URBAN SPATIAL RESTRUCTURING AND HOUSING DEVELOPMENT IN SHANGHAI, 1990-2002

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NATIONAL UNIVERSITY OF SINGAPORE
2004
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HOUSING DEVELOPMENT IN SHANGHAI,
1990-2002

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A THESIS SUBMITTED FOR THE DEGREE OF
MASTER OF SCIENCE (ESTATE MANAGEMENT)
DEPARTMENT OF REAL ESTATE
NATIONAL UNIVERSITY OF SINGAPORE
2004
ACKNOWLEDGEMENT

I wish to thank Professor Han Sun Sheng, my supervisor, for his guidance throughout the master’s program. Prof. Han has given many invaluable suggestions and comments with insights to China’s urban development and spatial analysis. I also wish to thank the Department of Real Estate, National University of Singapore for providing research scholarships and teaching assistantships during my stay in Singapore. I am grateful to many of my colleagues and friends in Singapore and China, who were of immense help during the course of data collection, analysis, thesis drafting and the final revision.

I also offer my thanks to my parents, my elder brother and my wife, whose support was a source of encouragement during the period when I spent long hours working on this thesis.
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SUMMARY

This thesis seeks to explore the spatial dynamics of housing development in Shanghai, China, in the context of rapid urban restructuring. Questions addressed include whether theories on the internal spatial structure of and processes about cities, which were derived from studies largely on American experiences, can explain the situation in Shanghai, and how indigenous factors, such as history, geography and institutional setup, contribute to the spatial dynamics. Data were collected from local newspapers and published as well as unpublished reports from various agencies. Field reconnaissance surveys were conducted in order to verify and complete the database. Descriptive statistics and some parametric and non-parametric analysis tools were used in data analysis. GIS was used interactively in data organization, analysis and results visualization. A complex polycentric organization in the period 1990-2002 was found to distinguish Shanghai’s spatial structure not only from its previous monocentric configuration, but also from any polycentric pattern ever found in other countries. National development strategy has been believed to have key impact on the formation of such a substantive restructuring process. Moreover, location factors, as an important representation of historical, political and socioeconomic shaping forces, have exciting explanation power for the variation of urban development. Findings of this study contribute to the literature by adding on to the discussions on urban spatial pattern of a major city in transitional China. This study also helps policy makers and private businesses in development/planning decision-making.

Keywords: Urban development; Housing value; Spatial structure; Shanghai
CHAPTER 1: INTRODUCTION

1.1 Background

1.1.1 Urban Spatial Development and Property Value Distribution

A challenging question in the field of urban studies is whether spatial restructuring in metropolitan areas has put great impacts on the property development over space. This question naturally concentrates on two layers of research processes. One is the urban spatial pattern; the other is the property value distribution.

For years, urban models and generalizations have developed and questioned as the spatial configuration of cities is shaped by many changing factors, and the analytical capability of researchers are constrained by conceptual and methodological limitations. In addition to the above complexity there are various contexts in which cities are evolving, which raise further questions as whether theories and generalizations developed can apply to other context.

Recently, theory of polycentric urban development based on western metropolitan experiences caused much discussion on whether it was common and applicable to a larger extent. Freestone and Murphy (1998, p287) proclaimed “polycentric spatial forms broadly analogous to those characteristics of American metropolitan evolution are apparent in other countries”. Garreau (1991) stated that the edge city is “being copied all over the world”. Ingram (1998, p1019) elaborated “strong regularities”, under which “large metropolitan areas are converging to similarly decentralized structures with multiple sub-centers, decentralized manufacturing and more centralized
service employment.”

Other researchers, however, argued that sprawl and decentralization process is far from homogeneous. Gordon and Richardson (1996) claimed that Los Angeles is “beyond polycentricity”, with continued dispersion of economic activity in the outside centers. Further Gordon and Richardson (1996) made an original distinction between “polycentricity” and “multinucleation”(specialized economic nodes instead of sub-centers) and “scatteration”(rampant dispersion of economic activities in contrast to agglomeration occurred in centers). Ingram (1998, p1019) suggested “remarkably strong regularities across countries and cities” and reminded “care must be taken in drawing such conclusions because some of these stylized facts may be based on technological or demographic factors as much as they are on theory or market outcomes.” The perception of Gordon and Richardson (1996) and the carefulness of Ingram (1998) are reasonable and significant to promote an argument that this model regarding the metropolitan spatial development may not be true or, at least, not accurate. Reasons for such an inaccuracy have arisen to be technology, data, and local factors.

Accompanying the evolvement of polycentric theory, some studies revealed that spatial dispersion of urban development led to a certain but changeable reorganization of property value distribution in cities. It is noticeable that in many rent gradient or hedonic price models the predominant influence of the distance to the central business district (CBD) on value dynamics declined. Yeates and Garner (1980, p215-6) noted that Chicago’s land value declined with increasing distance to the central business area in 1910 and 1940; while in 1940 higher values were clearly observed around the remote shopping centers. McMillen and McDonald (1998) evidenced that Chicago’s
downtown had less effect to attract high residential land values in 1981 than in 1971. In their later study on Chicago in the 1990s, they found that residential development took on a scattered spatial pattern, in which housing was not “being attracted to suburban quarter sections with favorable access to commuter rail stations, highway interchanges, or suburban employment sub-centers” (McDonald and McMillen 2000, p155). Han and Basuki (2001), based on their studies on Jakarta, showed variational explanation power of different distance variables on residential property value changes between the early and the late 1990s.

1.1.2 China’s Economic Development

China has experienced drastic socioeconomic and political changes in its transition of planned economy to market economy. Such changes shape a distinctive context in which urban spatial structures evolve differently from both western cities and other transition economies in Eastern Europe or Asia.

1.1.2.1 Economic Development Process

Since 1978, China has experienced different phases of social and economic development. According to Chen (2001), there were three phases for the period 1978–2001, i.e., “growth, development and enhancement of comprehensive competition power”. In the “growth” phase from 1978 to 1989, sheer growth of economic quantum was emphasized in order to meet the demand for large quantity of goods and products. In the “development” phase in the 90’s, rapid economic growth encountered bottlenecks. For instance, structure, technology, environment, etc. cannot support further growth any more. In order to continue economic growth, main task of this phase was to restructure the social and economic system, and to mitigate the interior conflicts. In the end of the 90’s came the phase of enhancement of
comprehensive competition power. It aimed at promoting the entire national economy, and improving the competitive advantage in the global market.

1.1.2.2 Socialist Market Economy

This post-1979 reform period has produced vast economic and political shifts in China, characterized by gradual introduction of market mechanism and newly emerged economic actors. First came the “Open-Door” policy in the early 1980’s, which encouraged inward investment and thus greatly increased foreign trade. This policy initially applied in the early and mid-1980’s to the special economic zones (SEZs) and “Open Cities” in the coastal region, giving them preferential policies for economic development (Yang, 1997; Cannon 2000).

Consistent with these shifts was the attempt to cultivate a “relatively unconstrained growth” of the non-state sector (Lardy, 1998, p. 21) whilst preserving the state sector. This measure has been so successful that the Chinese economy, measured by GDP, grew on average by 10.4 percent annually in the period 1990–99. Per capita GDP in 1999 also doubled that of 1990 in US dollars (State Statistical Bureau, 2000). The non-state sectors experienced drastic changes while the rural economy grew at a rapid pace. As Cannon (2000, p17) observed, “the rural economy is now in the midst of a deep social change in which there are many more individualized actors than before, together with many layers of local entrepreneurial states that vie for control over land and other resources, labor, capital and government favors”. The relationships of the people to the land have forever been altered in terms of control, ownership and rights of use. For instance, almost all farmland was transferred from collective units into family and individually controlled smallholdings in just a few years of the early 1980s. Rural industry, especially township and village enterprises (TVEs), have changed the
ways of using the land and all other natural resources, including water, forests and rangelands. Zhang (2003) made a conclusion that the non-state sector, mainly rural industry and foreign-invested enterprises (FIEs), have been crucial to China’s economic growth by challenging the dominant state sector successfully. His claim was consistent with Liu and Dong (2000, p68) who claimed “their share in China’s industry in terms of gross output rose from 45.4 per cent in 1990 to 74.5 percent in 1997, while that of the state sector declined from 54.6 per cent to 25.5 per cent over the same period”.

As a part of the economic reform, the relationships between the central and the local governments and between governments and enterprises changed to a large extent. The central government achieved the rapid economy growth at the cost of loss of control to local governments and private enterprises. Now these liberalized parties are no longer mere recipients of economic policies determined from above, but have many more opportunities to act independently, within policy frameworks that allow for more private initiative (Cannon, 2000). Consequently, there is a seemingly plausible consensus that the expansion of market mechanism has underpinned China’s economic success in the past two decades (Zhang, 2003). It is suggested that China should be put into the categories of “Emerging Market Economies” or “Transition Economies”.

Whether or not China’s reform has been really that successful is a question subject to debate. First, relaxation of central control actually adds higher risk to the individuals. They have been absolved of collective welfare and social safety mechanism, which were the responsibility of higher-level authorities. Second, despite the magnitude of the contribution of non-state sector to China’s rapid economic development, state sector is far from retreat from the historic stage. Instead, it remains its dominance in national economy (Woo, 1999). In the 14th Chinese Party of Communists (CPC)
Congress held in 1992, “socialist market economy (SME)” was determined to be the national economic system in China. The market was assigned a primary role in the allocation of resources, but at the same time, the dominance of the state sector, including both state-owned enterprises (SOEs) and collectively owned enterprises (COEs), was insisted in. Third, even “transition” in economic system deserves a scrutiny. Cannon (2000) argues that economic transition is symbolized by the fundamental change from central state planning and predominant state ownership to a model liberalization with dominance for markets and private enterprises. He further claims that China’s state is certainly an interventionist one, which differentiates it from other transition economies (in eastern Europe or Asia).

Above all, China’s reform has profound effect on the social relationship, economic development, and political system. The new interactions between individuals, enterprises and local governments, and the actions of various levels of the state, have created so different a country that is unrecognizable in comparison with just twenty years ago. These changes have inevitably reorganized the land use and reconfigured the transportation systems, and finally reshaped the urban spatial structure.

### 1.2 Research Questions

Previous research on urban transformation in developed countries has revealed a general pattern of urban spatial development. But later this model was queried, following some findings of complexity in the urban structure of both developed and developing countries. Recent research began to converge to the distinctiveness of Chinese urban development process and its shaping forces in an unprecedented socialist transitional economy. Under economic restructuring and globalization, the polarized social class, the flooding migrants, and the state are jointly reshaping new
social spaces in urban China (Pannell 1995; Ma 2002). This signifies the close relation between social changes and spatial transformation. Firstly, social stratification in China has aroused hot interests (Walder 1995). The equalized social order in the socialist era is undermined and the new social structure is stratified (Lu 2002). A class of new urban poor is increasing (Gu and Liu 2001), which suffers deteriorated social status and housing consumption. On the other extreme, clustered “Zones of affluence” are appearing, for example, in Beijing, the new rich begin to hold increasing similarities of lifestyle with their “Western” models (Hu and Kaplan 2001). However, due to the lack of data, the investigation of urban spatial pattern has lagged far behind the urban development in Chinese cities (two exceptions can be found in Wu and Yeh 1997; Cheng and Masser 2003). In particular, three critical questions still lack clear answers:

1. What characteristics can we discern in the spatial structure of Chinese cities?

2. What are the factors shaping the urban spatial structure?

3. Does urban spatial restructuring in China conforms to the theories and generalizations developed in the literature?

This study takes Shanghai, the largest commercial and financial center in China, as a case, trying to explore its urban spatial structure through the analysis of housing development during 1990-2002. Shanghai is selected because of its critical role in China’s modernization and development. Shanghai, with a population estimated to be in excess of 13 million, is the biggest city in China and one of the largest in the world. It is of overwhelming importance in the commercial life of the country. The manufacturing outputs of Shanghai, which include a whole range of light and heavy industrial products, is far greater than that of any other province or city in China.
Shanghai played a major role in the development of China’s banking and financial sectors (Brian Hook, 1998). With the opening of Pudong, Shanghai is expected to assume a dragon-head role for economic growth in the Yangtze River basin (Han, 2000).

### 1.3 Objectives of Study

The main objective of this study is to examine the urban spatial organization in Shanghai using the distribution of housing price as a yardstick. The changes in the location of housing development and distribution of housing prices reflect the trend of urban spatial restructuring. For Shanghai, the most populous city of the world, housing price dynamics are representative of urban spatial changes and hence selected. Considering the majority of economic activities and housing development have taken place in the central city of Shanghai (central Shanghai), this study focuses on the central city area.

Here *urban spatial organization* refers to the way in which urban social and physical elements such as transportation and housing are arranged or related to each other. *Shanghai* refers to the central city of Shanghai instead of metropolitan Shanghai. The *central city* is bounded by the Outer Ring Road, the *middle (central) zone* is bounded by the Inner Ring Road, while the * peripheral zones* refer to the five zones between the inner ring road and outer ring road. Urban core refers to the People’s Square area, the core of the planned CBD. Sub-center is defined by the American Heritage Dictionary as a secondary center, especially a commercial or shopping area located away from the main business sector of a city. In this study, *sub-centers* in central Shanghai refer to the planned secondary centers away from the CBD.
Secondly, this study investigates the influence of location factors on Shanghai’s housing development. Location factors refer to the accessibility characteristics of house projects, for example, the distance of house projects to the CBD.

1.4 Significance of Study

This study contributes to the study of internal urban spatial structure, especially to the understanding of one of the most significant large cities in China.

Rapid urban growth in Shanghai has been impressive not only in the changes of infrastructure, but the physical form and appearance of the city. These changes, as reflected by the housing development, obviously differ from those occurring in western countries and other developing countries. The sites of housing projects in this city spread all over in space, from the central area to the non-central areas, from the interior of the 500m-radius buffer of the Inner Ring Road to its exterior, as well as from Puxi to Pudong. Housing price shows an even more complex distribution. It is significantly higher in the middle zone than those in the peripheral zones, with the highest point in the planned CBD and second highest point in Lujiazui financial center. Housing projects clustered along the east-west axis have higher prices than other areas. Housing price among the five peripheral districts is unevenly distributed as well, with higher prices clustered in the west part and lower prices scattered in the east part.

This study also contributes to the understanding of the metropolitan property market. It is widely accepted that individual’s enjoyment of life or utility is affected by or consists of many desirable items. Values of these items can be measured by looking at how much an individual is willing to pay for it. In this regards, housing price should be fixed in accordance with the determinants, or desirable items in a property market.
Thus, studies on location factors contribute to the understanding of property markets by uncovering its impact on housing price.

Practically, this study may be helpful to individual house buyers, developers and policy makers. Housing buyers can acquire valuable purchasing guidance such as how Shanghai’s housing price distributes spatially? Where are the locations with high and low prices? Does housing price in a specific location match to the benefits gained? Property developers can now plan their new projects based on the analysis of development sites as well as the benefit and cost associated with the location advantages. As to the policy makers, how much the land use right should be charged has troubled them since the land reform in 1987. The spatial structure of property values analyzed in this study is a good reference for land value appraisal. So the information from property market would provide a crucial guidance on the setting up of land leasing fee.

1.5 Organization of Study

This study is organized into seven chapters.

Chapter one introduces some background information about urban spatial pattern and China’s economic development. Research questions, objective and significance of the study and its organization are identified. Chapter two provides a review of studies related to the patterns of urban spatial restructuring both inside and outside China as well as spatial variables. Chapter three specifies the research design including selection of study area and temporal coverage, hypothesis, explanation of independent and dependant variables, source of data, analysis method and research limitations. Chapter four illustrates the process of urban spatial changes and housing development in
Shanghai before and after 1990. Chapter five examines the spatial pattern of housing price distribution. Chapter six analyzes the relationship between the location factors and the housing price variations in Shanghai. Chapter seven finally concludes the findings in this study and recommends for future studies.
CHAPTER 2: LITERATURE REVIEW

2.1 Patterns of Urban Spatial Restructuring

2.1.1 Metropolitan Spatial Restructuring

Studies on American urban experiences reveal five stages of urban development process as a result of the advances in transport and communication. Prior to 1850, most manufacturing industries located close to waterways and rail terminals for low cost of freight. Intra-urban transport and communication (e.g. wagon and telegraph were the main tools) were inconvenient and costly. This led to the formation of a simple monocentric city, with a core area near the harbor or railhead and residences surrounding the core (Moses and Williamson, 1967). Between 1850 and 1890, electric streetcars and subways made residential expansion possible and thus formed a bit more complex monocentric pattern: still one core but much more concentrated residential districts around stations along the mass transport lines (Warner, 1962). In the early 20th century, truck, telephone, and later the advent of cars allowed both spread of industries outside from the center for lower land values and residential expansion to the wilderness between the center and mass transport stations (Moses and Williamson, 1967; Barrett, 1983). After World War II, the creation of suburban rail terminals and highway system weakened the core’s agglomeration power and advantage for inter-city shipments. This enabled manufacturing to leapfrog out to the outmost suburbs with service and office remaining in the center, but still no sub-center formed in this stage as no agglomeration of a variety of economic activities occurred (Anas, Arnott, and Small, 1998). More recently, the concept of “edge city” appeared in the literature, it is sub-centers at the nodes of major express highways. Initially driven by
the rapid automobile access, edge city developed from a single company, even a single individual, to a sub-center concentrated on office and retail, in conjunction with other types of development including residential (Garreau, 1991). Accompanying the concentration of economic activities in edge cities and the weakening of the central business district, polycentric urban structure took shape (Shearmur and Coffey, 2002).

Recent urban spatial studies stressed manifestly a consistent polycentric development pattern. As Ingram (1998) and Dowall and Treffeisen (1991) summarized, large metropolitan areas tended to converge to similarly decentralized structures with multiple sub-centers, highly decentralized manufacturing sector and centralized service sector. Within the massive theoretical and empirical work, population and employment distributions attract the most attention from these researchers due to the data availability. Based on the analysis of population distribution and variation in both industrial and developing countries, Ingram (1998) claimed a decentralized metropolitan population with flatter and flatter density gradients. Furthermore, population growth in large cities usually did not increase the population density of high-density areas, but promoted densification of less-developed areas and expansion at the urban fringe. Such development tendency attributed mainly to an increasing desire of housing consumption and improvements in transport performance (Meyer and Meyer, 1987). Another two determinants of decentralization emphasized by Ingram (1998) are land market and public infrastructure provision, which ensure efficient supply while demand pattern remains similar across cities. Studies within large cities over time also implicated a marked tendency for employment to decentralize, with the proportion of jobs in the center falling over time and most new growth in employment located out of the center (Meyer and Gomez-Ibanez, 1981). Similar spatial distribution of employment with that of population was suggested as the
result of convenient freeways and special facilities such as airports that determine the employment agglomeration (Shukla and Waddell, 1991).

Later examination on urban space-economy, however, aroused broad argument among researchers on the similarity of urban organization. Waddell and Shukla (1993), in their study of Dallas-Fort Worth, described a dispersed employment pattern that emphasized the role of corridors and denied the large-scale clusters in so-called sub-centers. Gordon and Richardson (1996, p289) criticized previous research results in Los Angeles case by arguing that “although…it is considered the prototypical polycentric metropolitan region, and is widely referred to in studies of polycentric metropolitan structures…current spatial structure trends in the Los Angeles metropolitan region are telling a somewhat different story”. Using the 1990 definition of sub-centers and 1990 employment data, they found as small as 12 percent of the region’s jobs is located in the centers including downtown. Such proportions was quite inconsistent with standard interpretations of the polycentricity hypothesis that implied a considerable job clustering in a number of major sub-centers, thus made them conclude a “dispersed pattern” beyond polycentricity in Los Angeles.

After detailed examination of the dispersion of economic activity continued outside centers, Anas et al (1998) found that “even sprawl is far from homogeneous” (p1427) as “complex patterns” (p1445) existed inherently in the urban spatial structure. Sources of current urban spatial dynamics were subsequently analyzed and organized in order. Agglomeration economies were obviously given the first-order importance in shaping cities. The agglomerative or centripetal force can be easily caused by spatial inhomogeneities, internal scale economies in production, scale economies external to firms including those arising from spatial contacts and imperfect competition (Anas et
al 1998, p1445). As agglomeration was a result of market processes, government policies undoubtedly played a major role in urban spatial change, notably through land use controls and the provision of public infrastructure (Anas et al 1998, p1428). Indeed, “an infinitely complex cityscape” was evolving, as center-periphery relations were redefined through the interaction of market forces, government regulations, and local circumstances (Bruegmann 1995).

