

**Applying a Spatio-Temporal Approach
to the Study of Urban Social Landscapes in Tianjin, China**

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ABSTRACT

China's economic reforms of 1978, which led to the country's transition from a centrally-planned to a market-oriented economy, ushered in a phase of accelerated urbanization. Influenced by the economic transition and taking advantage of its privileged geographic and historic position, Tianjin has seen dramatic changes in its social landscape during the last three decades. Given this context, this study aims at understanding the different urban socio-spatial patterns of Tianjin and their mechanisms in three distinctive economic contexts by adapting both statistical and spatial approaches. Due to increasing population mobility caused by the economic reforms, the urban social landscape of Tianjin has become increasingly multifaceted, characterized by a "one axis, two nuclei" urban morphology. The rise of the Binhai New Area (TBNA) in the southeast is creating a dual-core urban social structure in Tianjin, with its traditional Urban Core located in the center of the city. In terms of the Urban Core's expansion and population movements southeast toward the TBNA, an asymmetric suburbanization process is evident in Tianjin. Meanwhile, an additional population shift toward Beijing in the northwest is significant during 2000-2010, illustrating the changing relationship between these two neighbouring municipalities. By integrating itself with Beijing, Tianjin has not only recovered from under Beijing's shadow during the centrally-planned economy period, but is also benefitting from Beijing in order to flourish.

RÉSUMÉ

Depuis les réformes économiques de 1978, la Chine a connu, par la transformation de d'une économie planifiée à une économie de marché, une vague d'urbanisation accélérée. Influencée par la transition économique et ses positions privilégiées en termes géographique et historique, Tianjin a subis des changements drastiques au niveau de son tissu social depuis les trente dernières années. En tenant compte de ce contexte, la présente étude vise à mettre en lumière les différents modèles sociaux-spatiaux urbains de Tianjin et leurs mécanismes subjacents dans trois contextes économiques différents, et ce à l'aide de méthodes d'analyse statistique et spatiale. De par l'augmentation de la mobilité des individus suite aux réformes économiques, le caractère du tissu social urbain de Tianjin est devenu complexe, tel que caractérisé par le modèle de morphologie urbaine "axe une et noyaux multiples". La création du nouveau secteur Binhai au sud-est de la ville a créé une structure sociale urbaine à deux centres à Tianjin, avec le noyau traditionnel situé au centre-ville. L'expansion du centre urbain et le mouvement de la population vers le secteur Binhai ont amené un processus de périurbanisation notoire à Tianjin. Au même moment, un décalage de la population de Tianjin vers Beijing au nord-ouest lors de la période 2000-2010 illustre un changement de relation entre les deux villes voisines. En fusionnant avec Beijing, Tianjin a non seulement récupéré de l'ère de l'économie planifiée où elle était moins visible que sa voisine, mais elle bénéficie maintenant de la place de la capitale chinoise pour prospérer.

摘要

1978 年的改革开放与其伴随而来的经济体制改革使得中国的城市面貌发生了翻天覆地的变化，城市社会空间也因此产生了巨大的转变。本文以 1990、2000 及 2010 年人口普查数据为基础，利用城市因子生态分析方法配合多元回归与聚类分析技术，对改革开放以来天津城市都市区社会空间结构及其演化进行研究。通过对比研究，本文发现形成天津城市都市区社会空间结构的主因子、社会区类型、社会空间形态及形成机制均产生了显著变化。80 年代的天津都市区社会空间结构受到政府政策的制约，相对简单，而随着时间的推移，其形态趋于复杂。经过三十年的发展，天津都市区的社会空间结构基本形成“两核一轴”的形态，滨海新区已逐步发展成为城市的第二中心。同时，进入经济转型期后，随着户口政策的放宽和房屋分配制度改革的推进，天津的郊区化进程日益显著。然而，与其他同类城市均衡放射式的郊区化形态不同，天津的郊区化进程深受滨海新区对人口凝聚作用的影响，呈现东南强，西南和西北弱的特点。此外，作为距离首都北京最近的直辖市，天津的发展长期以来一直受到北京的制约。然而该研究发现，进入 21 世纪以来，在市场经济体制的作用下，天津与北京相邻的城市区域呈现出了快速发展的态势。以首都北京为依托，天津凭借自身得天独厚的地理优势，进入了前所未有的快速发展阶段。

