzhou	Liaoning
Jilin	Jilin	Mudanjiang	Heilongjiang
Wuxi	Jiangsu	Yangzhou	Jiangsu
Xuzhou	Jiangsu	Wenzhou	Zhejiang
Jinhua	Zhejiang	Bengbu	Anhui
Anqing	Anhui	Quanzhou	Fujian
Jiujiang	Jiangxi	Ganzhou	Jiangxi
Yantai	Shandong	Jining	Shandong
Luoyang	Henan	Pingdingshan	Henan
Yichang	Hubei	Xiangfan	Hubei
Yueyang	Hunan	Changde	Hunan
Huizhou	Guangdong	Zhanjiang	Guangdong
Shaoguan	Guangdong	Guilin	Guangxi
Beihai	Guangxi	Sanya	Hainan
Luzhou	Sichuan	Nanchong	Sichuan
Zunyi	Guizhou	Dali	Yunnan