Some researchers explored the complexity of metropolitan spatial development by case studies outside US and discussed their findings in comparison with one another. Recent Australian researches together indicated that below the general convergence of suburbanization and metropolitan recentering trends, the forms emerging and the processes involved were culturally and historically specific (Freestone and Murphy 1993). Forster (1995, p64) warned that focusing on the global at the expense of the local risked a superficial analysis, as did the uncritical importation of fashionable theory and labels to explain national trends.

O’Connor and Stimson (1997) put their concerns on the comparison between Australia and US of the shifts in the location of population and economic activity. They argue that such shifts would have a critical influence on a range of economic, social outcomes, and hence urban transformation. By dividing the settlement in Australia into four units and analyzing the geography of urban change, they claimed that the major urban areas of the nation have hosted the majority of the population and most of the housing construction and business activity in the past decades. Their further inspection inside the major areas revealed inspiring facts. On the one hand, the evolution of Australian settlement has mirrored the US growth experience in the middle and outer suburbs. These regions remained predominant in function and scope, as evidenced by
the location of the nation’s jobs and housing. On the other hand, Australia expressed a
distinct high concentration of urban space. Population growth concentrated in some
regions where new facilities were constructed, while many new job opportunities
accompanying a small number of large projects were anchored to just a few sites. In
the US context, it may be common that a disproportionate share of population and
investment projects dispersed to a large number of locations even to the exurb areas.
Reasons for such markedly different outcomes from US researchers, they argue, would
be the small size of the Australian economy, the lack of mid-sized cities and major
deterrents to development in the metropolitan areas, as well as many new
communication and transport technologies.

Using Melbourne as a case, Healy and O’Connor (2001) obtained new insights on
suburban spatial development in Australia. They took data from the 1986, 1991, and
1996 censuses and divided the Melbourne metropolitan area into 11 Statistical Local
Areas (SLAs) to analyze the jobs and housing location. Some key findings were
discovered in their study. First, there remained a high self-containment in many
regional labor and housing markets, even in the context of rapid job and housing
growth. Second, the Core region (defined as a large inner plus high status suburban
region) did not show more significance than other regions. Rather, its labor market has
shrunk a little due to the obvious preference of Australian for larger suburban
residential sites. All these findings put serious doubt on two broadly held notions:
suburban sprawl and revival of inner city. In effect, they perceived a highly ordered
response of housing to job growth in the suburbs. The stable geography of inflows of
people and the links between their jobs and housing locations has been formed over a
decade and thus would not be changed substantially.
Some geographers explain the different urban spatial changes between the Australian and American cities from a cross-cultural perspective. Mees’ (1994) argues that the fundamental metropolitan form of Australia is reshaped, to a large extent, by its long history of suburban development, good public transportation systems, “paucity of urban freeways,” stronger local governments and planning systems promoting less “open slather” development, and wide-spread gentrification and retention of status by inner and middle-distance suburbs. Freestone and Murphy (1998) make an innovative complement to Mees’ argument based on a comparative case study of Sydney. Their study reveals the differences between Australian cities and the US experiences in that the suburban economic scale is far away from that of an edge city and there is little evidence of metropolitan centers being ringed by the same sort of new centers found outside major American cities. Somewhat alike those claimed by Mees’, Freestone and Murphy (1998) identified four critical factors to explain the relatively modest number and scale of new suburban commercial centers in Australian cities. First, Australian domestic market was very small, lacking of “technopoles” of advanced economies. Second, the effects of suburban growth have been much less serious than in the US. In fact, substantial vacant office space and reduced central rents have promoted a back-to-the-CBD migration. Third, a conventional road system inhibited further improvements in outer city transportation. Although new freeway building did occur, they were not of the scale to “eliminate the primacy of the CBD” (Fishman 1987, p192). Fourth, regulatory planning constraints stress the general principle of urban consolidation of existing centers and containment. Towering above all these partial explanations of the differences between the Australian and the international evolution, Colby (1933) has elaborated the logic of the development of world space economy as a dynamic equilibrium between definite centrifugal and centripetal forces. This
equilibrium was redefined by Freestone and Murphy (1998) as one between push (rising property values and rent levels, central area congestion, and agglomeration diseconomies) and pull (accessibility, space, amenity, and prestige) factors. Australia, apparently, was the case driven more by pull forces than push forces, experiencing urban spatial changes that appear to be more evolutionary than revolutionary (Freestone and Murphy 1998).

2.1.2 Metropolitan Property Value Distribution

It is well known that spatial redistribution of property values exists relative to different stages of metropolitan spatial development. The first knowledge of the property value surface in metropolitan areas roots in von Thunen’s theory of agricultural land use which was set forth in *The Isolated State* (1826). According to von Thunen, a city serving as the sole market of the agricultural products was used to create a model of concentric arrangement of agricultural land use. In this model there was a distance decay pattern, with heavy and perishable farming in the inner ring around the city while lighter and durable goods production moving toward the outer rings. Reasons for above arrangement were transportation and location rent. As distance increased from the city, returns on the land would diminish because transportation costs to the city increased. Thus lower location rent and less intensive use of the land would be committed. Thunen’s model was introduced by Hurd in 1903 to the study of urban land values. He argued that distance to the center of the city would be the determinant for land value.

Alonso (1964) expressed accurately the classic theory of rent and location, and established a bid-rent function to describe the negative relation between distance from the city center and the rent. Thus, higher land values converged on the areas close to
the city center, and lower land values were formulated in the fringe areas. The location of different urban activities, such as office, commercial, industrial and various residence types, is explained by the ability of respective economic yields. A monocentric pattern of land value with the highest in the city center and gradual declining values further away from the center formed to generalize metropolitan property value dynamics.

A number of studies were then carried out to test the monocentric property value pattern. Lusht (1997, p27-28) examined the land value pattern of Topeka, Kansas, and found it markedly similar to the theoretical model. He also obtained similar empirical results in other cities in America, Australia, Canada, England, Scotland and Japan (Lusht 1997, p27). Abelson (1997) revealed that in Sydney, Australia, house and land prices decreased exponentially with distance to the central business district from 1931 to 1989.

Nevertheless, a drastic decline was perceived of explanation power of distance variable in shaping the property value surface over the years. Yeates and Garner (1971) unveiled that distance variable alone could explain 75% of the land value variations in Chicago in the early 20th century, but in the 1960s, only 10% of the land values changes were explained by the distance variable. After reviewing the archival price data of New York City’s vacant land between 1835 and 1900, Atack and Margo (1998) found that average nominal land prices at the CBD increased over 3% annually between 1835 and 1895, but declined rapidly at the end of the century. Before the Civil War, the price of land per square foot witnessed a sharp decrease with distance from the central business district (CBD); while after the Civil War, the distance gradient flattened and the explanation power of the distance to CBD on price per square foot declined markedly.
The weakening power of distance variable in explaining land value changes was due mostly to the improvement in transportation system. The modern highway network, the obsolete mass transit and the wide use of automobiles in American cities weakened the spatial link between land value and large business centers (Sivitanidou 1997), and so boosted the emergence of regional centers around major highway intersections (Fonseca and Wong, 2000). This led to a polycentric urban form and a quite new property value surface.

In a standard urban economics, land value surface at any point in time should reflect commuting costs, income, and demographic characteristics (Clapp et al 2001, p47). When generalized for polycentric structure, this theory justifies a U-shaped land rent gradient, declining with distance from the city center and then rising to the proximity to subcenters. If enough agglomeration economies develop in subcenters to dominate the traditional center, then the land value surface may slope upward with increasing distance from the downtown (Anas et al., 1998). Thus, polycentric rent gradient was regulated in a shape inconsistent with the negative exponential curve in a monocentric setting.

Some empirical research revealed a general assumption of the polycentric pattern in the urban spatial structure of many American cities. McDonald and McMillen (2000), on the basis of their prior research, inferred that many suburban areas in the early 1990s had large subcenters with significant effects on nearby population density, land values, housing prices, and employment density. Chicago, for example, was declared as a polycentric city (McMillen and McDonald, 1998). Because employment subcenters had a pronounced effect on population density, though access to the CBD continued to influence density patterns well into the suburbs. After controlling for access to commuter train stations, highway interchanges and other site-specific
variables, employment subcenters remained strong effects on population density, which could be seen clearly in the declination of density by over 7 per cent per mile with distance from subcenters. Suburban workers would pay a premium to live near their workplaces, raising population density near subcenters.

Other empirical findings, however, rejected the polycentric urban economics theory (Clapp et al 2001, p43). In Washington DC, it was the result of demographic changes and technological innovations rather than the development of suburban employment nodes shaped the land value surface not conforming to the bid rent predictions of polycentric urban theory (Clapp et al 2001). Sivitanidou (1997) found substantial flattening of the office land value gradient from large subcenters in Los Angeles, 1989 to 1994. Edel and Sclar (1975) demonstrated that in Boston, property values increased with distance from the downtown by 1970. Bollinger et al. (1997) found a positive gradient from the downtown for office rents in Atlanta.

McDonald and McMillen (2000) examined suburban real estate developments completed in metropolitan Chicago during the years 1990 to 1996. The industrial, commercial, and residential sectors were studied separately. They found that industrial development was attracted to locations nearer to downtown Chicago, highway interchange but not to employment centers. Commercial development, in contrast to industrial development, was more likely to occur in locations proximate to suburban subcenters, whilst distance to downtown Chicago had no effect. Residential development indicated a rather scattered pattern relative to existing polycentric urban structure. Housing was not attracted to sites with favorable access to commuter rail stations, highway interchanges, or suburban subcenters over the years. Indeed, proximity to highway interchanges and suburban employment centers had negative effects on the probability that housing development took place.
Shearmur and Coffey (2002) conducted a comparative analysis in an attempt to reveal the complex polycentric structures and their evolution for four largest Canadian metropolitan areas: Toronto, Montreal, Vancouver, and Ottawa-Hull. By using employment data from Statistics Canada and detailed census questionnaire over the period 1981 - 1996, both cross-sectional and time-series spatial analysis were conducted. Two distinct approaches were employed to examine the data: analysis of employment centers and analysis of concentric rings. After empirical definition of employment centers, the distribution and change of total and sectoral employment within them was analyzed, while the analysis of concentric rings made it possible to understand the evolving spatial distribution of employment between 1981 and 1996. Three distinctive patterns of space economy were discovered, they are, strong CBD and CBD fringe with weak development of suburban areas in Montreal and Ottawa, growing suburban centers and weakening CBD in Toronto, and both strong fast-growing CBD and sub-centers in Vancouver. Only Vancouver appeared consistent with the standard polycentric urban economics. They further emphasized the descriptive analysis and no attempt was made to explain the patterns because of rich possibilities to fully explore the factors of local physical geography, policy, history and probably cultural predispositions and preferences. They also refuted a threatening issue on whether or not timing contributes to the difference of patterns and trajectories by arguing “the data do not support such a view”.

Complementary studies of spatial restructuring were conducted in cities of developing countries. Dowall and Leaf (1991) used surveyed land value data of 262 kelurahan (villages) in Jakarta as indicator of spatial variation. They found that land values in Jakarta were higher in central area than that in those areas further away from the CBD, reflecting an uneven urban development. The impact of distance to CBD,
infrastructure and land title on the median value of residential land were assessed and their explanation power of spatial change were supported by statistical analysis. Dowall (1992) revealed somewhat similar pattern in Bangkok, that is, the spatial pattern of land values for housing market was highest in the city center and subsequently declined with distance. The gradient was flattening out over the years as suburban land prices increased faster than those in the central city.

2.1.3 Property Value Distribution in Central Cities and Its Shaping Forces

Recent studies on property value distribution in central cities revealed a metropolitan-like polycentric pattern. Although a part of metropolitan area, central city usually covers an area which is big enough to accommodate a complex polycentric spatial distribution of property values. With central business district as its core, central city in common consists of the majority of urban built-up areas and partially undeveloped or development controlled suburban areas, and so is much larger than the traditional inner city, which is a small old city area facing deterioration and drastic economic restructuring.

By using the latest release of kelurahan-based land value data, Han and Basuki (2001) provided insights into the urban spatial structure in the central Jarkata. Assisted by parametric and non-parametric statistics, as well as the choropleth mapping and analysis functions of the Geographic Information System, they discovered a drastic spatial variation in the central city by affirming that “one could also easily find cheap land parcels whose values were lower than the lowest land values of some parcels in non-central regions of the city, reflecting the mixture of slums and skyscrapers in central Jakarta”. Physical determinants, especially distance variables, were found
significant in shaping the land value distribution and so the urban spatial pattern.

Han (2004a) examined the spatial distribution pattern of housing price in the selected central areas of two Pacific-Asia metropolises: Beijing and Jakarta. In Beijing, an extended central city was selected as the study area in that the majority of Beijing’s housing development located in this area of about 700km$^2$. In Jakarta, data covered the 661 km$^2$ DKI Jakarta area, which is the abbreviation of Special District of the Capital City. None of the two cities was similar to a smooth surface featuring a cone or the roof top of a circus tent. Instead, Beijing’s housing price surface was more like the roof top of castles, whilst Jakarta’s resembled the shape of two TV towers. Many factors including physical settings, history, and institutional frameworks shaped the dynamic price terrains in two central cities. Properties in each of the identically defined geographical sectors and in the history-development core showed distinctive profiles and curve fitting statistics.

Singapore is a special metropolitan region in Asia. It only covers a fully urbanized area of 683 km$^2$, which is smaller than a common metropolis. In most sense, it is equivalent to the central city of a metropolis by its land scale and the degree of urbanization. Han et al (2002) studied the urban development in Singapore through the analysis of distribution pattern of transaction prices of landed housing. They stated that the planned prime housing area accommodated those properties with the highest transaction prices. Han (2004b) made use of global and local spatial autocorrelation statistics to explore the spatial clustering of condominium values in Singapore’s context of polycentric urban development. Empirical results revealed a remarkable redistribution of condominium projects in the 1990s among the planning regions, which was in line with the polycentric urban development policy. Global Moran statistics indicated a spread of condominium values over space. Yet local Moran statistics exposed that high condominium value clusters continued in the central area, no clusters of this sort forming
around the planned regional centers.

In a macroscopic view, general characteristics of urban spatial variations were described qualitatively and explained from the aspects of local physical geography, socio-economy, policy, history, and culture, like most studies on China. Yet in a more microscopic view, intra-metropolitan spatial structure was mainly explored through quantitative analysis of the distribution of population (Ingram, 1998; Zheng, 1991), employment (Gordon and Richardson, 1996; Meyer and Gomez-Ibanez, 1981; Shukla and Waddell, 1991; Waddell and Shukla, 1993; Shearmur and Coffey, 2002) and property value (Dowall and Leaf, 1991; Dowall, 1992; Figueroa 1995; Han and Basuki, 2001; Han et al, 2002; Han, forthcoming; Peiser, 1987). A large amount of data from population censuses, records of property transactions, or lists of firms was necessary to investigate the specified changes of urban spatial structure (Wu and Yeh 1997). Once the spatial distribution of population, employment or property values were revealed, a host of independent variables were evaluated to explain the observed patterns. Among them, spatial variables should be placed of the first importance. Spatial variables can be viewed as the quantitative reflections of the socioeconomic factors on the transformation of urban spatial structure. They also need large quantity of data for quantitative analysis, and the results would make socioeconomic effects more discernable. Spatial determinants include neighborhood, accessibility, and proximity externalities. Evaluating these factors’ significance and influence in the hedonic model is essential for explaining distribution of population, employment and property value, therefore attracted a variety of factor studies.

Kain and Quigley (1970) reduced thirty-nine individual location characteristics to five factors using factor analysis. The indices included the quality of adjacent parcels, the
percent of the neighborhood dedicated to commercial uses, the amount of local commercial traffic, and numerous other potential externalities.

Li and Brown (1980) distinguished the positive influence of accessibility on house values from the negative effect of proximity to nonresidential use. Proximity variables included in their study are proximity to a corner grocery store, neighborhood park, school, river, ocean, conservation land, expressway interchange, or major thruway. They concluded that accessibility, congestion, pollution, and unsightliness characteristics give high explanatory power of house value variations.

Peiser (1987) used macro-location and micro-location, development expectations and neighborhood characteristics to analyze the determinants of non-residential land value. He found that spatial determinants affected land values of industrial, commercial and office land use in quite different ways. For example, proximity to the CBD affected office land value but this effect did not happen for industrial land value. Similarly, proximity to suburban nodes contributed significantly to office land value but not to commercial land value.

McDonald and McMillen (1990) thought that different explanatory variables should be defined for different metropolitan areas, considering the distinctively social and cultural context of each region. They then identified a set of explanatory variables which were believed to be more appropriate for the context of Chicago and found that one sub-center had a significantly positive effect on land value.

Shukla and Waddell (1991) found that the distance to the CBD had different effects on industrial land uses. CBD maintained the strongest attraction to finance, insurance and the real estate industry, while less to manufacturing and wholesale trade, and the least to retail trade.
In applying the hedonic model to the property market, Iain et al. (1998) systematically specified the determinants of house prices into four groups, that is, structural, accessibility, neighborhood, and environmental factors. Of which the last three groups falls into the category of location characteristic. Neighborhood factors describe the characteristics of the local area in which the property is located and census data are a good indicator of these attributes. Accessibility variables define the ease with which local amenities can be reached from the property and for their study schools, bus routes, railway stations, shops, parks, and the Central Business District were all considered. They extracted a sample of 4,000 properties from a $50 \text{km}^2$ urban area in Glasgow, Scotland for the year of 1986, entered all variables of a specific group into an ordinary least squares (OLS) regression and examined the adjusted $R^2$. The results show that, as a group, neighborhood variables accounted for most of the variation in property prices, followed by structural variables, environmental variables and accessibility variables.

In the research on the spatial structure of land values in Jakarta, Han and Basuki (2001) found that spatial variables, especially distance to the central business district, were important in shaping land-value patterns in Jakarta, but the explanatory power of distance declined over time” (p1841). Other distance variables, like commercial establishment within 1 km radius, distance to the nearest highway entrance, contributed to the land value variations to a small extent.

In summary, previous studies revealed that the spatial variables of distribution of population, employment and property value were characterized by distinctiveness in different local contexts and had different effects on different types of land use. The determinants also varied depending on the transformation of the economic structure of
the cities. For instance, in the trend towards a polycentric urban structure, distance to
the CBD becomes less significant to property market.

Cheng and Masser (2003) discussed Wuhan’s urban spatial changes and modeled
major determinants of urban variations in the period 1993–2000. Exploratory data
analysis was presented to visually explore the spatial impacts of each explanatory
variable, and spatial logistic regression technique was then used to provide a
systematic confirmatory approach to compare the variables. The study shows that the
major determinants are urban road infrastructure and developed area, and master
planning played limited role in guiding Wuhan’s growth in the period of study.

Lusht (1997) revealed that factors such as topography of a site, land use zoning,
floodplain elevation requirement became important considerations in property
valuation assessment. Empirical findings also showed that site characters, distance to
main amenities such as regional centers, school and parks, local changes in population
and housing units and ethnic mix, as well as planning policies such as land use zoning
were all important factors shaping the property value surface.

2.2 Studies on China’s Urban Development and Spatial Transformation

There are many themes explored in Chinese urban research. Because of the lack of
data, very few quantitative studies of urban spatial variations have been made for
Chinese cities. Most of the studies emphasized on identifying the general urbanization
or urban transition process, and scrutinizing the fundamental forces driving Chinese
urban development like policy changes, and ideologies. They provide a sound
theoretical background for the occurrence of spatial variations in a nationwide historical and political context.