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LIST OF ACRONYMS

CBD	Central Business District
FDI	Foreign Direct Investment
PCA	Principal Component Analysis
PRC	People's Republic of China
TBNA	Tianjin Binhai New Area
TDFD	Tianjin Duty-Free District
TEDA	Tianjin Economic-Technological Development Area
WTO	World Trade Organization

PREFACE

There are two basic formats for a thesis accepted in the Department of Geography, known as thesis format and article format. This thesis adapts the article format with an article (located in Chapter 4) in preparation for submission to the *Urban Studies* journal. The candidate is the first author of the article, while Dr. Huhua Cao is the second and corresponding author. In order to satisfy the stylistic criteria for the submission of the manuscript to the journal, some tables were omitted from the text of the article, but are referred to in the footnotes or are provided in the appendices of the thesis for consultation.

CHAPTER 1. INTRODUCTION

With the rapid growth of urban populations and supporting infrastructure in the last century, cities have played a vital role in the development of modern society. In recent years, large numbers of people migrating from rural areas to cities seeking economic opportunities and better lives have caused remarkable urbanization rates. The global proportion of people living in urban areas rose dramatically from 13% (220 million) in 1900, to 29% (732 million) in 1950, to 49% (3.2 billion) in 2005, and 60% of the global population is projected to live in cities by 2030 (United Nations 2005, 2007). Urban studies, which aims to understand city dynamics and present insights into the social and economic challenges in urban development (Knox and McCarthy 2005), is becoming increasingly significant.

The urban socio-spatial structure is one main aspect of urban studies. The urban socio-spatial structure is affected not only by the physical environment, but also by individual behaviour, culture, politics, economics as well as social organization. The use of different approaches from a variety of fields such as sociology, economics, geography, and other social and physical sciences allow for a better understanding of urban socio-spatial structure. The emergence of human ecology (known as the “Chicago School”) in the United States in the 1920s encouraged a developing awareness of the social, economic, and political significance of cities (Grove and Burch 1997, Park et al. 1925). As early as the first half of the 20th century, three classic models were proposed by western countries as the foundation of urban socio-spatial structure studies: The Concentric Zone model by Burgess (1925), Hoyt’s Sector model (1939), and the Multiple-nuclei model by Harris and Ullman (1945). In

the 1960s, following on the Chicago School's ecological approach, factorial ecology provided a new method to study urban socio-spatial structure. The factorial ecology approach argued that social space was dominated by three main dimensions, each of which influences particular urban socio-spatial patterns: the socio-economy, the family and the ethnicity. The factorial ecology approach is widely applied to studies of urban socio-spatial structure, because it represents the complexity of urban social structure by space. Although the ecological perspective is an important and widely adopted method, it has not been very widely applied to the context of China.

China's official transition to a market-oriented economy in 1992 accelerated urbanization and resulted in urban spatial structures that differ substantially from cities in the West. As a result of this, Western urban socio-spatial theories have limited implications when applied to Chinese cities. Chinese scholars began to measure the socio-spatial structure of Chinese cities by adapting factorial ecology in the late 1980s. Previous literature in this field has focused primarily on Beijing, Shanghai and Guangzhou; Tianjin, a significant Chinese municipality known as the economic center of Northern China, has received sparse attention from researchers. Furthermore, there are few studies that compare the increasing complexity of socio-spatial structures in the context of different economic systems (centrally-planned economy, market-oriented economy and markets in transition). This research will attempt to fill this gap in the literature by measuring the socio-spatial structure of Tianjin using a factorial ecology approach. This study will consider the three different economic systems as the dominant factor that affects the changes urban socio-spatial structure in contemporary

China. In order to better understand possible issues related to urban socio-spatial structure in China, this research aims to summarize the different urban socio-spatial patterns and their mechanisms under three distinct economic contexts.