It was stated that the complexity of urban changes in North America can be better understood based on two influential paradigms: “growth machine” model pioneered by Logan and Molotch (1987) and “urban regime” analysis popularized by Stone (1989). These paradigms are questionable when attempting to explain the growth of Chinese cities, because of the over-emphasized internal and growth-oriented forces in these models at the cost of a broader causation like state reconfiguration, national political strategizing, and regional economic transformation (Lin 2002, p312). As Lin (2002) stated, China’s urban growth has been effectively shaped by the state’s political strategies formulated not only out of growth considerations but also ideological commitments and social concerns (p313). Similarly, Chinese urban transition fit into neither the Lewis’s (1954) “structural transformation model” of economic development nor the Todaro’s (2000) “price-incentive model”. The former model focused on the withdrawal of surplus rural labor from the agricultural sector and its transfer to the modern industrial sector whose growth then absorbs the surplus. The latter sought the maximized total productivity through the use of mechanisms such as appropriate technology and related strategies. For China, the most densely populated country of the world, the essential issues associated with urban transition is the full absorption of the surplus rural labor into more productive sectors for social and political stability while enabling maximum advantage to be taken of the abundant labor force (Oshima 1987). China’s urban transition was hence made more complicated. Its determinants deserved detailed investigation. Pannell (2002) claimed that state policy and regulations had salient influence on directing urban transition to a success, by affecting various aspects of the economy, society, and the cities and towns. He then
declared with confidence of several driving forces, e.g., population and demographic processes, people’s migration patterns, employment restructuring, means to finance economic growth and development, as well as investment in fixed assets.

Han and Wong (1998) further added an ideological dimension to the Chinese urbanization research. Both anti-urban and pro-urban attitudes were reviewed in their study. They argued that such a political opposition in Chinese urbanization was an outgrowth of the conflict between Marxist theory and traditional Chinese agrarianism. To achieve the communist goals in line with the Marxist theory, a series of development strategies were released, e.g. Great Leap Forward, readjustment, reform and openness, etc. They prudentially identified the chain reactions and interaction between these strategies and urbanization. Development strategies acted through cities and countryside to reach certain political and economic goals. During the process, the level of urbanization increased rapidly until it had to be controlled by new strategies when central finance cannot afford.

2.2.1 Economic Reform and Urban Development

Major institutional changes made in 1978 were viewed by many China specialists as one of the decisive forces explaining the dynamics of Chinese urban development (Lin 1998; Ma 2002). Two major phases of urban change can be readily identified before and after 1978.

Prior to the economic reforms initiated in 1978, large cities under Mao were understood as the key nodes of the centrally planned economy, bases of socialist industrialization, and centers to maintain social stability and national integrity (Lin 2002, p313). On the one hand, in order to achieve optimum industrial growth, the Maoist regime had managed to limit investment in the agricultural sector and minimize
the cost of urban service provision, a strategy known as “economizing urbanization” in socialist economies (Chan, 1992). On the other hand, such a strategy had led the Maoist regime to retain the surplus rural labor force in the countryside and block the upgrading of rural settlements into cities. Despite the efforts to limit the growth of large cities and to facilitate the development of smaller ones, large cities had dominated the urban hierarchy established by the Maoist regime. Plus, urban development in the central and western interior had been promoted at the expense of the eastern coast out of the consideration of national defense and exploitation of natural resource (Lin 2002, p313). Hsu (1996) compared urban development and population increase of the pre-reform and reform era in Guiyang and Luoyang, both small cities ranked low in the urban hierarchy. Based on these two cases, she claimed that the government economic policies and urban directives of the pre-reform era have been critical shaping forces of the functions and land use of Chinese cities - “not just in those decades, but also for many years beyond that period” (p909). Indeed, once the economic structure of a city was determined, it was difficult to change (Hsu 1996, p895). Hsu’s arbitrary statement apparently needs detailed examination. As Lin (2002) argued, China’s urban functional and geographic system changes constantly, as a result of changing political and economic forces in different historical contexts.

The economic reform initiated in 1978 and subsequent institutional changes have brought about “marketization” (Walder 1995) and “decentralization” (Zhu 1999) to China’s urban development. This new political economy has created numerous developmental opportunities for enterprises and local entrepreneurial bureaucrats as well as greater freedom of local governments, and finally resulting in the formation of “local corporatism” involving not only local authorities but also a mix of non-governmental actors (Lin, 1997). “Rural transformative development” (Huang
1990) from below and relax of central state from above have produced a “dual-track system” (Lin 2002) in China’s urban hierarchy, featured by the dominance of both large cities and a large number of newly emerged small cities. Under the pressure of global market forces, development strategy has tended to re-emphasize the leading role of the eastern coast in China’s urban development. As shown in a recent study by Zhu (1999), informal local urban regimes formed in the booming coastal cities, during the transition economies, are competing for local growth by financial gains from urban land and property development (p546). Therefore, the cities in the post-Mao era have functioned not simply as an assembly of financial assets and land property but as the locus of economic and social transformation engineered by the state for both growth and non-growth considerations (Lin 2002, p299).

Wu (1997) proclaimed that transitional economies emerged after 1978 induced profound transformations of political economy, functions of urban planning as well as urban organization and land development (p259). Under this transition, new built environment was formed to reflect the changes of urban development. Taking metropolitan Guangzhou as an example, he identified the new elements in the changing built environment, including new business district, gentrified residential communities, new social areas, urban sprawl, large peripheral residential communities, development zones and sub-centers (Wu 1997, p282). By doing such a case study, he stated that the examination of the detailed structure of built environment as well as the political economy could provide a better understanding than merely reference to the “socialist ideology” (Wu 1997, p281).

Han and Wong (1994) paid particular attention to the role of coexisting reform and pre-reform policies of the 1980s and to the underlying factors that affected the pattern of Chinese urban growth. Not like those researchers who took the reform policies as
dominant in drastic urban change, they perceived the uncertainty of policy effects and resulting complexity of Chinese urban growth. 66 cities from mainland China was randomly selected and some 16 variables were analyzed by statistical methods. The results of analyses suggested that these two major groups of policies in the 1980s acted as countervailing forces on Chinese urban growth. Reform policies stimulated Chinese urban growth by pushing (via rural reform) and pulling (via urban reform and open policy) simultaneously. Pre-reform policies contained the growth of large cities and directed urbanization into the countryside. Although weakened by reform policies in the control, pre-reform were retained to ensure smoothness in the transition. They also found that industrial development was the most influential factor accountable for the rapid urbanization. It was city planning that balanced the growth of urban population and the expansion of the built-up area.

2.2.2 Land Reform and Urban Spatial Development

Cheng and Masser (2003) presented another important time division by stressing that “urban development process of Chinese cities is differentiated as two distinguishing periods before and after 1978/1987...the economic reform in 1978 and land reform in 1987 are the key factors impacting the urban development process” (p200). Though both economic reform and land reform are important in shaping the changes of Chinese cities, land reform in 1987 played the most significant role in restructuring the urban spatial patterns. As Wu & Yeh (1997) claimed, economic reform did have some impacts on the spatial structure of Chinese cities, but their impacts were not as great as the land reform in 1987. Particularly after the introduction of the paid transfer of land use rights such as land leasing, urban spatial structure of Chinese cities has been undergoing considerable changes. For example, new social areas are been formed
through the clustering of high-quality commercial housing in some urban areas (Yeh and Wu, 1995). Land development process has been drastically changed by the new land-leasing system, which brought about accelerating land conversion, urban sprawl and a new spatial distribution of land development within the metropolitan area (Yeh and Wu, 1996).

A mixture of urban sprawl and redevelopment characterizes the new spatial development pattern in China after land reform initiated in 1987. As Zhang (2000) explained, urban sprawl expressed the activity of disproportional expansion of urbanized areas into undeveloped land. Most US researchers have characterized urban sprawl pattern by leapfrog, commercial strip development and large expanses of low-density development (Ewing 1997). Although there is some common features in urban sprawl between China and the US such as the large-scale conversion of farmland to urban uses and leapfrog development in the urban fringe, there is a distinctive sprawl pattern in the Chinese version. Unlike the weakening downtown areas in the US cities affected by the sprawl activities, central cities are still booming in China. And most importantly, it is the poorer that have to move to suburban areas in Chinese cities while the richer in US prefer to live in the urban fringe (Zhang 2000, p129).

Researchers have attributed China’s urban sprawl to the land market force created after reform, and to the changes in power distribution over urban development. For example, Naughton (1995) observed the newly created districts to host the identical sprawl of urban activities occurred in suburban areas. He then indicated that government and changing internal economic forces, rather than the marketplace, were the main driving forces of urban sprawl in China, because district specialization was more a result of both state priority for certain types of development or in a lack of state priority which leaves land open for other uses without market control.
Shue (1995), in her research on a small town (Xinji) in northern China, found the sprawl of even state power in addition to the expansion activities themselves. She also noticed that in the Chinese context, the relaxing of central government’s intervention made “the local state’s presence now seems both more selective and more efficacious”.

China’s “work-unit” system (danwei in Chinese) was also given great importance by scholars in analyzing the urban restructuring of Chinese cities. Wu (1997) indicated a coexistence of conflicts and coalition in this transformation process. Conflicts involved those between central and local government over land premiums, as well as those between municipality and farmers, and state work-units and the public. While a potential coalition was consist of municipal government, overseas capital, and “big builders” (large state work-units) for development.

It was identified that main factors contributing to sprawl in China were the combination of land market and government’s reaction (especially at the local level) to the marketplace. The public sector was also seen in many research. Zhang (2000) found that besides private interest groups outside the government, the public sector itself consisted of and represented various “public” interest groups. The conflicts among these interest groups thus significantly aggravated sprawl, made government consensus over sprawl hard to reach, and weakened any efforts on sprawl control.

2.2.3 Comparative Analysis of Urban Spatial Variations

A number of qualitative studies have found some determinant policies (e.g., marketization, land leasing, urban planning, decentralization of decision making) and main development actors (e.g., central government, local state, work units, developers and investors) which shape the urban space of Chinese cities (Cheng and Masser 2003). This perception provides a valuable framework to understand the Chinese cities in the

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profound spatial transformation. However, urban spatial changes of cities in China must be fully investigated by looking into the location factors. Socioeconomic and political forces could be uncovered by examining the physical factors such as location and neighborhood. By using Geographic Information System and remote sensing technology, it is now possible to integrate large quantities of data for dynamic spatial analysis of the urban development processes.

Wu and Yeh (1997) applied aerial photos, GIS and statistical analysis methods for modeling land development pattern and examining its determinants in Guangzhou before (1979-87) and after (1987-92) the land reform. In their study, land reform of 1987 was viewed critical to the drastic change of the spatial distribution and locational characteristics of land development. In order to overcome the shortage of land transaction data in Guangzhou, land development in two periods was analyzed by using aerial photo as an alternative. It is found that there has been a significant restructuring of spatial distribution of land development in Guangzhou since the adoption of the new land-leasing system in 1987. Industrial land development declined considerably while development for commercial and residential land uses increased. Focus of land development moved away from the old industrial districts in the northern and southern parts of the city towards the densely populated city center and new development zones circling around. The determinants of land development were analyzed using a logistic regression model. They found that the main determinants of land development have changed from distance from the city center to closeness to the city center; from proximity to inter-city highways to proximity to city streets; and from more related to less related to physical condition of the sites. Urban planning was playing a less important role in development control. The changing spatial distributions and determinants of land development suggested the emergence of new

2.3 Shanghai’s Urban Transformation

Shanghai is the largest industrial city and the economic powerhouse of socialist China. This city also represents one of the most successful cases of economic development in the 1990s. According to Zhang (2003), gross domestic output (GDP) in the municipality has experienced two-digit annual growth since 1992; per capita GDP in US dollar terms has more than tripled between 1990 and 2000. Shanghai has therefore become one of the most studied cities in the past decades. A rich range of literature provides description and analysis on various aspects of urban transformation, e.g. urban development (Wu 1999), state and market interaction (Han 2000) and place promotion (Wu 2000).

It has long been accepted that economic liberalization has undermined state control by introducing market mechanism, as had a fascinating chain reaction to China’s urban development. Han (2000), however, in his study on Shanghai, argued that state control has not been undermined that much. Rather, it remains the key role in determining the timing, the pace and the economic and spatial configuration of Shanghai’s urban development. The state was further inspected by analyzing the central and local state respectively. The central state, although weakened, was crucial in promoting the urban development. Yet the local state was obviously empowered in enterprise control and the intervention of resource allocation through decentralization. The local state thus remained influential in urban spatial restructuring. Global and regional markets were indispensable for decision-makers in analyzing the urban dynamics in its particular setting (Han and Yan, 1999). Openness of Pudong (East Shanghai) was an instance for
the interplay between state and market. The key decision was largely made by the central government. The industrial and locational readjustment in this special economic zone of Shanghai was the outcome of intensive competition among local states. Moreover, local state had to respond to market demands and supplies in order to survive and to achieve high-speed economic growth (Wu and Zhang, 1994).

Under the set of interrelated factors, Shanghai has experienced drastic economic and spatial restructuring. A new cityscape emerged accompanying the soaring investment from foreign and domestic sources in the post-1992 period (Han 2000). A new economic structure has been forming with the dominant tertiary and pillar industries. The rural landscape was also reorganized by industrialization.

Also focusing on assessing the influence of state on economic development, Zhang (2003) drew a quite different conclusion. He argued that it was the sheer scale of investment, rather than selective interventions, or improved economic management at the local level, were the keys to Shanghai’s economic success. Rapid urban transformation, in some sense, was produced purposely through concentrated investment, inasmuch as the central state’s ambition to promote it as a global city and the local state’s desire to achieve rapid growth. Local state was criticized of being the causation of numerous failure and ineffectiveness. Due to the lack of market knowledge and self-determination, it was hard for the local decision-makers to direct structural transformation correctly although they can influence the resource allocation. In this sense, central state, not local, played a dominant role in Shanghai’s economic development. But both of them cannot prevail over the market forces (Zhang 2003).

So far, the majority of research interest has been centered on the macroeconomic development and its determinants. Relatively little research has been devoted to a
major sector of transitional economies, e.g. the land and construction sector. Li (1997)
took Shanghai as a case study, attempted to examine the land market mechanism introduced by the land-use right reform in China through the analysis of land price behavior. He found that Chinese local authority was avoiding the open market competition to the investors or developers by granting land through private treaty mechanism. Land price therefore was distorted. Despite such a deviation from the market norm, local authority sustained the situation. Possible reasons for this may be the various invisible interests in land. As Dowall (1993) stated, political and ideological preferences always took priority over actual economic consequences, especially in a transitional economy. On the one hand, the deeply rooted ideology of the concept of “cost as value” made the underpricing acceptable to the authority. On the other hand, to avoid the disproportionate (as many as 40 per cent) share in land revenue with the central government, local authorities preferred to transact the land-use right in a “black box”. By granting land in private treaty mode rather than open market competition to the developers, the local authorities were actually distorting the land prices achieved in the emerging market (Li 1997, p321). The underpricing effect, however, has not been shown fully as the secondary land market is almost non-existent. As the land market developed and frequent resale of land-use rights became feasible, residual land value would very close to market land price. As such, the first batch of developers would gain abnormal profits through the underpriced land-use rights they obtained. To compensate for the initial underpricing, the central authorities need to share the profits by issuing a new tax policy and so would deter investment interests.
CHAPTER 3: RESEARCH DESIGN

3.1 Choice of Study Area

Shanghai, with a metropolitan population of over 13 million, is the largest industrial city and the economic powerhouse of China. Its administrative region, or the metropolitan area, covers a land area of 6,340 square kilometers (Figure 3.1). The city extends about 120 kilometers in north-south direction and nearly 100 kilometers in east-west direction. It has an urban area of 3,924.24 square kilometers and rural area of 2,416.26 square kilometers. Its land area covers 6,219 square kilometers and water area runs 122 square kilometers. Shanghai is now divided into 18 administrative districts (Huangpu, Luwan, Xuhui, Changning, Jing’an, Putuo, Zhabei, Hongkou, Yangpu, Baoshan, Minhang, Jiading, Jinshan, Songjiang, Qingpu, Nanhui, Fengxian, Pudong) and one county (Chongming), among which there are 132 towns, three townships, 99 sub-district committees, 3,393 neighborhood committees and 2,037 villagers' committees under the city's jurisdiction. Chongming Island (County) is the third largest island in China, covering an area of 1,041 square kilometers.
Central city of Shanghai (Figure 3.2) refers to all the areas encircled by the Outer Ring Road, which covers a total area of 667 square kilometers, with a built-up area of 600 square kilometers. It is the most energetic and hence representative part of the metropolis, featuring a quite large size (about the area of whole Singapore), highly urbanized development, the accommodation of the majority of commercial and residential land use in the metropolitan Shanghai, and the spread of three tiers of planned centers: the CBD, urban centers and district centers. Given its most dynamic urban spatial transformation and densest house development, the central city is used as the study area. This area includes all the six old administrative districts (Huangpu,
Hongkou, Jing’an, Luwan, Yangpu, Zhabei – which are integrated in Figure 3.1 as “six old districts”), main portions of Changning, Pudong, Putuo, Xuhui, as well as minor portions of Baoshan, Jiading, Minhang, Nanhui.

For the convenience of the analysis of housing sales distribution and the scrutiny of details in local spatial variations of urban development, a highly practicable division of the central city defined by the comprehensive plan of Shanghai central city (1999-2020) is adopted in this study. According to the plan, six zones (Figure 3.3) are defined in line with the requirements of the present administrative districts, and with the distribution of major public centers:
1. The Middle Zone – areas within the Inner Ring Road. This area possesses major functions of tertiary sector like finance, trade, information and service, complemented by residential, cultural, tourist and recreational functions. The Lujiazui in Pudong and the Bund (within original British Settlement) in Puxi are planned to form the Central Business District (CBD).

2. The North Zone – areas in Yangpu, Hongkou, Zhabei and Baoshan districts between the inner and Outer Ring Roads, with dominate functions of urban industries, scientific research, goods collection and distribution, residence.

3. The West Zone – area in Putuo, Changning, Zhabei and Jiading districts between the inner and Outer Ring Roads. This zone is separated from the north district by Hutai Road while the boundary between the west district and the south district is West Yan’an Road. The dominant functions are commerce, commodity trade, foreign trade, fine chemical industry, mechanical industry, warehouse and residence.

4. The South Zone – areas in Xuhui, Minhang, Luwan, Nanshi and Changning districts between the inner and Outer Ring Roads. Its major functions are commerce, exhibition, new high-tech industries, science, education and residence.

5. The Northeast Zone – region within Pudong New Area between the inner and Outer Ring Roads to the north of Zhangjiabang. Its main functions are export processing, residence, shipping and bonded warehouses.

6. The Southeast Zone – region within Pudong New Area between the inner and Outer Ring Roads to the south of Zhangjiabang. Its major functions are high-tech industries and residence with high environmental quality.
3.2 Temporal Coverage

This study focuses on a 12-year period from 1990-2002, during which Shanghai experienced drastic changes in urban space economy and housing provision.

Before 1990, Shanghai had lagged for years in obtaining a comparable degree of municipal autonomy from the central government, when comparing to other major cities on China’s east coast. However, once barriers were removed in 1990 when the State Council made an important strategy of opening and developing Pudong New
Area, the pace of reform has been impressive. In 1992, the Fourteenth Party Congress proposed another important strategy in its document – “with development and opening up of Pudong (East Shanghai) as the spur, to further open up the cities along the Yangtze River, to build Shanghai into one of the world economic, financial and trade centers as fast as possible and to actuate a new economic surge in the Yangtze Delta and the whole Yangtze Valley”, showing clearly the direction for Shanghai to develop in the future. Throughout the 12 years, Pudong has succeeded in attracting foreign investment and exports by the provision of preferential incentives. As the model of China’s Special Economic Zones (SEZs) and new industrial and commercial center, Pudong has contributed much to relieve the spatial pressure on old urban area of Shanghai. The spatial restructuring of metropolitan Shanghai is also associated with the successful redevelopment of the old urban area previously flooded with dilapidated housing and fragmented industries. Shanghai is now one of the pioneers in experimenting with urban land markets and leads other major cities in attracting foreign capital for housing development and building of urban infrastructure (Wu 1999, p207). In sum, rapid urban growth in Shanghai, as spearheaded by both China’s reform and local economic strategy, has brought profound changes in the organization of spatial structure and the reconfiguration of housing provision systems.

### 3.3 Hypothesis

In Webster's 1913 Dictionary, two definitions are given for hypothesis.

1. A supposition; a proposition or principle which is supposed or taken for granted, in order to draw a conclusion or inference for proof of the point in question; something not proved, but assumed for the purpose of argument, or to account for a fact or an occurrence.
2. (Natural Science) A tentative theory or supposition provisionally adopted to explain certain facts, and to guide in the investigation of others; hence, frequently called a working hypothesis.

This classic dictionary clearly expresses that in natural science, a hypothesis is more inferential and devoted to explaining rather than examining, while in other scientific subjects, a hypothesis is applicable for both exploratory and inferential purpose.