CHAPTER 2. LITERATURE REVIEW

2.1. URBANIZATION PROCESS

Urbanization refers to the physical transformation process from rural and natural land (agricultural society) to a metropolitan urban one, which can be considered a result of global change (Antrop 2004, Deng 2005, Grove and Burch 1997, Knox and McCarthy 2005). Urbanization has been considered a dominant demographic development and an important component of global land transformation. It is not simply a physical process; it is also associated with major changes in social and economic structures (Deng 2005), which can be characterized by, among other things, population migration and industrial transformation. Urban studies seeks to understand the city, its dynamics and functions, and to present insights into the social and economic challenges in urbanization (Knox and McCarthy 2005).

2.1.1. Historical Urbanization

The origins of urbanization date back thousands of years, with some archaeologists contending that the first cities were established around 8000 years ago (Fouberg 2011). Generally, there were two urban revolutions worldwide. The first revolution was spurred by the development of irrigation around 3500 BCE, which generated the agricultural surpluses and increased agricultural efficiency required to allow time for leisure and social activities such as religion and philosophy. Historically speaking, there were six separate civilizations that emerged under this first urban revolution: Mesopotamia, the Nile River Valley, the Indus River Valley, Huang He, the Wei River Valley, and Mesoamerica and Peru. Over time, urbanization diffused outward from these civilizations (Knox and McCarthy 2005).

During the last decades of the 18th century, the Industrial Revolution brought about the second urban revolution. Labourers migrated to cities in large numbers to find work in expanding factories, and urban populations soared as a result. At the same time, scientific advances in medicine ensured a steady decline in death rates. In this period, cities became unregulated centers of activity dominated by overcrowded slums. During the late 19th and early 20th centuries, manufacturing in cities and urbanization both grew rapidly, resulting in changes to the transportation system. During the second half of the 20th century, factories began to be located further away from central urban cores into more suburban settings (Fouberg 2011).

2.1.2. World Urbanization Today

Today, more than half the world's population is urban (UN DESA 2011). Some of the developed world has become almost completely urbanized. According to the United Nations (2011), the percentage of the Australian population residing in urban areas Australia is 89%; while in other less developed regions, the current rate of urbanization is unprecedented. From 1950 to 2010, the growth rate of the urban population has increased by 4 times its original rate. Looking ahead, more than 67% of the world's population will be urban by 2050. Among them, it is estimated that 93% of urban growth will take place in Asia and Africa, and to a smaller extent in Latin America and the Caribbean (UN DESA 2011). Urbanization has thus become a vital issue for future human society.

In such a context, the process of urbanization is becoming more and more complicated. Knox (2007) has argued that “urbanization is not simply a process of the

demographic growth of towns and cities. It also involves many other changes (economic, social, and political changes), both quantitative and qualitative”. Different subgroups of people according to their different social, economic and ethnic conditions often gather in different physical territories. Therefore, when they migrate to different regions, the overall social space pattern is transferred accordingly, creating spatial segregation and aggregation.

2.2. SOCIAL SPACE THEORIES

2.2.1. Urban Ecology: Integrating Humans into Ecology

For most of human history, studies about urban ecology, or the influence of “biophysical processes, ecological systems and evolutionary changes” (Alberti et al. 2003) have focused on non-human processes such as water or parks, wildlife species, vegetation coverage, and urban agriculture (Ditchkoff et al. 2006). These studies neglected the effect of humans on the Earth’s ecosystem. Humans affect Earth’s ecosystems at remarkable rates through conversion of land and resource consumption (Turner 1989), alteration of habitats and the composition of species (McKinney 2002), as well as through evolutionary processes (Alberti et al. 2003, Zipperer et al. 2000). Therefore, urban ecology, which is composed of a hybrid of natural and human elements, is becoming a preferred method for studying ecosystems. In urban ecology, scholars consider urban areas as part of a broader ecological system. They regard urban ecosystems as open, dynamic, and highly unpredictable systems (Pickett et al. 1997) which are dominated by human beings (Alberti et al. 2003).

Although urban areas cover a relatively small area of the Earth’s surface, their effects on ecosystems are extraordinarily large, complex and powerful (Sadik 1999). According to

Alberti (2003), cities “are both complex ecological entities, which have their own unique internal rules of behavior, growth, and evolution, together with important global ecological forcing functions.” Rebele (1994) divided urban ecological research into two broad types: social sciences-oriented and ecology-oriented. Traditionally, these two approaches to urban ecology have advanced independently of one another.

2.2.2. The Chicago School

The Chicago School produced a series of theories which can be viewed as a milestone among social space theories, especially that of Urban Ecology. As mentioned in the last section, the chief difference between urban and natural ecosystems is the degree of human influence on the biotic and physical environment (Walbridge 1997). The Chicago School provided a different perspective for studying urban ecology which argued that cities were environments like those found in nature, governed by many of the same forces of Darwinian evolution that affected natural ecosystems (Park 1925). Viewing the city as an organism with its own metabolic processes, Park (1925) posited that the spatially and territorially distributed movement of human beings (or a “spatial relationship”) is formed through processes of competition and selection. A significant product of the Chicago School was Burgess’ (1925) ideal model of the city (Figure 1) (Grove and Burch 1997). Processes such as concentration, centralization, segregation, invasion, and succession give form and character to this model (Burgess 1925, Grove and Burch 1997).

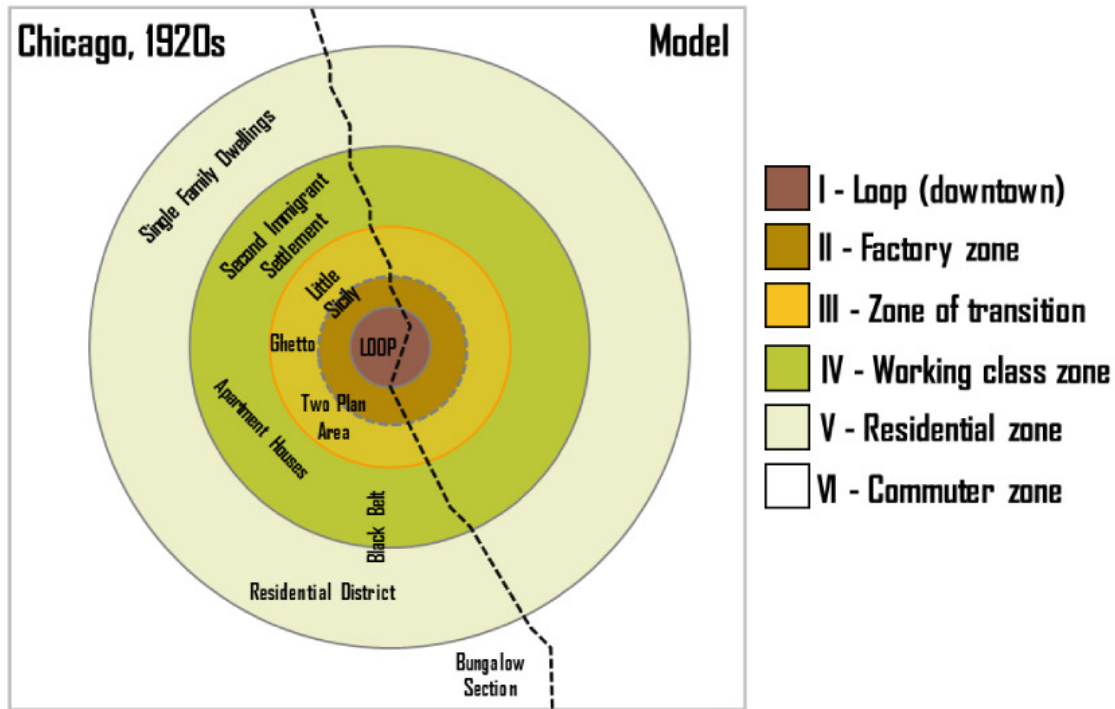


Figure 1. Burgess' Zonal Model Applied to Chicago (Burgess 1925)