Fischer (1998) inspected the most important criteria for spatial data analysis models and concluded that spatial analysis method should be “data-driven rather than theory-driven in nature, and essentially exploratory rather than inferential in a conventional spatial hypothesis testing sense”. There is a clear need for a quantitative exploratory spatial data analysis (ESDA), which “provides useful means to generate insights into global and local patterns and associations in spatial data sets”. Han and Basuki (2001), in their study in Jakarta, seek to explore the spatial pattern of land values and the determinants by testing three hypotheses.

To examine the spatial dynamics of housing price in central Shanghai, four hypothesis are postulated for testing in this study, which is basically data-driven:

1. \( H_0 \): There is no significant difference for housing price between the middle and five peripheral zones of the central city.
   \( H_1 \): Housing price in the middle zone has higher value than that in the peripheral zones.

2. \( H_0 \): Housing prices are evenly distributed in the five peripheral zones of the central city.
   \( H_1 \): There are spatial variations of housing prices among the five peripheral zones.
3. $H_0$: There is no significant difference for housing price inside and outside the 500-meter buffer area along Inner Ring Road.

$H_1$: Housing price within the 500-meter buffer along Inner Ring Road is significantly different with that outside the buffer area.

4. $H_0$: Housing price in the central city is a function of spatial variables.

$H_1$: There is no relationship between spatial variables and housing price.

$$\ln(Z) = f(COM, DCBD, DDEV, DHOS, DMRT, DSCH, DTA)$$

Where:

$Z =$ Housing Price

$COM = 1$ if property is within a 300 meters radius from the nearest commercial area

$DCBD =$ distance to CBD

$DDEV =$ distance to nearest development zone

$DHOS =$ distance to nearest hospital

$DMRT =$ distance to nearest MRT station

$DSCH =$ distance to nearest school

$DTA =$ distance to nearest tourist attraction

The first two hypotheses are to explore whether monocentric or polycentric structure the central city is discernable in. Through these two hypotheses, the development stage of central Shanghai’s spatial structure can be exposed. Whether its urban change bears
similarities to western cities or remain the original status can be detected. The third is to test the complexity of spatial variation when affected by certain important infrastructures like the Inner Ring Road. With the fourth hypothesis, it is hoped that the significance of key spatial factors will be determined.

### 3.4 Dependant and Independent Variables

**Dependent Variable (Z)**

Advertised prices of 867 residential projects marketed between 2001 and 2002 are used in this research. Housing price of each project is mean price measured in RMB Yuan per square meter. The primary data source is the Shanghai Real Estate Transaction Center (SRETC). The SRETC obtains sales data from the real estate transaction centers in each district and from some large brokers. This database contains important information on each residential property, such as project name, unit price (minimum, average, maximum), address and year built.

**Explanatory Variables**

As Iain et al. (1998) has specified, determinants of house prices can be systematically classified into four groups, that is, structural, accessibility, neighborhood, and environmental factors. Of which the last three groups falls into the category of location characteristics. Because of the lack of structural data for the projects, this study focuses on spatial variables. Here seven independent variables (Table 3.1) are measured, they are the distance to the nearest tourist attraction, the distance to the nearest hospital, the distance to the nearest development zone, the distance to the nearest MRT station, the distance to CBD, the distance to the nearest school, the
commercial amenity dummy variable.

**Commercial amenity dummy variable**

City-level commercial areas are mainly distributed at four streets (Nanjing Road, Middle Huaihai Road, Middle Xizang Road and North Sichuan Road) and three centers (People’s square, Yu Garden, New Railway Station). District-level commercial areas concentrate on Xujiahui, Huamu, Jiangwan-Wujiaochang and Zhenru.

**Distance to CBD**

According to the comprehensive plan of Shanghai central city (1999-2020), the Lujiazui core area (region between South Pudong road and Dongchang road) in Pudong and the Bund (region between Hongkou port and Xin Kaihe to the east of Henan road) in Puxi are defined as Shanghai’s Central Business District (CBD). The CBD, with about 3 km² planned area, possesses the major functions of finance, trade, information and service, complemented by residential, cultural, tourist and recreational functions. The bund is the traditional financial center of Shanghai, the infrastructure and buildings in the bund were mostly constructed between the 1920’s and 1930’s. Outdated establishments have not been able to make the requirement of modern official business, despite the little advantage of transportation, location and low dealing cost. As the newer part, Lujiazui has persisted in high standard of planning and construction in order to match and exceed the old financial core. Through 12-year efforts since Pudong’s opening, the Lujiazui core area has left the bund far behind whether in layout, planning, design, telecommunication, high-tech or in preferential policies. Until February 2002, there are totally 114 financial agencies settled in the CBD, including about 50 foreign banks. Besides, headquarters of 26 multinational
companies or subsidiaries, over 80 investment companies are agglomerated in Lujiazui. Shanghai Stock Exchange, Shanghai Diamond Exchange and the third future exchange are also accumulated there. The straight-line distance to the geometry centroid of CBD is measured in GIS.

**Distance to the nearest development zone**

Most of the development zones locate in Pudong new area. Another two main high-tech and industrial development zones, Hongqiao and Caohejing, are south and west of the city core, functionally as well as spatially separated from each other (Piper Gaubatz, 1999). The straight-line distance to the geometry centroid of the nearest development zone is measured in GIS.

**Distance to the nearest MRT station**

Rail transit lines now in Shanghai are 65 kilometers long. Expressway, MRT and LRT consist of three layers of the metropolitan mass transit system. Expressway connects the suburban areas with the central city. MRT goes through the central city and is finally combined with the expressway. LRT mainly covers the areas of low population density, as the supplement of MRT. Shanghai is actively engaged in planning and developing its transit system. It is planned that about 193 km transit lines would be built in order to make the rail transit into the primary means of public transportation system. The straight-line distance to the nearest MRT station is measured in GIS.

**Distance to the nearest hospital (DHOS), the nearest school (DSCH) and the nearest tourist attraction (DTA)**
Here hospitals, schools and tourist attractions are selected from Shanghai Street Atlas (2002, 2003). Straight-line distances between them and each property project are measured in GIS.

Table 3.1 Summary of Dependant and Independent Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Symbol</th>
<th>Description</th>
<th>Unit of measurement</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td>Z</td>
<td>Housing Price</td>
<td>RMB Yuan per square meter</td>
<td>Shanghai Real Estate Transaction Center (SRETC)</td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td>COM</td>
<td>Commercial amenity</td>
<td>1 = presence 0 = absence</td>
<td>Shanghai Street Atlas</td>
</tr>
<tr>
<td></td>
<td>DCBD</td>
<td>Distance to CBD</td>
<td>Unit on GIS map</td>
<td>Shanghai Master Plan</td>
</tr>
<tr>
<td></td>
<td>DDEV</td>
<td>Distance to the nearest development zone</td>
<td>Unit on GIS map</td>
<td>Shanghai Street Atlas</td>
</tr>
<tr>
<td></td>
<td>DHOS</td>
<td>Distance to the nearest hospital</td>
<td>Unit on GIS map</td>
<td>Shanghai Street Atlas</td>
</tr>
<tr>
<td></td>
<td>DMRT</td>
<td>Distance to the nearest MRT station</td>
<td>Unit on GIS map</td>
<td>Shanghai Street Atlas</td>
</tr>
<tr>
<td></td>
<td>DSCH</td>
<td>Distance to the nearest school</td>
<td>Unit on GIS map</td>
<td>Shanghai Street Atlas</td>
</tr>
<tr>
<td></td>
<td>DTA</td>
<td>Distance to the nearest tourist attraction</td>
<td>Unit on GIS map</td>
<td>Shanghai Street Atlas</td>
</tr>
</tbody>
</table>

Mainly secondary data were used as the data sources. Major publications used for this study are listed below:

1. Shanghai Master Plan
3. Information on infrastructure development provided by Shanghai Land Use and Urban Planning Administrative Bureau
5. Other real estate publications
3.5 Method

The Geographic Information System (GIS), descriptive statistics, parametric and non-parametric analysis, as well as forward multivariate regression models are employed to explore the spatial pattern of urban restructuring and housing development.

3.5.1 GIS

GIS is a computer system that can store, manipulate and display geographically referenced information. It is a container of maps in digital form, and always used to answer the fundamental question, “where?” Here besides its routine functions like storing and visualizing geographic data, this study focus on three key functions of GIS, that is, buffer, prediction surface creation, and 3D profile.

Buffer

Creating a buffer around features provides a visual representation on the map of the area within a certain distance of one or more features. By using a buffer, features in other layers that fall within the buffered area can be selected. In this study, two 500-meter buffer areas are created: one surrounds the sub-center of each zone; the other is along the Inner Ring Road. 500 meters are used here as an empirical distance within which the projects are believed to be affected by the sub-center and Inner Ring Road. Projects that fall completely inside the buffer areas are then selected to make comparatively statistical analysis with the others.

Prediction Surface and TIN
The surface is a function of the spatial coordinates where the function represents some variable of interest, either what actually occurred in nature or a mathematical model of the variable. In most cases there is no enough point data ready for use. Only from limited sample points the whole spatial organization of data in the study area cannot be exposed. Surface models allow storing and creating surface information in a GIS. A surface model approximates surface by taking a sample of the values at different points on the surface and then interpolating the values between these points. Although this method has been applied to multiple fields such as hydrology, there are few applications in housing. This study constructs surface models using both grid method to build a continuously smooth terrain and a Triangulated Irregular Network (TIN) method to create sharp breaks of slope between uniform-slope facets. Kriging, one broadly used grid model relied on both mathematical and statistical methods including autocorrelation (statistical relationships among the measured points), is chosen to create prediction surface. Generally speaking, things that are closer together tend to be more alike than things that are farther apart (Tobler. 1970). In the process of prediction, a point too far away may actually be detrimental because the point may be located in an area that is dramatically different from the prediction location. One solution is to consider enough but small weighted points to give a good sample. Unlike the most frequently used IDW interpolation, which forms weights just using a simple algorithm based on distance to predict values at unmeasured locations, kriging weights for the surrounding measured points come from a semi-variogram that scrutinizes spatial structure of the data. Predictions are then made for locations in the study area based on the semi-variogram and the spatial arrangement of measured values that are nearby. Here the house price is viewed as the “elevation” and modeled at each site of Shanghai to a smooth terrain. All of the 867 projects (sample points) are used for estimation in
this study. The surface is forced to pass through each sample point so that it remains unaltered, or exact in the prediction.

The TIN model is another main approach in building digital surface. It represents a surface through a series of irregularly spaced points with height values stored at the nodes. From these points, a network of linked triangles forms the surface. When building TINs, the original sample points are used, providing a useful check on the accuracy of the model. Further, TIN model makes the elevation and sharp slope more discernable.

The prediction for housing price variations is implemented through ArcGIS package, a geostatistical analysis program.

3D Profile

3D profile is a graph of the height of a surface along a specified line. In this study, the curves (profiles) are essential to understand the variation of housing price in various directions. 3D lines to a certain direction are plotted first. Profiles, with the changes in elevation over distance, are then created across the price surface along the 3D line.

3.5.2 Non-parametric method

Non-parametric method is used to test the first three hypotheses. The main advantages of using non-parametric tests such as Mann-Whitney Test and Kruskal-Wallis Test include: 1) They are easier to use and understand; 2) they do not require that the population being sampled is normally distributed; and most importantly, 3) they can be applied to situations in which parametric tests cannot be used. A major problem with non-parametric tests is that sample size must be larger for a non-parametric test to have
the same probability of committing the two types of errors (alpha and beta). Given the large enough sample size (867) in this study, this problem has been limited to a considerable small range and the results of the tests here can be as exact as parametric procedure.

3.5.3 Forward Multivariate Linear Regression

Multiple linear regression analysis is conducted in order to quantify the relationship between the dependent variable (housing price) and the explanatory variables (seven spatial factors). To suit the assumption of normally distributed dependent variable, housing price is transformed to a form of its natural logarithm. Forward method selects variables to enter the model one at a time based on the entry criteria, and so is especially useful in determining the spatial variables that can be influential for each level or group of samples. The Statistical Products and Services Solutions (SPSS) package is used for the computations. Correlation detection is conduct to see if there is strong relationship among variables. T-test, F value and standard error are computed for multiple decision use. Collinearity problem is paid particular attention in the regression analysis. Severe collinearity leads to unreliable estimates of the regression coefficients, which have larger variances and covariances. VIFs (variance inflation factors) is a frequently used method to detect the severity of multicollinearity by looking at the extent to which a given independent variable can be explained by all the other explanatory variables in the model. There is no table of formal critical VIF values, a common rule of thumb is that if VIF of a variable is close to 1, there is little collinearity; but if more than 5, there is a severe collinearity.
3.6 Research Limitations

Some limitations naturally exist in the research:

1). China’s housing market is far from well-organized and housing transaction system is in construction. Data on housing transaction price and attributes, especially those for time-series analysis, are not available. Although this study covers a 12-year period from 1990 to 2002, the changes of urban spatial structure and housing development cannot be fully explored. Quantitative description and analysis can only focus on the recent urban and housing spatial pattern. Former changes are analyzed mainly through reviewing of the existing literature on Shanghai’s spatial transformation.

2). Data obtained from Shanghai Real Estate Transaction Center (SRETC) are advertised sales price of residential projects rather than actual transaction price. Some characteristics in the process of urban and housing development may be obscured like the peaks (highest prices) and troughs (lowest prices).

3). Only locational influence on housing price is measured in this study. Structure and other variables are ignored because of the lack of data. It makes the efforts problematic to understand the determinants of housing price in full scale.

4). A little inaccuracy of the project locations and the map distance from a selected property to the ending points occurs because of the error inherent in the digitizing process, measuring devices and data sources.
CHAPTER 4: URBAN SPATIAL TRANSFORMATION
AND HOUSING DEVELOPMENT IN SHANGHAI

4.1 Urban Spatial Transformation

4.1.1 Spatial Changes Prior to The Study Period

Urban settlements in Shanghai can be traced back to the North Song Dynasty (960-1127). Markets in Shanghai came forth in the South Song Dynasty (1127-1279). Shanghai accommodated local administrative functions in the Yuan Dynasty (1271-1368). In 1553, walls were constructed surrounding Shanghai and symbolized the formation of this "city". Shanghai was opened up and served as a trading port to Western countries in 1843. Its foreign trading continued a rapid growth and took place of Guangzhou to be the largest trading center in just 10 years after 1843. Most of the trading activities concentrated in the foreign settlements. The human scale of foreign settlements reached its peak in 1940, accommodating about 4 million people. Besides large population inflow and trading boom, foreign settlements’ development also founded on the ports, productive and business function, and the intensely domestic and foreign investment. The total shipping of Shanghai ports increased from 8485 tons in 1844 to 37,650,000 tons in 1936. Over 10 cargo piers and 10 docks were built along the Huangpu River (Zhang 2001). Manufacturing began to flourish after factories were allowed to launch in the foreign settlements. Financial and transport function were also added in to make this region the largest business center in China before Japanese intrusion in 1937. Substantive aggregation of investment was another key factor ensuring the sustaining development of the foreign settlements. Foreign investment has mounted up to 1.1 billion US dollars till 1931. This amount further increased to 1.53
billion US dollars in 1940 (Zhang 2001). Drastic population growth and economic development after 1843 with no doubt had great impact on the spatial form in this region. The urban space first broke through the limitation of ancient city walls and expanded to the areas outside the walls. A large-scale spatial sprawl was then witnessed in the subsequent 60 years. A stable spatial structure came into being in the early 1900s and continued till 1949. Figure 4.1 illustrates the public settlements mainly composed by British and American settlements, as well as French settlement. All of them outspread along the Suzhou River and Huangpu River. Situated in south bank of Suzhou River and west bank of Huangpu River, British settlement occupied the most advanced locality. As the first foreign concession set in Shanghai, it also experienced a longer development and hence hosted more intense economic activities and substantive population aggregation. It is the first central district of Shanghai in the real sense, with a number of factories, warehouses, piers, banks and foreign firms. Cultural facilities and commercial areas also developed rapidly there. In the mean time, some regions (Hongkou, Yang Shupu, Zhabei, Jiangwan, and Putuo) to the south of central district grew to form a "Chinese city"(Zheng 2003, p12), which was under the rule of Chinese government and used to differentiated with the foreign concessions.
Although little effect was seen, local government did intend to control the out-of-order spatial development and sprawl in this city through some plan, e.g. the metropolitan plan of Big Shanghai posed in 1929. According to the plan, the region between Jiangwan and Wusong was chose to be the new urban area. Except allocating the traditional facilities like ports, piers, railways and stations, zoning was first introduced into the plan despite only three functional zones (administrative, commercial and residential) defined for the land use. The plan of central district adopted the typical western urban layout of grid streets and radiated roads, together with that of the traditional Chinese axis symmetry. This plan was only partially implemented due to the Japanese invasion in 1937. Shanghai was re-planned after the World War II (1941-1945). Based on the current situation both in foreign settlements and Chinese city, this plan took a palm-shape urban layout: urban areas extended through major
transportation axes, among the developing plots large quantities of farmlands and green space were reserved. Expressway and ring road consisted of the arterial road system and used to link satellite towns and old urban area. Nowadays metropolitan spatial organization has gradually formed in terms of this mode.

After the founding of the People's Republic of China in 1949, Shanghai’s urban configuration was affected greatly by the optimum industrialization strategy at the national scale (Lin 2002). Moreover, certain pre-reform policy by central state placed strict containment on the size of large cities in fear of overmuch financial and populous burden (Han and Wong 1994). Under such circumstance, new plan scheme of spatial development paid much attention to setting up satellite towns in the suburban area and expanding outside from the fringe of old urban area. In the 1950s, a large amount of industrial districts were established in the area between the nowadays inner ring road and outer ring road, including Wujiaochang, Pengpu, Taopu, Caohejing, Changqiao, Qingning Temple, Gaoqiao, and Zhoujiadu industrial districts. Workers' new villages were constructed accordingly near these industries. Both industries and their subsidiaries developed around the old city fringes. Due to the rapid industrial growth in Shanghai, six satellite towns, Minhang, Wujing, Songjiang, Jiading, Anting and Wusong, were built successively in the exurban areas (outside the current central city) after 1958. In the initial years of 1970s, Jinshan satellite town was established as the petrochemical base. Later in the same decade, a large iron and steel united enterprise founded in Baoshan county, together with Wusong industrial district, formed a new Wusong satellite town. So far, a complete town system took shape, with the old urban area as the center, Jinshan and Wusong satellite towns as the two wings, as well as sporadic towns and urban settlements distributed all around. This system persisted unchanged till 1990. Despite the elaborate spatial layout, the satellite towns could not
attract enough population and grew very slowly as a result of the insufficient infrastructure, undeveloped service industry, and the lack of mass rapid transit.

Prior to the economic reforms initiated in 1978, slow urbanization and few spatial variations, caused by the optimum industrial growth strategy adopted by the Maoist regime at the expense of urban consumption, characterized the old urban area of Shanghai (Chan 1992). A few projects were launched to mitigate the transport pressure and to meet the demand of domestic and foreign trade, e.g. newly built Zhongshan ring road, rebuilt Longhua Airport, and the construction of sea ports and piers. Despite this, historical insufficiency of investment on land use, transport, population and housing brought in huge pressure to Shanghai's urban construction. After the economic reforms, economic development was given the first priority. Several measures were used to improve the economic activities, e.g. establishing trade and business centers (Han and Wong 1994). In 1984, Shanghai government proposed an urban spatial development guideline that integrated reconstruction of old urban area and construction of new districts. The bund thus restored its function as the CBD and developed further. Besides, distribution of functional zones, and urban appearance in the old urban area changed a lot. Three key reconstruction districts were first established in the current central city, they are, Caoxi Road to Zhao Jiabang Road, new railway station, Si Ping Road. Later, Hongqiao new district was added in. Shanghai port was much improved. Nevertheless, in the whole 1980s, priority of development and favorable policies were given to eastern coastal cities and Hainan province, Shanghai was not paid enough attention to by the central government. In spite of much progress, Shanghai could not break away the difficult situation in relation to space development.
4.1.2 Spatial Restructuring in the period 1990-2002

In April 1990, former Premier Li Peng announced the central government decision to develop Pudong into the largest special economic zone (SEZ) in China (Huang 1991). In the process of making the decision, the central state played a key role, though the effects made by the municipal government were indispensable (Han 2000). According to Han (2000), opening up of Pudong was considered more for the economic development of the whole national than for the revitalization of Shanghai itself. Through such a action, the central state wish to express its commitment to the reform and open policy; to promote the space expansion of open areas from the east coast to inland regions; to experience a higher level of foreign investment and economic restructuring; and to develop Shanghai into a world city. After Pudong was designated as the largest new open area in 1990 by the State Council, the Fourteenth Party Congress in 1992 proposed a strategic goal of building Shanghai into "one dragon head (Pudong) with three centers (world economic, financial and trade centers)". Thus, political ambition and desire for economic development spur the severe spatial adjustment during 1990-2002 (Figure 4.2).
First, developing space extended across Huangpu River to Pudong (East Shanghai). As the model of China’s Special Economic Zones (SEZs), its key attractiveness is the provision of preferential incentives to foreign investors to promote investment and exports. Environment and enough developing space of course are two of the most significant incentives. Pudong therefore has been mandated the highest urban planning and construction level. Large-scale urbanization was then conducted to accommodate the prospective business activities and provide space for future’s development. Planned for a three-phase development, Pudong is designed to relieve the spatial pressure on old Shanghai and become a new center of industrial and commercial
activities. According to the Pudong New District Master Plan in 1991, three points (Lujiazui, Huamu and Waigaoqiao) and one line (Yanggao road) were put high emphasis in Pudong’s development. Lujiazui financial and trade center, together with the bund, formed the new central business district (CBD). Huamu accommodated high-tech development zones and specific official and exhibition sectors. Waigaoqiao served as a bonded and port district. Yanggao road was the artery road linking these three points. To shape a modern living corridor along this line, cultural and recreational facilities as well as a host of green plots were arranged at its two sides. During the twelve years of construction, a new external, multifunctional urban district has rapidly stood up in the eastern shore of Huangpu river.

Second, old urban area has being renewed. In face of the heavy burden of population and infrastructure, renewal has two emphases – dispersion of highly dense population to new developing areas (i.e., Hongqiao Development Zone, Caohejing Development Zone) and rearrangement of unsystematic urban functions. Following the removal of remaining factories at the two sides of inner ring road, and the reconstruction of slums in batches, a new spatial organization that accommodated mainly tertiary sector and residential land use took shape in the old urban area.

Third, pivot infrastructures and three-dimensional traffic network were built to provide this city a fluid “skeleton”. Such a skeleton has definitely facilitated the population dispersion process and allowed the comprehensive development of the "big Shanghai" integrating east and west parts. Nanpu bridge, Yangpu bridge, cross-river pedestrian tunnel and Pudong international airport were completed successively after 1990. Lupu bridge, outer ring tunnel were in construction. Elevated Inner Ring Road (48km), south-north elevated road (8.45km), and Yan'an elevated road (14.8km) consisted of an
elevated road network, linking Puxi (West Shanghai) and Pudong (East Shanghai) through a number of bridges. No.1 subway line (21.39km), No.2 subway line (27.03km), and the first phase of Pearl light rail line (25km) composed a rail transportation system in a shape of a cross plus a half ring.

Fourth, an east-west urban developing axis was gradually in shape in the central city. Pudong's opening, reconstruction of old urban area and the linking transit have formed an advantageous developing line. Dispersed population and partial business sector aggregated along the prolonged line to utilize the neighboring facilities. Accompanied by cheaper land and housing, better environment and more space, they have grown to form the sub-centers outside the old urban area and thus consolidated the developing axis. This axis now starts from Hongqiao airport in the west, via Gubei residential district, Jing'an district, the bund, and ends at Lujiazui in the east. Its two ends, especially Lujiazui, are the developing cores while the middle part is protected and controlled severely, only moderate development activities are allowed there.

4.1.3 Spatial Planning for Future Development

The previous master plan of Shanghai was approved by the State Council in 1986. The implementation of this plan has brought great social, economic and urban development of Shanghai and gigantic changes for the appearance of the city. The plan has thus laid a solid physical foundation and has formed a basic framework for Shanghai towards the 21st century. The new Comprehensive Master Plan of Shanghai (1999-2020) was approved by the State Council on May 1, 2001.
The general intention of this plan was to form an integral urban and rural development structure by rationalizing the land uses and constructing suburban towns energetically, as well as to enhance the composite functions of the central city by controlling the population growth and land use scale and orderly dispersing the population and industries towards the suburbs.

Shanghai’s development space would extend mainly along the sea (East Sea) and rivers (Yangtze River and Huangpu River) to form the riverside and seaside cities and towns and industries, which would consist of Baoshan New Town, Waigaoqiao Port (Bonded) District, Konggang New Town, Haigang New Town, Shanghai Chemical Industrial District and Jinshan New Town. Pudong New Area would remain the focus of development. Its spatial transformation would be facilitated by building new cities and central rural towns intensively. Chongming Island would be an important strategic space for Shanghai’s sustainable development in the 21st century.

The spatial structure of the entire Shanghai administrative area (6340 km²) features “three axes, five tiers and twelve centers” (Figure 4.3). According to the plan, the three axes would be composed of the Shanghai-Nanjing development axis, the Shanghai-Hangzhou development axis and the development axis along the sea and rivers. Five tiers refer to the urban hierarchy consisting of the central city, new towns, central towns, ordinary towns and central villages. This hierarchical urban structure takes the central city as the top one tier, integrating large, medium, and small-sized cities and towns to a balanced layout with the support of highways and railways. The central city, surrounded by Outer Ring Road, is the political, economic and cultural center of Shanghai. It has also experienced the rapidest urbanization process and densest residential development. A new town is where the district (county) government located, or a medium-sized city developing based on important industries and urban
infrastructures (airport, harbor etc). The eleven planned new towns include Baoshan, Jiading, Songjiang, Jinshan, Minhang, Qingpu, Nanqiao, Huinan, Chengqiao, Airport New Town and Harbor New Town. Backed by industries, a central town is a small-sized city developed from a systematically organized rural town with rational layout, superb geographical and economic conditions for development. About 22 central towns are planned, including Zhujiajiao, Sijing, Kangqiao, Fengcheng, Fengjing, Baozhen, Anting and Luodian. An ordinary town is in shape through merging several existing market towns according to their locations, transportation and resources. About 80 ordinary rural towns are to be formed. A central village is a new type modernized rural community/settlement consisting of several natural villages, which generally have distinguishing local features, beautiful environment, rational layout and complete infrastructures and service facilities. Twelve centers are composed of the central city and eleven new towns.
Figure 4.3 Structure of Cities and Towns
Limited in the Outer Ring Road covering a total area of 667 km², the central city would organize its economy space in a “polycentric and ringed” pattern (Figure 4.4). The central business district (CBD) and commercial centers would be given the top priority to develop and refine modern city functions. The central business district includes the Lujiazui core area in Pudong and the Bund in Puxi. The city-level commercial areas center on the People’s square, including four famous commercial streets of Nanjing road, middle Huaihai road, middle Xizang road and north Sichuan road, Yu Garden, the Ever-brilliant city of Shanghai railway station. There are four sub-centers namely Xujiahui, Huamu, Jiangwan-Wujiaochang and Zhenru. Industries are separated by the two ring roads. Within the Inner Ring Road would mainly distribute tertiary sector including finance, commerce, trade, information and service sectors, and properly reserve compatible industries. The areas between Inner Ring Road and Outer Ring Road would accommodate high-tech, high value-added, and non-polluting industries. About 20 large residential areas are also planned to intensely build in this region.

In order to facilitate the spatial reorganization, this plan also emphasized the construction of a complete traffic system. “Three ports (that is, International Container Pivot Port, Asia-Pacific Aerial Pivot Port and Modern Information Port) and two roads (expressways and express railways)”, along with the artery sea routes, would formed a speedy and convenient external transport system. While “two network (namely mass rapid transit network and expressway network)” would devote to serving the intra-metropolitan traffic.
Figure 4.4 City Structure of Shanghai

Legend:
- Elevated Road
- Freeway
- Highway
- Inner Ring Road
- Outer Ring Road
- River
- Bridge
- Urban Center
- Urban Sub-Center
- District Center
- Development Zone

Legend:
- Elevated Road
- Freeway
- Highway
- Inner Ring Road
- Outer Ring Road
- River
- Bridge
- Urban Center
- Urban Sub-Center
- District Center
- Development Zone
4.2 Housing Development

4.2.1 Housing Development in the Period 1949-1978

Once the economic center in the 1930s, Shanghai experienced a malformed development period in housing structure and distribution. Housing in that period was polarized to the lofty ones and slums. Lofty houses were built especially for the riches with fine design, shining decoration and quiet environment. Built near the convenient municipal establishment, most of them assembled in the foreign settlements, especially in the central district which originally was the British settlement. Slums, on the other hand, were for the poor, in the shape of land boat, hut, etc. They were crowded, simple and crude, without even the most fundamental facilities such as water drainage and supply, power supply, etc. Slums initially emerged in the both side of Huangpu River and Suzhou River. Refugees’ massive inflow made the slums spread out to the interspace between factories and wild land near the railways. According to the statistics of Shanghai Urban Construction and Management Committee (SUCMC), by 1949 totally 322 slums were distributed sporadically in Shanghai, each accommodating more than 200 households. They occupied a total land area of 11.09 million m², with 0.20 million rough huts and a total floor area of 3.23 million m². About one third (1.15 million) population of the entire Shanghai lived in these areas. The majority of the slums situated in the undeveloped regions outside the foreign settlements, e.g. the present districts of Zhabei, Putuo, Changning, Xuhui, Jing’an, Luwan, Nanshi and Pudong. Due to the poor living conditions, slums were not counted into the normal residential area, as resulted in as few as 3.9 m² per capita living space in 1949 (Table 4.1).
Despite a new Maoist regime founded in 1949, Shanghai could not get out of the dilemma of housing shortage. Until the economic reform in 1978, housing construction had been in an unbalanced and slow progress. It is largely shaped by the housing system in the highly planned economy that government took charge of the whole things of housing from financing, construction to allocation. Rent was very low and housing production costs were non-recoverable, creating a heavy financial burden on the government (Chiu 1996, p361).

In the first 17 years after 1949, the emphasis of housing development was placed to reconstruct the slums in order to make homes for those living under the poorest housing conditions. Through roads to the residential district were built, foul smell ditches were filled, and slums were rebuilt to the simple housing with brick walls and tile roofs. In the meantime, local government started to build a few new housing and widen the scale from year to year (Table 4.1). From 1950 to 1966, total investment on housing construction was 0.52 billion Yuan and a total residential floor area of 8.95 million m² were built. Almost 0.19 million households moved to 40 residential new villages in which the housing conditions were much improved. These new villages were mostly built in the original sites of slums, such as Caoyang New Village in Putuo district, Tianshan New Village in Changning district, Rihui New Village in Xuhui district, etc. Still, the per capita living space remained 3.9 m² at the end of 1966, as the result of the policy orientation to the reconstruction of old slums. In the nationwide "Cultural Revolution" chaos period (1967-1976), productive construction investment dominated Shanghai's urban development. Thus, housing development was neglected. Investment on housing construction was only 0.45 billion Yuan. Completed residential floor area decreased to 5.89 million m². As few as 36 thousand households moved into 43 newly built residential new villages. The ten-year economic chaos apparently
slowed down Shanghai’s housing construction, exacerbating the confliction between the intense desire of people on housing improvement and housing shortage. Furthermore, it damaged the administration system and order in housing construction that had shaped since 1949, resulting in the dropping housing quality and incomplete public facilities.

In sum, housing development in Shanghai from 1949 to 1978 was so slow that no more than 17.92 million m² residential floor areas were completed, with just 0.6 m² increase of the average per capita living space from 3.9 m² in 1949 to 4.5 m² in 1978. Housing construction was featured by small scale and low quality standard. By 1978, there were 0.45 million households living under the especially difficult conditions that per capita living space was less than 2 m². Housing provision became the biggest problem in Shanghai.

Table 4.1 Investment in Residential Housing and Floor Space of Buildings Completed

<table>
<thead>
<tr>
<th>Year</th>
<th>Investment in Residential Housing (100 Million RMB Yuan)</th>
<th>As Percentage of Total Fixed Asset Investment (%)</th>
<th>Floor Space of Residential Housing (10000 m²)</th>
<th>Per Capita Living Space (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1949</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>3.9</td>
</tr>
<tr>
<td>1966</td>
<td>0.27</td>
<td>4.2</td>
<td>52.77</td>
<td>3.9</td>
</tr>
<tr>
<td>1967</td>
<td>0.18</td>
<td>4.7</td>
<td>34.83</td>
<td>3.9</td>
</tr>
<tr>
<td>1978</td>
<td>1.79</td>
<td>7.4</td>
<td>199.61</td>
<td>4.5</td>
</tr>
<tr>
<td>1989</td>
<td>34.67</td>
<td>16.1</td>
<td>1246.58</td>
<td>6.4</td>
</tr>
<tr>
<td>1990</td>
<td>42.94</td>
<td>18.9</td>
<td>1339.02</td>
<td>6.6</td>
</tr>
<tr>
<td>2002</td>
<td>584.51</td>
<td>26.7</td>
<td>1880.50</td>
<td>13.1</td>
</tr>
</tbody>
</table>

Source: Shanghai Statistical Bureau 2002, 2003
4.2.2 Housing Reform after 1978

After the economic reform in 1978, hundreds and thousands of intellectual youths returned to the city in the wake of the Cultural Revolution. A financial strain on housing production was acutely felt by the government. There was a strong need for housing reform (Table 4.2). Housing system reform was, therefore, initiated to break thoroughly the mode of "Tong Jian Tong Fen" (both construction and allocation planned by the government as a whole) for liberating the government from the heavy burden (Xiao 2000). In the beginning of 1980s, Shanghai introduced a series of measures geared towards the diversification of the sources and capital for production (Table 4.3). With government remaining the traditional housing provider, enterprises and individuals joined in for housing production. Enterprises were required to bear responsibility for providing homes to their workers. The housing funds, as the main capital source, were self-financed by work units to cover the construction cost. Government, on the other hand, would provide a certain amount of loan and administrative support. As such, work units were not only in charge of the construction, but also allocation and management of the housing stock. Later, organizations and individuals of other places in the country and overseas Chinese were encouraged to invest on Shanghai’s residential properties (Zhang and Li 2003). Meanwhile, housing commodification was experimented in 1984 by selling housing to enterprises, organizations and individuals at prices set according to the quality of the units (Chiu 1996, p362). In 1986, Shanghai started to charge for the land use on three kinds of enterprises (joint venture, sole proprietorship and foreign-funded), which signified the initiation of the land reform on Shanghai. The first plot of rented land was approved in 1988. The paid transfer of land use rights attracted a bulk of capital both domestically and overseas. Accordingly, housing construction and redevelopment of old urban area
were boosted concurrently by all these favorable policies and measures. In the period 1979-1989, the completed floor space of residential housing reached 151.83 million m$^2$, 8.47 times of that in the former 30 years. Per capita living space increased from 4.5 m$^2$ in 1978 to 6.4 m$^2$ in 1989 (Shanghai Statistical Bureau 2002). With no doubt, housing development in the ten-year period made rapider progress than that of the former 30 years. However, housing tension was far from been got rid of. For instance, several generations living in one room, several couples in one room and no home after marriage, were still typical phenomena in Shanghai. This inconsistency between the rapid development and housing strain could be explained from three aspects. First, historical deficit in housing production could not be filled up in such a short period. Second, it was enterprises rather than the end-users (i.e., the households) paid the full market price for housing consumption. As the housing funds of the enterprises dissipated, the above measures were less effective in relieving the problems of housing shortages. Third, commodification was rudimentary in that operations were confined to the sale of homes and the scale was limited to relatives of overseas Chinese and enterprise employees (Chiu 1996, p362).
Table 4.2 Time Table of Shanghai’s Housing System and Reform

<table>
<thead>
<tr>
<th>Period of Time</th>
<th>Dominant Housing System</th>
<th>Main Housing Policies and Measures</th>
<th>Results and Influence of the Political Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1949-1978</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1949-1966</td>
<td>Reconstruction of Slums</td>
<td>Neglected Housing Production</td>
<td>Rent was very low and housing production costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>were non-recoverable, creating a heavy financial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>burden on the government</td>
</tr>
<tr>
<td>1967-1978</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1979-1989</td>
<td>Diversification of the sources and capital for production</td>
<td>Rent was still very low, government and enterprises together took primary charge of the housing provision, with individual commencing to join in</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td></td>
<td>Limited commodification cannot attribute much to the housing shortage</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>Experiment on Housing Commodification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990-1999</td>
<td>Public Housing Fund (PHF); rental increase with housing allowance; housing bonds; home purchase at concessionary prices</td>
<td>Promotion of housing consumption; the welfare attribute of housing began to fade away whilst its value increased; new financing channels were fostered</td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>Sales of self-contained public houses</td>
<td>Commodify the once public welfare houses</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>Admission of bought public housing to market; reduction of transaction tax and fees; full openness of second-hand housing market; redevelopment of 3.65 million m2 slums; full openness of domestic commodity housing market; diversification of leasing types; citywide real estate transaction network</td>
<td>Development of two markets for newly built houses and second-hand houses</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>End of the Entity Housing Allocation</td>
<td>Termination of free or low-rent housing occupation</td>
<td></td>
</tr>
<tr>
<td>2000-2002</td>
<td>Commodity Housing System</td>
<td>Majority of Shanghai’s residents have looked at the market for houses; government was no longer in charge of housing production and allocation.</td>
<td></td>
</tr>
</tbody>
</table>

4.2.3 Housing Development in the period 1990-2002

Since 1990, Shanghai has issued a series of housing reform policies from the three key aspects of provision, circulation and consumption to promote housing construction and intensify housing commodification (Table 4.3). A reform program aiming to consumption was proposed and approved by the State Council in 1991. This program announced four original measures, that is, promotion of Public Housing Fund (PHF), rental increase concurrently with housing allowance, compulsory purchase of housing bonds, and home purchase at concessionary prices. Of which the most important are Public Housing Fund and rental increase. PHF, as a long-term savings deposit, was the main way to solve the housing problem of low-income households and accrue funds for employees' future housing expenditures. In 1992, Shanghai took its lead in providing PHF mortgage loans for individual housing purchases. Aimed at enhancing supports to housing consumption, Shanghai again issued a sequence of financial policies, such as reducing the lending rates in 1997, lengthening the loan term in 1998, and introducing commercial mortgage loan for individual housing purchase (Zhang and Li 2003). The individual housing purchasing power was then largely enhanced, and the demand in the housing market rose. Traditional low rent system, once boasted as a socialistic welfare, made the housing production cost non-recoverable and routine maintenance unaffordable, further impeded the housing development in Shanghai. Rent reform for public housing initiated in 1991 hence directed towards rental increase and reduction of the ratio of rent to sale price. Rents were doubled immediately, and continued a 50% annual increase in each of the 4 years after 1995. Average rents increased from 0.52 RMB Yuan per m² in 1991 to 1.04 RMB Yuan per m² in 1998. As for the low-income households, rental increase was exempted or balanced by certain amount of allowance.
Another two new policies, namely, sales of self-contained public houses and admission of bought houses to market, were added in later to complement the reform program issued in 1991. Sales of public houses, a significant measure came forth in 1994, intensified the housing system reform ever implemented in that it not only boosted the proportion of owned units to the total housing stock, but also precipitated the transition from welfare housing consumption to the purchase of commodity housing in the market. While the policy of admitting bought public housing to market intended to hasten the development of two markets for newly built houses and second-hand houses. Employees were encouraged to improve their living conditions by selling the owned public houses in the second-hand housing market and then upgrading to new houses. This policy thus advanced the circulation of second-hand houses and sales volume of newly built houses in the two housing market, as well as forming a common recognition among the citizens of "Zhufang Zhao Shichang" (literally means looking for housing in the market).