The Chicago School successfully applied an ecological approach to study the complexities of urban society (Grove and Burch 1997, McKenzie 1925), especially to the study of social problems such as disease, crime, insanity and suicide (Burgess 1925), conceiving of the city as a closed functional system that could be regarded as an organism. In spite of this contribution, the Chicago School has its limitations. The most significant criticism of this approach, as was pointed out by Firey (1945), is that it overlooked the role of “sentiments” and “symbolism” in people’s behavior in determining urban society’s pattern - in other words, it ignored the subjective world. Secondly, the notion that either human social structure or individual behaviour could be explained solely by biological facts was rejected by scholars. They argued that human characteristics are more complicated than those

of other species (Grove and Burch 1997). Thirdly, the Chicago School was rejected due to its apparent similarity to Social Darwinism, which had been used to justify the inequalities among individuals, groups, races, and societies (Burch 1971, Masters 1989). Lastly, many social scientists objected to the Chicago School's conceptual and statistical approach (Burch 1971, Firey 1945, Firey 1947, Masters 1989, Robinson 1950) to explain individual behaviour. Finally, the biological analogy received much criticism for its similarity to the disreputed concept of Lebensraum (Knox 2010).

2.2.3. Evolution of Models on Urban Social Space Structure

There are three classical models of urban social spatial structure which emerged out of the Chicago School with increased levels of complexity: the Concentric Zone Model (Burgess, McKenzie and Park 1925), the Sectoral Model (Hoyt 1939) and the Multiple-Nuclei Theory (Harris & Ullman 1945).

The Concentric Zone Model

As early as 1826, the German economist Von Thünen (1826) claimed that the urban structure of an isolated city would be characterized by concentric economic rings (e.g., business, residential, industrial, agriculture). This is an important foundation for concentric zone theory as well as central place theory, which depict cities as more or less concentric or symmetric structures with one or more Central Business Districts (CBDs).

Park and Burgess (1925) adapted Von Thünen's model to land use in Chicago to explain some social problems such as unemployment and crime (Burgess 1925, Park et al. 1925).

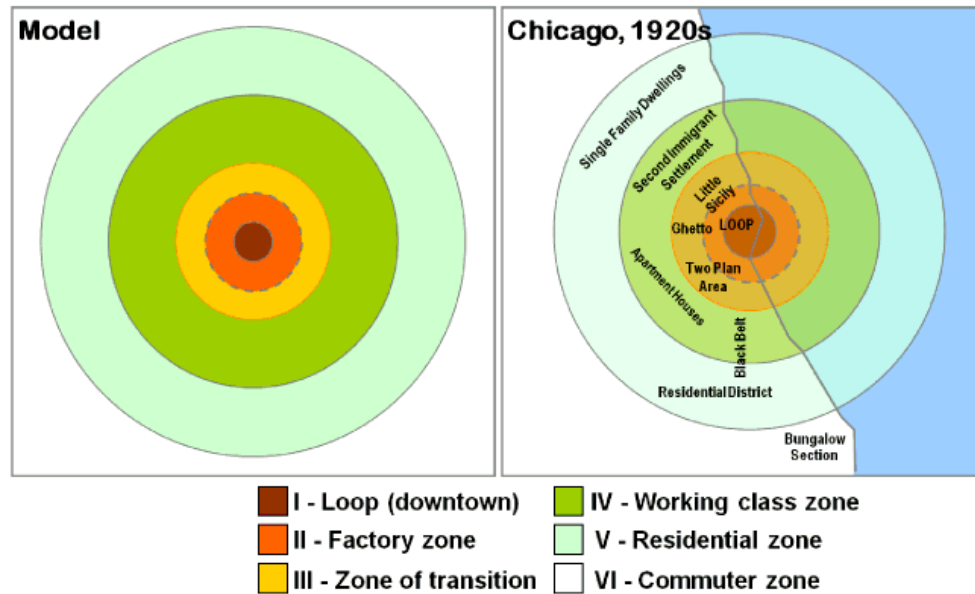


Figure 2. Concentric Zone Model (Rodrigue et al. 2009)

This model is an ideal type and it has been challenged by many contemporary urban geographers. The model does not work well with cities outside the United States, particularly with those developed under different historical and geographical contexts. Even in the United States, because of advancement in transportation and information technology and transformations in the global economy, cities are no longer organized with clear “zones”.

The Sectoral Model

In 1939, Hoyt (1939) modified the Concentric Zone Model by considering major transportation routes in cities. Hoyt theorized that cities would tend to grow in sectoral (wedge-shaped) patterns, emanating from the CBD and centered on major transportation routes (Figure 3). In this model, the commercial functions would remain in the CBD, but manufacturing activities would develop in a wedge surrounding transport routes. Residential land use patterns also would grow in wedge-shaped patterns with a sector of lower-income

households bordering the manufacturing sector and sectors of middle- and higher-income households located far from industrial sites.

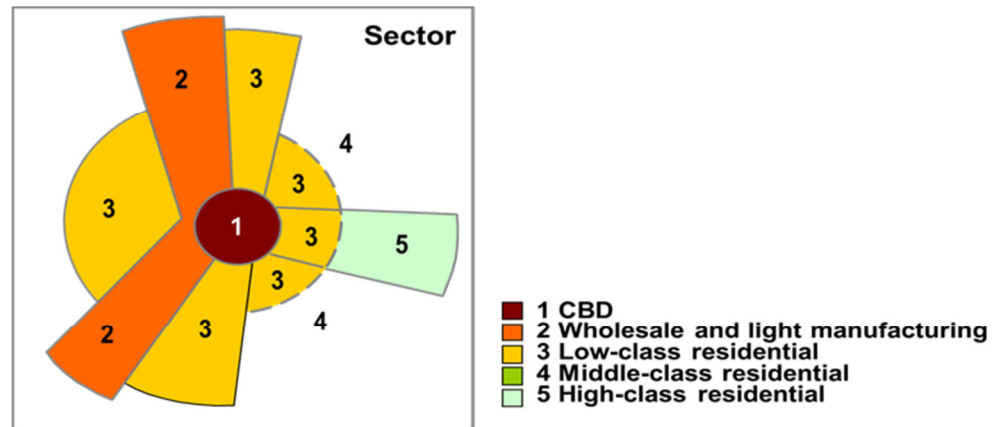


Figure 3. Sectoral Urban Land Use Models (Rodrigue et al. 2009)

The Multi-Nuclei Theory

By 1945, Harris and Ullman (1945) realized that, with the increasing development of suburban areas, many cities no longer fit the traditional concentric zone or sector models. Treating the CBD as the major center of commerce, they built a more complex model (Figure 4). They suggested that specialized cells of activity would develop according to specific requirements of certain activities, different rent-paying abilities, and the tendency for some kinds of economic activity to cluster together (Harris and Ullman 1945).

With the development of urban social geography, the above three classic models are developed and improved by constant revision. Several descriptive and analytical models of urban land use have been developed over time.