Since 1996, real estate markets have steadily stepped into a mature situation, as activated and ruled by a series of new measures. They further advanced the housing circulation and consumption while against the high vacancy rate. First, the transaction tax and fees were reduced. Second, the second-hand housing market was completely opened. Based on the policy of admitting second-hand houses to market, a part of public houses were permitted to put to market at once after they are bought, while the others could be exchanged with commodity houses by filling the price difference. Third, a redevelopment plan for 3.65 million m$^2$ slums was proposed to facilitate the occupancy of vacant commodity houses. From 1991 to 2000, almost one million households who had longed for a bigger living space and better living conditions moved out of their simple houses. The demand for new dwelling houses immediately
rose. Fourth, the domestic commodity housing market was opened to individuals from other provinces. A policy came forth to encourage them for housing purchase by providing permanent residence status to those who bought houses in Shanghai. Fifth, a variety of leasing types, including pre-lease (leasing in advance of construction), lease transferred to sale, etc., were adopted to activate the commodity housing market. Finally, a citywide real estate transaction network was established, consisting of Shanghai Real Estate Transaction Center and its subsidiaries in each districts and county. More than 800 professional staffs served for this network. Together with the growing housing agent companies, this network created a fundamental external environment for ruling the housing transactions and booming the housing markets.

Shanghai Comprehensive Housing Reform Scheme launched in December of 1999 signified the termination of the welfare free or low-rent housing system. Since 2000, the majority of Shanghai's residents have looked for the market for houses; those who were not able to afford housing purchase have had to rent the low-cost dwellings. Government was no longer allocated the houses as welfare. Houses transacted in the market hence were titled “commodity houses”, meaning that these houses were to be sold as commodities but not allocated as welfare.

The practice of these measures for circulation and consumption had created phenomenal effects on housing markets (Table 4.4). The sold area of newly built commodity houses jumped from 5.29 million m² in 1996 to 10.57 million m² in 1998, and then increased steadily to 18.46 million m² in 2002, with a 24.7% average growth per year. The traded area of second-hand houses even experienced a rapider growth in the period 1996-2002, increasing from 0.25 million m² to 13.42 million m², almost doubled per year. The leasing activities, though not frequently occurred relative to the sales, also grew regularly. Further, the ascendant average price of commodity housing
signified that the value of houses as a kind of commodity was more and more recognized.

Table 4.3 Commodity Housing Sold and Leased, and Exchange of Second-hand Houses in Main Years

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sold Area of Commodity Housing (10000 m2)</td>
<td>528.56</td>
<td>617.02</td>
<td>1056.77</td>
<td>1243.33</td>
<td>1445.87</td>
<td>1681.48</td>
<td>1846.38</td>
</tr>
<tr>
<td>Among which, Villas and Flats</td>
<td>49.18</td>
<td>23.28</td>
<td>20.84</td>
<td>39.45</td>
<td>53.44</td>
<td>87.63</td>
<td>182.55</td>
</tr>
<tr>
<td>Private Bought</td>
<td>244.83</td>
<td>403.44</td>
<td>786.94</td>
<td>1009.25</td>
<td>1242.67</td>
<td>1571.19</td>
<td>1795.03</td>
</tr>
<tr>
<td>Traded Area of Second-hand Houses (10000 m2)</td>
<td>25.09</td>
<td>87.68</td>
<td>197.56</td>
<td>336.69</td>
<td>648.23</td>
<td>1031.48</td>
<td>1341.60</td>
</tr>
<tr>
<td>Sales Volume of Commodity Housing (100 million RMB Yuan)</td>
<td>156.90</td>
<td>178.35</td>
<td>319.76</td>
<td>385.64</td>
<td>480.97</td>
<td>615.17</td>
<td>739.89</td>
</tr>
<tr>
<td>Among which, Villas and Flat</td>
<td>35.04</td>
<td>18.80</td>
<td>16.64</td>
<td>22.56</td>
<td>32.65</td>
<td>53.68</td>
<td>105.65</td>
</tr>
<tr>
<td>Private Bought</td>
<td>57.87</td>
<td>109.89</td>
<td>229.08</td>
<td>307.02</td>
<td>408.29</td>
<td>570.27</td>
<td>715.23</td>
</tr>
<tr>
<td>Average Price of Commodity Housing (Yuan/m2)</td>
<td>2968</td>
<td>2891</td>
<td>3026</td>
<td>3102</td>
<td>3326</td>
<td>3659</td>
<td>4007</td>
</tr>
<tr>
<td>Among which, Villas and Flats</td>
<td>7125</td>
<td>8078</td>
<td>7982</td>
<td>5720</td>
<td>6109</td>
<td>6126</td>
<td>5787</td>
</tr>
<tr>
<td>Private Bought</td>
<td>2364</td>
<td>2724</td>
<td>2911</td>
<td>3042</td>
<td>3286</td>
<td>3630</td>
<td>3985</td>
</tr>
<tr>
<td>Commodity Housing Leased (10000 m2)</td>
<td>14.31</td>
<td>21.38</td>
<td>27.34</td>
<td>42.71</td>
<td>59.29</td>
<td>65.99</td>
<td>76.85</td>
</tr>
<tr>
<td>Among which, Villas and Flats</td>
<td>4.48</td>
<td>6.39</td>
<td>14.90</td>
<td>23.02</td>
<td>37.43</td>
<td>36.17</td>
<td>35.22</td>
</tr>
<tr>
<td>Private Bought</td>
<td>4.1</td>
<td>5.83</td>
<td>4.99</td>
<td>4.41</td>
<td>11.42</td>
<td>9.06</td>
<td>16.59</td>
</tr>
</tbody>
</table>

Source: Shanghai Statistical Bureau 2002, 2003

Greatly affected by the post-1990 reforms to promote consumption, the production of housing is no longer the primary responsibility of the government or enterprises. In the beginning of 1990s, state budget on housing provision was reduced gradually, and the housing funds of enterprises were almost exhausted. The planned and designated housing production system dominant in 1980s could not meet the people’s demands on
housing any more. A hybrid housing system (coexistence of welfare and commodity houses) hence took shape to intensify the pre-1990 measures on diversifying and multiplying the construction resources (Chiu 1996, p365). Apart from the traditional state investment, new financing channels have been opened up since 1990. During the period 1990-1998, for example, resettlement funds of 15 billion RMB Yuan assembled through land leasing were launched into housing construction; 104 plots of lands were sold to foreign investors, who would then build about 9 million m$^2$ housing on these sites. Besides, 11.6 billion RMB Yuan loan from Public Housing Fund for construction and revenue of 5.5 billion RMB Yuan by selling public houses were also used for housing construction. Supported by the large amount of capital from financial organizations like commercial bankers, and spurred by the high returns, real estate development companies have grown rapidly to be the major players in housing provision. The number of estate development enterprises skyrocketed from 94 in 1991 to 4173 in 1998 (Li 2001). By introducing market and emphasizing the housing attribute as a commodity, the reforms had in effect fostered new channels of non-government construction funds, basically sourcing from individual households.

Diversified investment pattern, together with the gradually mature real estate markets as well as rapid economic growth, contributed to the parallel development in housing construction. From 1990 to 2002, there were 416.88 billion RMB Yuan invested in housing development, 18 times of the amount in 1979-1989. Annual housing investment rose from 4.29 billion RMB Yuan to 58.5 billion RMB Yuan. The proportion of housing to total fixed asset investment also mounted from 16.1% to 26.7%. A total residential floor area of 210.88 million m$^2$ was built. By 2002, Shanghai's per capita living space was 13.1 m$^2$, double of that in 1990. In the meantime newly built housing multiplied, old residential districts were renovated.
After the launch of renewal plan for 3.65 million m² slums in 1992, nearly 0.18 million households whose living space was less than 2.5 m² were rehoused at the end of the year. By 1999, another 0.07 million households whose living space was less than 4 m² were resettled. So far, the problem of housing shortage, which impeded Shanghai’s progress for several decades, was solved essentially. The composition of dwelling houses was much optimized as well (Table 4.4). The total floor area of villas and apartments in 2002 increased 2.9 times of that in 1990, while the simple housing, dropped 58%.

Table 4.4 Composition of Dwelling Houses In Selected Years (Unit: 10000 m²)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwellings</td>
<td>4117</td>
<td>4403</td>
<td>8901</td>
<td>11906</td>
<td>20865</td>
<td>26906</td>
</tr>
<tr>
<td>Villas</td>
<td>128</td>
<td>134</td>
<td>158</td>
<td>179</td>
<td>250</td>
<td>580</td>
</tr>
<tr>
<td>Apartments</td>
<td>90</td>
<td>92</td>
<td>118</td>
<td>111</td>
<td>206</td>
<td>223</td>
</tr>
<tr>
<td>Staff Dwellings</td>
<td>1140</td>
<td>1402</td>
<td>4884</td>
<td>7998</td>
<td>17939</td>
<td>23777</td>
</tr>
<tr>
<td>Improved Residential Block</td>
<td>433</td>
<td>434</td>
<td>474</td>
<td>454</td>
<td>428</td>
<td>411</td>
</tr>
<tr>
<td>Old Residential Block</td>
<td>1777</td>
<td>1822</td>
<td>3067</td>
<td>3004</td>
<td>1896</td>
<td>1802</td>
</tr>
<tr>
<td>Simple Housing</td>
<td>464</td>
<td>437</td>
<td>123</td>
<td>85</td>
<td>84</td>
<td>52</td>
</tr>
<tr>
<td>Other</td>
<td>85</td>
<td>82</td>
<td>77</td>
<td>75</td>
<td>62</td>
<td>61</td>
</tr>
</tbody>
</table>

Source: Shanghai Statistical Bureau 2002, 2003
CHAPTER 5: SPATIAL DISTRIBUTION PATTERN OF URBAN AND HOUSING DEVELOPMENT

5.1 Distribution of Housing Projects in Shanghai

An examination of locations of housing projects allows an initial analysis on spatial dynamics of housing construction activities. From figure 5.1, housing projects sold publicly during 2001 and 2002 in Shanghai could be deeply impressed by their uneven accumulation along the main transportation line, like the Inner Ring Road and freeways. Combined with table 5.1 below, some other features can also be highlighted.
Figure 5.1 Shanghai Housing Sales Distribution (2001-2002)
Table 5.1 Housing Sales in Shanghai (2001-2002)

<table>
<thead>
<tr>
<th>No. of Projects</th>
<th>Percentage of Total No. of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>867</td>
</tr>
<tr>
<td><strong>Middle vs. Peripheral Zones</strong></td>
<td></td>
</tr>
<tr>
<td>Middle Zone</td>
<td>413</td>
</tr>
<tr>
<td>Peripheral Zones</td>
<td>454</td>
</tr>
<tr>
<td><strong>500m Buffer of Inner Ring Road</strong></td>
<td></td>
</tr>
<tr>
<td>Inside</td>
<td>75</td>
</tr>
<tr>
<td>Outside</td>
<td>792</td>
</tr>
<tr>
<td><strong>Zoning</strong></td>
<td></td>
</tr>
<tr>
<td>Middle Zone</td>
<td>413</td>
</tr>
<tr>
<td>West Zone</td>
<td>99</td>
</tr>
<tr>
<td>North Zone</td>
<td>91</td>
</tr>
<tr>
<td>South Zone</td>
<td>100</td>
</tr>
<tr>
<td>Southeast Zone</td>
<td>67</td>
</tr>
<tr>
<td>Northeast Zone</td>
<td>53</td>
</tr>
<tr>
<td>Outside the Outer Ring Road</td>
<td>44</td>
</tr>
</tbody>
</table>

First, there are as many as 47.6% projects were located in the middle zone. To the surprise, most of the projects dispersed in the fringe of this zone, but not assembled in the CBD for the locational advantage. Possible explanation is that renowned commercial streets were historically formed there, as well as the planned central business district, leaving little space for the residential construction.

Second, 8.7% projects lay within the 500-meter radius buffer of Inner Ring Road. For such a small belt area, the amount of development activities was quite large. It is noticeable that the main transport lines, in another word, the accessibility has lead an essential role in site selection for housing construction.

Third, five peripheral zones cover a much larger area than the middle zone, but only accumulated 52.4% of the projects. With regard to the zonal partition, a relatively large
housing projects were observed in the South (11.5%), West (11.4%) and North (10.5%) zones similarly, which all belonged to Puxi (West Shanghai). A moderate amount of development occurred respectively in Southeast (7.7%) and Northeast (6.1%) zones, which are the main zones of Pudong (East Shanghai). The least projects (5.1%) spread outside the Outer Ring Road. Historical urban development in Shanghai would be the best reason for such an unbalanced distribution of housing construction in the east and west zones of Shanghai, which are separated by Huangpu River. Pudong has long been ignored by the state till 1990 and hence too undeveloped to attract people living and working there. Residents of Shanghai ever believed that it was better to own a bed in Puxi than a house in Pudong. The situation has changed to a great extent after 1990 when Pudong opened up. However, more time is necessary for the complete transformation of development focus and people’s belief.

In general, housing development in this city varied much in space, from middle zone to peripheral zones, from the interior of the 500m-radius buffer of Inner Ring Road to its exterior, as well as from Puxi to Pudong, etc. Further study will concentrate on analyzing the spatial variation of housing price by using GIS techniques and statistic methods.

5.2 Distribution of Housing Price in Shanghai

5.2.1 Hypothesis Test for the Middle and Peripheral Zones

As defined in chapter three, the middle zone refers to the area bounded by the Inner Ring Road. The peripheral areas consisted of five zones (South, West, North, Southeast and Northeast), as well as the districts outside the Outer Ring Road. Table 5.2 provides descriptive statistics of the average prices of housing projects developed
in these two areas during 2001 to 2002. Figure 5.2 further provides a visual demonstration of the statistics in Table 5.2. Obviously the general price levels and distributions are quite different between these two groups. The mean (6191 RMB Yuan) and median (5750 RMB Yuan) of average housing price in middle zone are much larger than those of peripheral zones. While the kurtosis (8.37), skewness (2.37) and range (13034 RMB Yuan) of peripheral zones area are all greater, displaying a relatively skewed distribution with a long right tail of extreme large values (outliers) and more substantive variations of average price. The middle zone, on the other hand, is more normally distributed. Table 5.3 ranks the average housing price and provides the Mann-Whitney test statistics for two groups. The mean rank of middle zone almost doubles that of peripheral zones. At the 0.05 level of significance, there is enough evidence to conclude housing price in the middle district has higher value than that in the peripheral zones.

The first null hypothesis that no significant difference for housing price in Shanghai between these two areas is therefore rejected. This result is quite consistent with basic urban location and economics theory, and its empirical evidences can be observed in many cities of the world. The attractiveness of middle zone (comparable to the central area in many cities) for both households and other land users like firms stems from lower transport costs reduced by clustering activities, scale economics in production, permitted high-density land use, information sharing among firms, and linkage across firms (Ingram 1998, p1020). In a competitive housing market, households have to compete not only among themselves, but also with a variety of other land users. They must pay more to occupy the central locations. Furthermore, huge population and land pressure on Shanghai promote a rapid expansion to farther or less desirable locations. This makes centrally developed sites more valuable, and increases housing prices
accordingly (DiPasquale and Wheaton 1996, p58).

Table 5.2 Descriptive Statistics of Average House Price in the Middle and Peripheral Zones

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>Median</th>
<th>Kurtosis</th>
<th>Skewness</th>
<th>Range</th>
<th>Std. Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle</td>
<td>413</td>
<td>2000</td>
<td>13500</td>
<td>6191.12</td>
<td>5750.0</td>
<td>2.12</td>
<td>1.42</td>
<td>11500</td>
<td>1963.55</td>
<td>385545.56</td>
</tr>
<tr>
<td>Peripheral</td>
<td>454</td>
<td>1744</td>
<td>14778</td>
<td>4337.07</td>
<td>4022.5</td>
<td>8.37</td>
<td>2.37</td>
<td>13034</td>
<td>1639.27</td>
<td>2687192.30</td>
</tr>
</tbody>
</table>

Figure 5.2 Histogram and Normal Curve for the Middle and Peripheral Zones

Table 5.3 Mann-Whitney Test for the Middle and Peripheral Zones

<table>
<thead>
<tr>
<th></th>
<th>Middle</th>
<th></th>
<th>Peripheral</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Rank</td>
<td>584.18</td>
<td></td>
<td>297.58</td>
<td></td>
</tr>
<tr>
<td>Sum of Ranks</td>
<td>241266.01</td>
<td></td>
<td>135012.00</td>
<td></td>
</tr>
<tr>
<td>Test Statistics for Average Price</td>
<td>Mann-Whitney U</td>
<td>31727.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wilcoxon W</td>
<td>135012.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>-16.843</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2.2 Hypothesis Test for Five Peripheral Zones

In the light of the comprehensive plan of Shanghai central city (1999-2020), Shanghai (also the study area) was divided into six zones, namely Middle, South, West, North, Southeast, and Northeast. An extra district is added in to further the study outside the Outer Ring Road with 44 observations. Simply from Table 5.4 and Figure 5.3, housing price varies greatly from one district to another. West zone has the highest mean and median (average) price, followed by North, South, Southeast, Northeast and the outside zone. North zone ranges most from 2,450 RMB Yuan to 14,778 RMB Yuan, increasing six times. Northeast zone has the biggest kurtosis (the longest right tail shown in the histogram), implying the most probability to produce outliers. And the south zone holds a smallest skewness, hence presenting a curve closest to the standard normal distribution.

Kruskal-Wallis test (Table 5.5) for six zones indicates that at least one district has significantly different housing price in comparison to others. Thus the second null hypothesis that housing prices are evenly distributed in peripheral areas is rejected. Mann-Whitney test (Table 5.6) then conducted for five pairs of districts gave further information on the diversity of housing price among the districts. Results indicate that housing price in the west zone is slimly higher than that in the north zone, and the north zone has a bit higher housing price than the south zone. The same is true of the variations of housing price among the southeast, northeast and outside-outer-ring-road zones. However, they are all not statistically significant at a 5% significance level. Only a difference in the pair of south/southeast is evidently supported by the test statistics. This naturally set apart the peripheral areas of Shanghai into three groups, Puxi (composed of West, North and South districts), Pudong (consisted of Southeast
and Northeast districts) and the area outside Outer Ring Road. Housing price in Puxi is much higher than that in Pudong and the district outside Outer Ring Road, while within each group only minor difference is detected. Most possible explanation for such a general trend in housing price is the historically and recently developed infrastructure, amenities and functions for the six districts (refer to Figure 4.4).

Three zones in Puxi have been developed as the major area for the expansion of old urban area in Shanghai since 1949. They are featured by good infrastructure and amenities built in the past decades, as well as relatively moderate population distribution and land use. According to the new Comprehensive Master Plan of Shanghai (1999-2020), West zone mainly develops commerce, commodity trade and foreign trade; North zone accommodates urban typed industries, while the dominant functions of South zone are commerce, exhibition and education. Newly formed urban sub-centers (Jiangwan-Wujiaochang and Zhenru), together with a number of commercial streets, strengthen the district functions as the center for commerce and high-profit industries in the west and north zone. Most of expressways, MRT lines and elevated roads go through these three districts, making transport and commuting convenient.