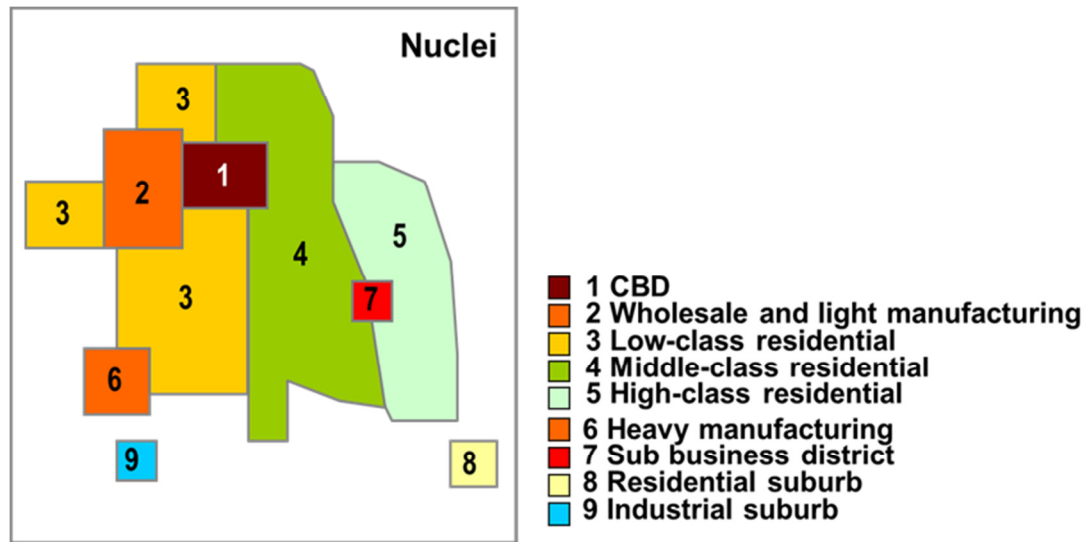


Figure 4. Nuclei Urban Land Use Models (Rodrigue et al. 2009)

2.2.4. Factorial Ecology

In the 1960s factorial ecology emerged as a new method in urban geography that studies urban social structure using factor analysis. This approach divides the city into different factors such as social, economic, demographic and housing areas (Knox and Pinch 2006, Murdie 1969). Through adapting techniques of factor analysis,¹ factorial ecology tries to “establish sets of basic dimensions (factors) in socio-ecological differentiation, as well as to reach empirical generalizations about these dimensions and to develop a theory of socio-ecological structure and change in terms of the dimensions” (Janson 1980, Murdie 1969, 453). Factor analysis uses a set of socio-ecological macro-unit variables to extract and interpret factors. In recent studies, factor scores are calculated and are mapped or used to cluster similar units into reasonably homogeneous spatial categories (Gu et al. 2005, Xu et al. 1989).

¹ Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors.

Shevky, Williams and Bell (1955) were the first to formulate quantitative social area analysis. Taking North American cities as examples, they explained three major dimensions of urban structure: (a) socioeconomic status (economic status or social rank); (b) family status (familism or stage in life-cycle); and (c) ethnic status (ethnic or minority groups). These dimensions work together to reflect the historical and geographical contexts in which the city was developed. Finally, it has been found that each dimension or factor displays a distinct spatial pattern which researchers have related to the classic land use models (Murdie 1969). The three factors respectively match with the multiple nuclei, concentric, and sector patterns of social areas.

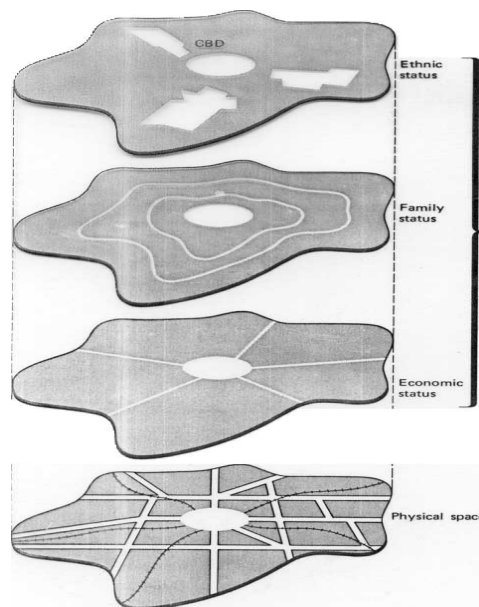


Figure 5. Idealized Model of Urban Ecological Structure (Murdie 1969)