The other two districts in Pudong, while have experienced an amazingly quick development since Pudong’s opening in 1990, cannot supply the huge demand for facilities and amenities. In addition, they are planned to be the sites mainly hosting export processing, high-tech industries and residence. A variety of industrial parks (for example, Waigaoqiao duty-free district, Jinqiao export processing district, Zhangjiang high-tech development zone, Sunqiao agricultural development zone) were administratively created. But they are far from well formed and working properly.
during the past 12 years. First, planning area of Pudong industrial zones exceeded the actual business capacity. At present, built area of Pudong industrial zones were limited. According to Xiong (2000), total built area of 9 city-level industrial zones in Shanghai only occupied 12.33 percent of their planning area; among the zones 4 were located in Pudong. The construction of self-contained infrastructure still needs a long time, even if it is supported by a large amount of foreign investment. Second, there are severe conflicts between Pudong and Shanghai’s economic development. Pudong was planned to host five multipurpose districts, each with a core area (Tang 1994). Shanghai also planned its own development districts and centers. According to the Comprehensive Plan of Shanghai 1999-2020, only one sub-center was planned in Huamu, Pudong besides the Lujiazui financial area as part of the CBD. Forced administrative zoning resulted in respective development of districts in disregard of the developing strategy of the whole city. Commercial development is very weak in the two districts, with only two district-level centers. Bridges (such as Yangpu Bridge, Nanpu Bridge, Xupu Bridge) and tunnels (such as East Yan’an Road Tunnel) do link Pudong and Puxi across the Huangpu River. The first magnetic aerotrain also makes it easy to commute from Longyang Road in Puxi to Pudong International Airport. However, sparse population distribution and non-commercial environment impede the effects on completing the road system within these districts. Besides, living in Pudong signified a low social status in history. This has not been much changed till now, and so frustrated the interest of housing purchase. The peripheral district beyond the Outer Ring Road is in a similar situation of districts in Pudong. Infrastructure and transport system are less developed, population and commercial activities sparsely distributed, which contributes an identical low level of housing price to this zone.
Table 5.4 Descriptive Statistics of Natural Logarithmic Average Price for Peripheral Zones

<table>
<thead>
<tr>
<th>ZONING</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Min.</th>
<th>Max.</th>
<th>Range</th>
<th>Std. Deviation</th>
<th>Variance</th>
<th>Kurtosis</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>99</td>
<td>5003.99</td>
<td>4500.00</td>
<td>2400</td>
<td>12500</td>
<td>10100.0</td>
<td>1793.24</td>
<td>3215715.75</td>
<td>4.00</td>
<td>1.78</td>
</tr>
<tr>
<td>North</td>
<td>91</td>
<td>4712.47</td>
<td>4250.00</td>
<td>2450</td>
<td>14778</td>
<td>12328.0</td>
<td>1902.93</td>
<td>3621146.04</td>
<td>8.20</td>
<td>2.31</td>
</tr>
<tr>
<td>South</td>
<td>100</td>
<td>4131.14</td>
<td>4188.75</td>
<td>2335</td>
<td>7000</td>
<td>4665.0</td>
<td>780.12</td>
<td>608583.08</td>
<td>1.64</td>
<td>0.56</td>
</tr>
<tr>
<td>Southeast</td>
<td>67</td>
<td>4050.58</td>
<td>3800.00</td>
<td>1744</td>
<td>12100</td>
<td>10356.0</td>
<td>1807.55</td>
<td>3267239.16</td>
<td>6.78</td>
<td>2.35</td>
</tr>
<tr>
<td>Northeast</td>
<td>53</td>
<td>3952.85</td>
<td>3700.00</td>
<td>2225</td>
<td>12500</td>
<td>10275.0</td>
<td>1729.74</td>
<td>2991987.98</td>
<td>13.49</td>
<td>3.32</td>
</tr>
<tr>
<td>Outside</td>
<td>44</td>
<td>3427.16</td>
<td>3495.00</td>
<td>1880</td>
<td>7500</td>
<td>5620.0</td>
<td>888.34</td>
<td>789142.42</td>
<td>9.43</td>
<td>2.02</td>
</tr>
</tbody>
</table>

Figure 5.3 Histogram and Normal Curve for Peripheral Zones
Table 5.5 Kruskal-Wallis Test for Peripheral Zones

<table>
<thead>
<tr>
<th></th>
<th>West</th>
<th>291.49</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>North</td>
<td>256.35</td>
</tr>
<tr>
<td></td>
<td>South</td>
<td>235.08</td>
</tr>
<tr>
<td></td>
<td>Southeast</td>
<td>187.60</td>
</tr>
<tr>
<td></td>
<td>Northeast</td>
<td>176.18</td>
</tr>
<tr>
<td></td>
<td>Outside Outer Ring Road</td>
<td>129.20</td>
</tr>
</tbody>
</table>

Test Statistics for Average Price

<table>
<thead>
<tr>
<th></th>
<th>Chi-Square</th>
<th>67.301</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Df</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 5.6 Mann-Whitney Test for Peripheral Zones

<table>
<thead>
<tr>
<th>Ranks and Test Statistics</th>
<th>West/North</th>
<th>North/South</th>
<th>South/Southeast</th>
<th>Southeast/Northeast</th>
<th>Northeast/Outside Outer Ring Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Rank</td>
<td>102.07/88.35</td>
<td>101.70/90.81</td>
<td>91.82/72.33</td>
<td>61.57/59.14</td>
<td>53.82/43.19</td>
</tr>
<tr>
<td>Mann-Whitney U</td>
<td>3854.000</td>
<td>4031.000</td>
<td>2568.000</td>
<td>1703.500</td>
<td>910.500</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>8040.000</td>
<td>9081.000</td>
<td>4846.000</td>
<td>3134.500</td>
<td>1900.500</td>
</tr>
<tr>
<td>Z</td>
<td>-1.718</td>
<td>-1.360</td>
<td>-2.554</td>
<td>-0.381</td>
<td>-1.852</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.086</td>
<td>0.174</td>
<td>0.011</td>
<td>0.704</td>
<td>0.064</td>
</tr>
</tbody>
</table>

5.2.3 Hypothesis Test for Areas Inside and Outside the 500-meter Buffer of Inner Ring Road

A 500-meter buffer was created around the Inner Ring Road, which is the most
important part in the elevated road system of Shanghai. In order to test the influence of main transport lines on housing price dynamics, Table 5.7 and Figure 5.4 shows the descriptive statistics and normal curve for housing price within and out of the buffer. Both results indicate a very similar variation of samples. Table 5.8 exhibits the results of Mann-Whitney Test for the third hypothesis. The mean rank is slightly higher for the buffered group but this is not statistically significant at a 5% significance level. Hence, the third null hypothesis cannot be rejected because there is no difference between the housing price inside and outside the buffer area along Inner Ring Road. This is not consistent with the prior analysis result on the locations of housing projects, in which plenty of housing construction activities assemble along Inner Ring Road. Researches on evolution of urban form also support the idea that spatial structure of modern cities is shaped, in large measure, by advances in transport and communication (Anas, Arnott and Small 1998, p1428). Such an abnormality of spatial variation of housing price could attribute to the far-reaching areas went through by Inner Ring Road. Prices of house projects in different sites along the road loop were not evenly affected. Plus, even if there was a positive effect of the entire road on the prices of houses in the buffer area, this effect could be blurred by the extreme large values in the non-buffer area, which make the price difference imperceptible between these two groups.

Table 5.7 Descriptive Statistics of Average House Price in the Areas Inside and Outside the 500m Buffer around Inner Ring Road

<table>
<thead>
<tr>
<th>Ring Road</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Median</th>
<th>Kurtosis</th>
<th>Skewness</th>
<th>Range</th>
<th>Std. Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside</td>
<td>75</td>
<td>3580.0</td>
<td>11000.0</td>
<td>5129.37</td>
<td>4850.00</td>
<td>4.96</td>
<td>1.93</td>
<td>7420.0</td>
<td>1306.76</td>
<td>1707631.08</td>
</tr>
<tr>
<td>Outside</td>
<td>792</td>
<td>1744.0</td>
<td>14778.0</td>
<td>5228.86</td>
<td>4750.00</td>
<td>2.55</td>
<td>1.44</td>
<td>13034.0</td>
<td>2079.99</td>
<td>4326358.46</td>
</tr>
</tbody>
</table>
Figure 5.4 Histogram and Normal Curve for Areas Inside and Outside the 500m Buffer around Inner Ring Road

Table 5.8 Mann-Whitney Test for Areas Inside and Outside the 500m Buffer around Inner Ring Road

<table>
<thead>
<tr>
<th>Mean Rank</th>
<th>Inside</th>
<th>457.35</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outside</td>
<td>431.79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum of Ranks</th>
<th>Inside</th>
<th>34301.50</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outside</td>
<td>341976.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Statistics for Average Price</th>
<th>Mann-Whitney U</th>
<th>27948.500</th>
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<td>Wilcoxon W</td>
<td>341976.500</td>
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<tr>
<td></td>
<td>Z</td>
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</tr>
<tr>
<td></td>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.398</td>
</tr>
</tbody>
</table>
5.2.4 Housing Price Surface and 3D TIN

Statistical tests for the three hypotheses uncover significant variation on housing price based on different partition of the study area. Yet this variation represents merely general trend between large regions. In this section, analysis of housing price will reveal a more detailed pattern of the central city. By using GIS technology, an overall perception of the price dynamics in Shanghai’s central city can be obtained.

Figure 5.5 Distribution of Shanghai’s House Price
Figure 5.6 Prediction Map of Housing Price

Figure 5.6 plots all the sample points in terms of their value. The darker the dots, the higher the prices. Dependent upon these observations, a grid prediction surface is created by kriging, a main geostatistical interpolation method. In the final product of prediction, the study area is classified to 11 sections, each with a different range of the house prices. The deeper the color, the higher the price. Figure 5.6 thus provides a forthright view of predicted price variations within the Outer Ring Road of Shanghai. It immediately reveals a strong trend of accumulation of high price in the north-south direction and a weaker one in the east-west direction. These trends next indicate a higher variation in the north-south direction than the west-east direction. Clearly this is
a strong evidence of the main direction of urban development along west-east axis, because housing price increases fast in the rapidly urbanized areas.

It is also noticeable that higher value properties are most likely to gather within the Inner Ring Road, with the highest price (Peak 1) in the planned CBD. Two elevated arterial roads across it were built upon the old arterial roads in the central city. Completed and opened to the public traffic successively in the 90’s, they took the main parts of the new traffic system. The second highest value (Peak 2) is in Pudong, situated at the intersection of inner ring road and an east-west arterial road. High-quality condos and semi-detached houses of low density prevail around this transport pivot, helping to cause a minor peak in the entire study area. The CBD, once the old city area, and the Pudong new area who host the peaks (Peak 1 and 2), as stated in prior section, is experiencing a drastic change in spatial structure and accommodating the majority of commercial activities. This is further confirmed by the steepness of the price gradient and the contours of high house prices. There appears to be a number of local peaks (i.e., Local Peak1 and 2) dispersed along the inner ring road. Besides the attractiveness of favorable transport and well-established environment for investment and employment, the local authority have been strived to make use of the location advantage to construct the superior residential area located by vanilla and new-fashioned lane. Both spatial and structural factors boost the relatively high price. Nevertheless, not all of the four planned urban sub-centers (Xujiahui, Huamu, Zhenru, and Jiangwan-Wujiaochang) and three district centers could accommodate a local peak. This deviation of the planned centers from the actual peaks questions their effect on the house prices. It may be simply because that the planned sub-centers have not well set up, and hence are not capable to accumulate high value properties.
For further inspection, a 3D TIN is derived from the sample values (see Figure 5.7). From this 3D map, great variations between peaks and troughs dominate the field of view, with gradually rising slope somewhere and precipitous ones elsewhere. This pattern goes much beyond a polycentric spatial organization, which is in line with the research of Piper Gaubatz (1999). The dynamics of housing price can be explained mainly by the location factors, which are discussed in a latter chapter.
Figure 5.7 3D TIN of Housing Price

Peak 1
LocalPeak1
-Xujiahui

Peak 2
Local Peak 2

North
South

West
East
5.2.5 3D Profile

3D profiles in eight directions are systematically selected for examining urban variations in property value distribution. Figure 5.8 shows the 3D profiles obtained from the grid prediction surface created by kriging method. These profiles represent variations of property value along the north-south and the east-west directions, and along diagonal lines 45 degree angles between the vertical and the horizontal lines (refer to figure below the profiles for the orientation). People’s square is chosen as the starting point “0” of each direction, due to its status as the political center (with Municipal People's congress Council and Municipal Government located in), commercial center (with city-level commercial streets surrounding and crossing it) and cultural center (with a set of nation-level and city-level cultural amenities such as Shanghai Museum, Shanghai Grand Theater situated in) of Shanghai.
Figure 5.8 Profiles of the 3D Prediction Surface of Housing Price

Note: The vertical axis is for housing price in RMB Yuan. The horizontal axis is distance from People’s Square in map units.
From Figure 5.8, a number of common and different points can be observed. First, the initially raising segments in profiles 0-1, 0-2, 0-3, 0-4 and 0-8 indicate that the city core (point 0) and the site of highest price (Peak 1) are not identical. Reason for this is the lack of samples in the city core. In effect, this area is strictly controlled by the urban plan of no residential use so that land can be reserved for its major functions like administration and culture. Therefore, the property value predicted in this place is lower than the actual highest value of samples nearby. Second, most of the profiles conform to the urban location theory except profile 0-5 and 0-8. Generally, higher values appear in the locations nearer to the city center and decay as the distance increases. Although some fluctuations of property values often occurred in association with adjacent amenities, they would not form a higher or identical peak in the decaying shape. Here profile 0-5 and 0-8 disobeys the theory in a large measure, with a considerable portion of the graphs (i.e., Peak2 and Local Peak1) do not conform to the distance-decay shape. It is mostly because the Lujiazui core area in Pudong and Xujiahui Planned Urban Sub-center stand just on the way of direction 0-5 and 0-8 respectively. In the new Comprehensive Plan of Shanghai Central City (1999-2020), the CBD of Shanghai is composed of Lujiazui core area in Pudong and the Bund in Puxi. Through 12-year development, Lujiazui is growing to be the new city center and strategic site for Shanghai’s future development. Third, each profile displays a different curve either from the frequencies of fluctuations or from the slopes. In another word, property values changes much along the eight directions originated from the city center.
5.3 Summary

Urban spatial structure is studied through analyzing the distribution of housing values in this chapter. GIS and statistical methods are employed to facilitate the spatial analysis. Some characteristics of urban spatial structure are revealed.

First, the middle zone (central area) bounded by the inner ring road yields significantly high value properties, including the highest housing price (Peak 1) in the planned CBD. While this leading status is being competed by the Lujiazui area as the new financial center, which bears the second highest housing price (Peak 2).

Second, the central city develops mainly along west-east axis. Properties concentrated along this axis have higher prices than the peripheral areas.

Third, house prices are highest in the middle, moderate in the west and lowest in the east. Functional planning evidently contributes to the price variations. According to the planned zoning of Shanghai central city, the middle zone mainly accommodates financial, commercial and cultural functions. The west part (composed of west, south and north districts) is concentrated by commercial, trading, exhibitive and educative functions, while the east part (including southeast and northeast districts) mainly hosting industrial land use.

Fourth and the last, the spatial pattern of the central city goes much beyond a polycentric organization. In three-dimensional views, great variations between peaks and troughs dominate the central city, with gradually rising slope somewhere and precipitous ones elsewhere.
CHAPTER 6: LOCATION FACTORS

Chapter 5 has examined the dynamics of house prices in the central city of Shanghai reflected by the variations of housing price distribution. Some historical and socioeconomic explanations were provided in addition to the structure description. They are convincing but only suitable to one or several parts in the entire study area. According to Iain et al. (1998), a systematic analysis of the housing price determinants should include structural, accessibility, neighborhood, and environmental factors. Since no structure data was available, this study concentrated on the other three aspects. Here accessibility was measured by three variables, i.e. distance to CBD (DCBD), distance to the nearest MRT station (DMRT), distance to the nearest development zone (DDEV), neighborhood was reflected by distance to the nearest hospital (DHOS), distance to the nearest school (DSCH), dummy variable for commercial amenity (COM); the variable selected for environment was distance to the nearest tourist attraction (DTA). Multivariate linear regression analysis is then conducted to examine the influence of seven location factors on housing price.

6.1 Statistical Results

Consistent with prior analysis of property value dynamics, multiple linear models are applied to three groups (entire city, central area and non-central districts) of properties. Table 6.1 and 6.2 gives the summary statistics and coefficients of regression models.

For the entire city, the model, as a whole, explains 46.1% of the variation in the average house prices. DTA (distance to the nearest tourist attraction) ranks first to explain 30.6 percent of the variance of the dependent variable. DDEV (distance to the nearest development zone) ranks second, holding a 5.3 percent explanatory power.
DCBD (distance to CBD) ranks third, adding 3.7 percent explanation for the whole variance. Next, DSCH (distance to the nearest school) and DMRT (distance to the nearest MRT Station) account for 3.5 and 3 percent of the variation, respectively. The F value of 147.472 and the t values for the five variables suggest that the overall regression model and each variable in this model are significant at a 0.01 level. Also, the VIFs for each variable are much less than 5, which is a common rule of thumb for a severe multicollinearity.

For the central area, the same five variables enter the model, but in a quite different order. DMRT enters first and explains 14.3 percent of the housing price variation. DSCH, DDEV and DTA enter next with a similar explanation power (2.7%, 2.5% and 2.2%). DCBD joins lastly, only accounting for 0.8 percent of the variation. They totally explain 22.5 percent of the property value dynamics. According to Table 6.1 and 6.2, this model and all its variables are significant at a 0.01 level and pass the collinearity diagnoses.

When regression analysis was carried out for each non-central district, different independent variables enter the models for different districts. In west part, DCBD explains 35.6 percent of the variation of the dependent variable. DHOS (distance to the nearest hospital) adds 12.2 percent explanation power to this model. Com (dummy variable for commercial amenity) then joins by totally explaining as many as 50.9 percent of price variation. In north part, DHOS alone contributes 33.8 percent to the housing price variations. In south part, DDEV (34.2%) and DMRT (10.4%) account for 44.5% price dynamics. DSCH (22.2%) and DTA (6.9%) were observed in southeast part as the only significant independent variables at a 0.01 level. In the models for northeast part and outside part, DMRT (38.8% for northeast part, 27.7% for
outside part) and DCBD (8.2% for northeast and 15.7 for outside) enters and explained 47 percent housing price variation in northeast part and 43.4 percent in the peripheral area. F values for each non-central part ranging from 13.157 to 49.469 indicate that all the models fit significantly at a 0.01 level. T values and their significance also signify that all variables in each model are significant at a 0.05 level. Most of the VIFs for the entering independent variables are less than 5 (severe collinearity) and close to 1 (no correlation), meaning little collinearity between them. However, a severe collinearity apparently exists between DMRT and DCBD in the model for northeast part, with a VIF of 5.158. Considering the more explanation power of DMRT in this model, DCBD is dropped as a redundant variable. New summary statistics and coefficient of this model are given in Table 6.3 and 6.4. DMRT alone explains 38.8 percent of price variation, significantly at a 0.01 level.
Table 6.1 Summary Statistics of Linear Regression

<table>
<thead>
<tr>
<th>Model</th>
<th>Variable Entered</th>
<th>R</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>Std. Error of the Estimate</th>
<th>F value</th>
<th>Sig. of F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire Central City</td>
<td>DTA (0.306)</td>
<td>0.679</td>
<td>0.461</td>
<td>0.458</td>
<td>0.2612</td>
<td>147.472</td>
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</tr>
<tr>
<td></td>
<td>DDEV (0.053)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>DCBD (0.037)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSCH (0.035)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<tr>
<td>Middle Zone</td>
<td>DMRT (0.143)</td>
<td>0.474</td>
<td>0.225</td>
<td>0.215</td>
<td>0.2553</td>
<td>23.600</td>
<td>0.000</td>
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<tr>
<td></td>
<td>DSCH (0.027)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>DDEV (0.025)</td>
<td></td>
<td></td>
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<td>DTA (0.022)</td>
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<tr>
<td></td>
<td>DCBD (0.008)</td>
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<td>Peripheral Zones</td>
<td>West</td>
<td>DCBD (0.356)</td>
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<td>0.494</td>
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<td></td>
<td>DHOS (0.122)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>COM (0.031)</td>
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<td></td>
<td>North</td>
<td>DHOS (0.338)</td>
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<td>0.338</td>
<td>0.331</td>
<td>0.2536</td>
<td>49.469</td>
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<td>South</td>
<td>DDEV (0.342)</td>
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<td>0.433</td>
<td>0.2537</td>
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<td>0.269</td>
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<td>Northeast</td>
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<td>0.449</td>
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<td>Outside</td>
<td>DMRT (0.277)</td>
<td>0.659</td>
<td>0.434</td>
<td>0.407</td>
<td>0.1839</td>
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<td></td>
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</table>

Note: F-value – the ratio of the explained sum of squares (ESS) to the residual sum of squares (RSS)

VIF - variance inflation factor
Table 6.2 Coefficients of Linear Regression Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t value</th>
<th>Sig.</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire Central City</td>
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<td></td>
<td>262.219</td>
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<tr>
<td></td>
<td>DTA</td>
<td>-2.40E-04</td>
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<td>-0.263</td>
<td>-7.823</td>
<td>0.000</td>
<td>1.801</td>
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<tr>
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<td>DDEV</td>
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<td>-0.247</td>
<td>-9.192</td>
<td>0.000</td>
<td>1.150</td>
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<td>DCBD</td>
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<td>-10.298</td>
<td>0.000</td>
<td>1.404</td>
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<tr>
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<td>-3.13E-04</td>
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<td>1.114</td>
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<td>-0.297</td>
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<td>-0.241</td>
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<td>Peripheral Zone West</td>
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<td>DCBD</td>
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<td>DHOS</td>
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<td>-0.351</td>
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<td>0.000</td>
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<td>COM</td>
<td>-9.89E-02</td>
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<td>-0.185</td>
<td>-2.472</td>
<td>0.015</td>
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<td>North</td>
<td>(Constant)</td>
<td>8.777</td>
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<td>172.568</td>
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<td>DHOS</td>
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<td>0.000</td>
<td>-0.581</td>
<td>-7.033</td>
<td>0.000</td>
<td>1.000</td>
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<td>South</td>
<td>(Constant)</td>
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<td>0.078</td>
<td></td>
<td>114.101</td>
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<tr>
<td></td>
<td>DDEV</td>
<td>-5.50E-04</td>
<td>0.000</td>
<td>-0.416</td>
<td>-4.638</td>
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<td>1.275</td>
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<tr>
<td></td>
<td>DMRT</td>
<td>-5.74E-04</td>
<td>0.000</td>
<td>-0.363</td>
<td>-4.053</td>
<td>0.000</td>
<td>1.275</td>
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<tr>
<td>Southeast</td>
<td>(Constant)</td>
<td>8.680</td>
<td>0.122</td>
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<td>71.013</td>
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<tr>
<td></td>
<td>DSCH</td>
<td>-1.05E-03</td>
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<td>DTA</td>
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<td>2.496</td>
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Table 6.3 Summary Statistics of Linear Regression Model for Northeast District

<table>
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<tr>
<th>Model</th>
<th>R</th>
<th>$R^2$</th>
<th>Adjust $R^2$</th>
<th>Std. Error of the Estimate</th>
<th>F value</th>
<th>Sig. of F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>DMRT</td>
<td>0.623</td>
<td>0.388</td>
<td>0.376</td>
<td>0.2522</td>
<td>32.327</td>
</tr>
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</table>

Table 6.4 Coefficients of Linear Regression Model for Northeast District

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t value</th>
<th>Sig.</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>(Constant)</td>
<td>9.052</td>
<td>0.151</td>
<td>60.131</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>DMRT</td>
<td>-9.33E-04</td>
<td>0.000</td>
<td>-0.623</td>
<td>-5.686</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

6.1.1 Summary

Statistic results indicate that not any one variable can be dominant in explaining the housing price variation for each group (entire city, central area and non-central districts). Except COM, each of other six variables enters a model as the main location factor. DMRT and DCBD appear frequently but account for very little variation in most cases. Negative values of B (unstandardized coefficient) and Beta (standardized coefficient) suggest that housing price decreases as distance increases. Relative high explanation power ($R^2$) of the mix of seven variables indicates that housing price is markedly influenced by the spatial factors.
6.2 Exploration of Location Factors

Distance to CBD

CBD is usually located toward the center of the city and attracts consumers from all parts of the city. In smaller cities, the CBD remains the major retailing, entertainment, and financial center, although in some larger cities these functions have been progressively usurped by outlying urban sub-centers or regional centers. The CBD in large metropolis tends to be subdivided into smaller functional regions, creating a core area surrounded by a fringe area (Herbert and Thomas 1982, p215). The core area is characterized by very intensive land use, as manifested by skyscrapers of various kinds. It is usually the focus of a city’s mass transit and freeway systems and dominated by specialized commercial activity, financial institutions, and main offices of large companies (Cadwallader 1985, p86). The fringe area of CBD, on the other hand, is characterized by less intensive land use, such as warehouses, transportation facilities, and light manufacturing. According to the bid rent theory, housing price is heavily dependent on accessibility consideration. Thus housing price should be observed the highest in the core of CBD, and decline first to its fringe area and then the farther urban area.

Statistical analysis in this study, however, indicates a relatively moderate relation of housing price distribution to distance to CBD, except in the west part. The negative and positive B and Beta occurring together imply the uncertain effect of DCBD on housing price. This abnormality can be explained from two aspects.

First, the planned CBD in the large Shanghai consists of the bund in Puxi and Lujiazui core area in Pudong (refer to Figure 4.4). Not like the bund, Lujiazui was newly
opened and so not fully developed. Including Lujiazui in the CBD area thus reduces its total attraction. Second, although the highest prices are observed in the planned CBD, there are also some other high price sites distributed in the central city. They sites indicate the existence of sub-centers, which would share commuters’ accessibility considerations and the effect on housing price with the CBD.

**Distance to the Nearest Development Zone**

The establishment of development zones (Figure 6.1) is gradually reorganizing the city around massive planned areas designed to attract and utilize outside capital investment resources. These zones not only serve as new focuses for economic activities, but also limit the types of commercial development within their bounds and separate the land uses within the urban plan (Piper Gaubatz, 1999, p1505). The development zones share some common features: preferential economic and legal environments like tax holidays for investment in business and industry, functional specialization such as high-technology development or export processing, and promises of future infrastructure development. These features make the zones attractive to both investors and employees to living nearby and so increase the housing price.

Statistical results in this study support the positive influence of development zone on housing price. Although this variable only entered the model for entire city, central area and south district, the consistent negative B and Beta imply that as distance to development zone increases, housing price decreases. For the south part, it is the primary explanatory variable. Possible reasons for this could be the Caohejing and part of Hongqiao high-tech development zones located in this district (see Figure 4.4). Caohejing functions as the high-tech and research and development center. Large multinational corporations such as Foxboro, Raychem Company Ltd, Philips
Semiconductor, 3M and L’Air Liquide have established manufacturing facilities there. A number of housing is been constructed for the anticipated influx of workers for the new industrial ventures. Hongqiao, located halfway between the city center and the international airport, is being developed as a traditional convention center, with facilities for foreign consulates, banking and management functions. It also includes a concentration of housing and ancillary services aimed at the resident foreign community.

Figure 6.1 Development Zones
**Distance to the Nearest Hospital**

With no doubt, good Hospital can provide convenience for the health safeguard of households living around. Thus housing price is expected to be higher by locating nearer to the high-level hospital of the city. But in this study DHOS only enters the models for west and north zones and explains separately 12.2 and 33.8 percent housing price variations. From figure 6.2, hospitals situate either close to MRT stations in west and north zones. This may be the reason why DHOS has significant impact on housing price in these two districts. Possible reasons for no significance in other districts may be few hospitals in south, southeast and northeast districts, and evenly distributed hospitals in the central zone.

**Figure 6.2 Hospitals**
Distance to the Nearest MRT Station

Many cities are confronting problems brought about by rapid population growth, such as traffic congestion, air pollution, and sprawling development patterns. To mitigate the unwanted side effects of population growth, the construction or extension of a rapid rail transit system is often prescribed. One of the positive factors is the access advantage provided by rail stations. Through rail, commuting time is reduced. Commuters should be willing to pay for these benefits by offering more for properties close to rail stations. The second factor that may cause higher property values in station areas is that neighborhood commercial services, such as retail establishments, may be attracted to these areas (Bowes and Ihlanfeldt 2001).

In this study, distance to the nearest MRT is the most significant independent variable and enters the models for entire city, central area, south, northeast and outside districts. DMRT has particular impact on housing price in the northeast and outside districts. All the negative B and Beta in multiple regression models imply that as distance to station increases, housing price declines.

Illustrated in Figure 6.3, most segments of MRT lines and stations are built in the central area and south part. MRT lines in south district are used to link Xujiahui sub-center, south district center and Caohejing high-tech development zone, which make the stations on the lines close to these centers. That is why DMRT has explanation power in the models for central area and south part. As to northeast and outside parts, there are almost no MRT stations inside. Possible reasons may be that the neighboring stations in other districts, which are also close to Huamu sub-center or south district center, have a marked impact on properties values.
Figure 6.3 MRT Stations
Distance to the Nearest School

High-quality schools integrate the advance of better peers, superior teachers, more involved parents, or more effective administrators, which causes at an aggregate level, the higher education level. Parents, especially those in low-income households, could consider it a financial benefit of their children to attend high-quality school and be willing to pay more for the houses located near the well-known schools (Black 1999).

In Shanghai, the primary and secondary schools are organized into three tiers: city-renowned, district-renowned and common ones. Students in Shanghai could only be accepted by the primary or secondary schools in the district where their house locate. Houses near city-renowned schools therefore have large attraction to the families who want their children to go to these schools. Universities are also arranged into national, provincial and civic ones. National universities usually have a large and beautiful campus open to the public and so positively affect the house prices nearby.

Statistical results in Table 6.1 and 6.2 display that DSCH enters the models for entire city, middle zone and southeast part. Figure 6.4 shows the distribution of city-renowned schools and national universities selected for this study. They are highly concentrated in the middle zone, only a small number scattered in the peripheral areas. This is why DSCH accounts for a part of property value variation at the city level and in the middle zone. It is also noticeable that none of the schools built in the southeast part while DSCH explains the most variation of housing price in this district. Possible reasons may be the desire of parents for good schools. Although there is no good school in this district, those in other districts while near their houses can produce adequate attractions to the parents.
Distance to the Nearest Tourist Attraction

Main attractions of urban tourism compose of the major cultural institutions (museums, theaters, concert halls, etc.) in a city’s historic core, main business district, shopping districts, and urban parks (Shoval and Raveh 2003). These sites are usually concentrated in the innermost parts of the metropolitan area (Burtenshaw, Bateman and Ashworth, 1991) together with accommodation services for tourists (Ashworth, 1989).
In this study, tourist attractions are arranged into two groups: cultural institutions and entertainment facilities. Like a typical western city described by Shoval and Raveh, the cultural institutions are mostly relics in the historical urban core, such as theaters (i.e., Shanghai Grand Theater), museums (i.e., Shanghai Museum), temples (Jing’an Temple) and colonial building complex in the bund. These sites have been widely accepted as the cultural centers and so appeal to both foreign and local residents. Another group of entertainment facilities are mainly collections of tea shops, brand shops and bars (i.e., Yu Yuan, Xintiandi). They are newly built and dispersed to cater for local people.

Negative impacts associated with tourist attractions may be traffic congestion, noise and pollution. These impacts, whether positive or negative, are calculated by examining the relationship between distance to the nearest tourist attraction and house prices.

Statistical results showed that DTA is significant for housing price in entire city, central area and southeast part. Especially at the city level, DTA first enters the model and explains as many as 30.6 percent housing price variations. However, this impact becomes faint in the central area and even negative in the southeast part. This unexpected change is possibly explained in two aspects. First, tourist attractions are evenly distributed in the central district (Figure 6.5). Thus houses everywhere in the central area could easily access to these sites. Therefore, very weak relationship between DTA and housing price variations is revealed in the central area. Second, tourist attractions near the properties in southeast district cause severe traffic congestion and so impact the housing price negatively.
Dummy Variable for Commercial Areas

Urban commercial activities mainly occur in various kinds of nuclear areas that are usually quite widely dispersed within cities. Some of these nucleations are unplanned, often at the intersection of two strips of ribbon development, while other, especially in younger cities, are planned shopping centers. Generally, there are four hierarchies of commercial areas in forming the urban spatial organization, that is, CBD, regional commercial centers, community centers and neighborhood centers. In this study,
commercial areas selected were in the regional and community tiers.

Analyses in this study indicate a very weak influence of commercial areas on spatial distribution of Shanghai’s housing price. COM only enters the model for west part with a 3.1 percent explanation power. This might be explained by the their quite scattered distribution in the central area and few of them forming in the non-central districts (refer to Figure 4.2 and 4.4). Accessibility to them thus makes no sense to the households in both central and non-central areas.

6.2.1 Summary

In this chapter, seven location variables are selected to examine the determination of housing price. Multiple regression analysis is conducted to test the overall fit of the model and assess the individual importance of the explanatory variables. Statistical results indicate that the models account for 22.5 to 50.9 percent housing price variation, which are a set of pleasing amounts for explanation solely by spatial factors. Coexistent negative and positive values of B (unstandardized coefficient) and Beta (standardized coefficient) suggest two-side impacts of variables on housing price. It is also observed that none of the variables can dominate in explaining the housing price variation for each group (entire city, central area and non-central districts). This is a strong evidence of the diversity of Shanghai’s city structure, which make housing price in different district affected by various factors.
CHAPTER 7: CONCLUSION

7.1 Summary of Findings

Spatial redistribution of property values does occur as a consequence of urban development. Recent theories on polycentric urban literature (Fujita 1989, Anas et al. 1998) highlight a general spatial distribution structure of property values. Empirical research findings (Edel and Sclar 1975, Sivitanidou 1997, McDonald and McMillen 2000, Clapp et al 2001), however, reveal that individual cities demonstrate unique spatial configurations, as multiple factors in the local context shape the spatial organization of cities. The drastic socioeconomic changes in China’s transition from a planned economy to a market economy have generated a distinctive context in which urban spatial structures evolve differently from both western and other Asian experiences. Nevertheless, discrepancies in data collection, measurement, and methods of analysis lead to the paucity of studies in Chinese cities in the existing literature. This study adds to this literature by uncovering the transformation of urban spatial pattern using house prices as the indicator and Shanghai as a case study.

Shanghai’s municipal boundary is large (6,340 km$^2$); but the central city, which is over 10% of the municipal land size, has a concentration of the metropolitan activities. Indeed, the central city has been the focus of public policies in infrastructure improvement and urban restructuring for the past decade. These include the development of new highways, bridges, tunnels and development zones, as well as renewed sub-centers. Given the data availability, this study focuses the spatial restructuring and the associated redistribution of housing values in Shanghai’s central city. The theoretical context of the study is thus grounded on metropolitan restructuring, rather than inner city redevelopment, as the latter has different
intellectual heritage where property price dynamics are more related to job creation and gentrification processes.

A distinctive polycentric spatial structure of housing price distribution is revealed in the central city of Shanghai. The middle zone bounded by the inner ring road accommodates housing of significantly higher values, including the highest housing prices (Peak 1) in the area between the Bund and Xujiahui. The Pudong new area accommodates housing with the second highest prices (Peak 2, also a sub-center). There exists a west-east axis for main urban development activities. Residential properties concentrated along this axis have higher prices than those away from it. In addition, housing prices in the west are uniformly higher than that in the east. In three-dimensional views, the spatial pattern of the central city goes much beyond a polycentric organization. Great variations between peaks and troughs dominate the central city, with gradually rising slope somewhere and precipitous ones elsewhere.

There are distinctive processes shaping the spatial pattern of the central city. First, government planning control is an influential factor generating the hot spots within the central city. The central government’s effort in developing Pudong (East Shanghai) into the largest special economic zone (SEZ) in China and the economic “dragon head” of the Yangtze valley means that Shanghai is the major urban center serving China and the region in corporate control, finance and manufacturing. Political ambition and desire for economic development offer Pudong favorable policies and substantive investment, which in turn spur major spatial readjustment in this area. Development was first extended across Huangpu River to Pudong. Pivot infrastructures and ring roads were built to provide convenient links between these two parts. A new planned CBD was then formed after integrating Lujiazui in Pudong with the Bund in Puxi. Promotion of Lujiazui to a part of the CBD boosted the housing
quality and real estate values to a comparable level to those at the Bund. As a horizontal extension of the CBD, an east-west urban development axis was gradually established in the central city. Economic activities were steered by the municipal government to concentrate along the axis through construction of mass rail transit system, provision of cheaper land and housing, as well as improvement of the environment and the efficiency of administration and management. Such an aggregation put a positive effect on ambient property values.

Second, market forces intensified the variations of house price distribution. Since 1990, Shanghai has issued a series of housing policies on the construction, circulation and consumption in order to use the “invisible hand” of market in solving the problems of housing shortage. Household demand for better quality housing was increased by the housing market reforms, thus led to an upsurge in the sales volume and then the prices of newly built houses. Rising returns in residential development again accelerated the construction activities of developers. In effect, the revenue incentive was so strong and attractive to a variety of developers that houses of different price levels scattered within the central city. Given the diversified demand and scarcity of urban land, it is not unusual that two residential projects oriented to different income-level households were at work in the same neighborhood, with one operated by a experienced developer and the other by a new comer.

Third, historical development posed an influence on the price dynamics in the central city of Shanghai. Since Shanghai was opened up to Western countries in 1843, social polarization grew. The housing stock reflected the social structure, with high quality houses for the rich and slums for the poor. Majority of the high quality houses were built in the foreign concessions, especially in the British settlement (i.e., the Bund area). Slums, on the other hand, spread in areas outside the foreign concessions. Such a
physical pattern reflecting good and poor quality houses continued in the Mao-era (1949-1976), by replacing the slums with public housing. Public houses built on the slum sites were usually of low quality as a result of limited funding and the enormous demand for shelters. Indeed, the need to deliver some of the revolutionary goodies to the urban workers in the era of heavy industrial investment left little choice and resources for housing development. As such, residents in the newly constructed housing estate inherited a stigma of poor economic status. In contrast, the Bund area hosted affluent houses accommodating residents with a higher status. This led to an accumulation of high value properties at the Bund and its vicinity but low value zones in and around some traditionally low quality and low status areas.

Fourth, as the microscopic representatives of the first three aspects, spatial factors definitely pose a unique influence on the property value distribution. In this study, seven location variables (i.e., distance to CBD, distance to the nearest MRT station, distance to the nearest development zone, distance to the nearest hospital, distance to the nearest school, distance to the nearest tourist attraction, and a dummy variable for commercial amenity) are selected to enter the multiple regression models for testing the determination of housing price dynamics. Statistical results indicate that the models account for 22.5 to 50.9 percent housing price variation in different zones, which are a set of pleasing amounts for explanation solely by spatial factors. Coexistent negative and positive values of B (unstandardized coefficient) and Beta (standardized coefficient) suggest two-side impacts of variables on housing price. It is also noticeable that none of the variables can dominate in explaining the housing price variation for each group (entire central city, middle zone and peripheral zones). Except the commercial amenities variable, all the six variables show some influences on the housing price. The distance to the nearest train station and the distance to the CBD
appear frequently in the models but they account for very little variations in most cases. This is a strong evidence of the diversity of Shanghai’s city structure, which makes the distinctive house price distribution from western and other Asian cities.

7.2 Conclusions

Shanghai in the period 1990-2002 experienced two interrelated urban transformation processes: the restructuring of its spatial structure and the reform of its housing system. Urban space was restructured through the construction of key infrastructures and the relocation of industries. Housing system reform introduced market mechanisms to the production and consumption of housing, hence increased both demand for and supply of residential properties. Rapid improvement in housing provision resulted in that the living space per capita doubled from 6.6m$^2$ in 1990 to 13.1m$^2$ in 2002. Drastic urban transformation generated a new property value surface which assembles a polycentric configuration. Lujiazui, which was planned and developed as a part of the CBD, showed strong influence to the distribution of high-end housing. Several new sub-centers (e.g., Xujiahui) were also added to the city structure, and their impact on the property value surface was discernible.

In central Shanghai, general price gradients do exist. However, there are significant distortions in space. This is largely due to the geographical and historical factors, which are discussed in Shearmur and Coffey (2002). The effects of the historical development zone observed in Beijing and Jakarta (Han 2004a) seem also at work in Shanghai. In other words, Shanghai is unique in its spatial structure and distribution of housing prices. But there are certain characteristics are in common with those observed in Pacific Asian and non-Pacific Asian cities.
Shanghai, which is the economic dragon head of China and one of the largest cities in the world, is indispensable in understanding the spatial structure and development of cities. This study reveals the spatial dimension of urban and real estate development and some location factors influencing on the spatial configuration of the city. The findings and methodology used in the study may be helpful to academics in exploring spatial patterns and processes in urban restructuring. This study may also be useful to practitioners in both public and private sectors in their decision-making processes. It has long argued that the local authority has failed to capture the land values in leasing out state land to developers, as land value had never been clearly defined. The spatial structure of the housing prices examined in this study is a relevant reference.

7.3 Limitation and Future Development

In this study, location rather than economic, political and cultural factors are emphasized. Hence some constraints and limitations are inherently attached to this study.

First, as a result of data constraints, strict assumptions on data for linear regression analysis such as normal distribution and no multicollinearity, cannot be fully satisfied. Second, distances are approximate values measured in map units, as the exact location of each property cannot be acquired with manual dotting accuracy on the map. Third, the regression models cannot explain most of the variations because other variables besides the location factors are not included. Last but not least, only linear regression models are employed to detecting the relationship between housing price and spatial variables, though there might be better models to analyze property value dynamics.

For future development, the project database has to be extended both spatially and temporally. Not only price attributes, but also the structural and legal attributes of
house projects should be included. More accurate maps are crucial to plot housing projects with exact location and vector layer for relative neighborhood and environmental factors. Besides, methods other than hedonic model, non-linear regression analysis for example, can be applied to explore the relationship between housing price and its shaping forces.
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