Owing to the increasingly complex demographic, cultural, political and technological environments of urban areas, this idealized model has limitations and needs to be further developed (Lo 2007). The classification of the city into sectors, zones and clusters associated

with socio-economic status, family status and ethnicity is too simplistic for current urban structures. This model does not accurately describe patterns of urban land use in all cities: many other significant factors have to be considered such as land use patterns, specific urban growth patterns, and road expansion patterns. According to Knox (2006), the arrival of immigrants, new dimensions of occupation, and the increasing social inequalities may drive cities to a new structure. Finally, these models are essentially static as they explain land use and describe patterns of urban land use in a generic city at a given point in time, but they do not describe the process by which land use changes. In light of these criticisms, geographers and sociologists began to develop and apply a variety of analytical techniques to the study of cities throughout the world.

2.2.5. Empirical Studies on Factorial Ecology

Literature on urban ecology has undergone tremendous transformation and revision since its conception in the 1950s. Before the 1960s, scholars such as Herbert (1967) adapted Shevky and Bell's method of studying social spaces in San Francisco and Newcastle (UK). With the development of factorial analysis, Bell has have begun and continued to focus on research developments in more than 10 US cities (Bell 1955). Their studies show that all the studied cities during that period share a common social space model. During the 1960s and 1970s, scholars examined Western countries' models more closely. Apart from the three dimensions concluded by previous studies, several other dimensions such as sex, age, rural population density and housing vacancy rate, have also been examined by studies on cities in the US, UK, Canada and Australia (Anderson and Bean 1961, Berry and Tennant 1965,

Carey 1966, Jones 1965, McElrath 1962, Murdie 1969, Schmid and Tagashira 1964, Sweetser 1962). At the beginning of the 1980s, as the number of cities being studied increased, a more spatio-temporal method was adapted: different years' data were widely adapted to illustrate different periods' social spaces (Davies and Murdie 1991, Hunter 1982, Perle 1981). During the same period, aside from Western cities, several non-Western cities were studied, such as Moscow, Hong Kong and Guangzhou (China) (Anthony et al. 1995, Lo 2005, Rowland 1992, Vasilyev and Parivalova 1984).

In contrast to Western countries, cities in Communist or former Soviet states are predicated on egalitarianism, with relatively homogenous societies. However, in these socialist cities, urban inequalities and differentiated social areas can still be widely observed (Andrusz et al. 2008, French and Hamilton 1987, Szelenyi 1983, Weclawowicz 1979). With the dissolution of Soviet Union, many socialist regimes transitioned to market economies, and “many features of socialist urban development are now decaying rapidly” (Szelenyi 1983, p. 288). Cities such as Puebla (Helene 2006); Warsaw (Regulska 2000), Ho Chi Minh (Smith and Scarpaci 2000), Havana (Scarpaci 2000), and Prague and Erfurt (Regulska 2000) have been studied. These countries have particularly similar attributes, such as a poor inner-city and residential segregation (Scarpaci 2000). According to the research conducted in these cities, the re-emergence of commercial activities in central cities, gentrification, housing differentiation, selective mobility among residents, and the uneven distribution of manual workers and professionals are the main factors causing the transformation of socialist countries' spatial landscape (Sykora 1999).

2.3. Urban Expansion Patterns

In 1977, Ottensmann described urban expansion as “the scattering of new development on isolated tracts, separated from other areas by vacant land (p.392).” Ewing (1994) argues that urban expansion is a natural expansion of metropolitan areas. These definitions converge on the agreement that urban land expansion is the sprawling outward of a city and its suburb toward lower-density and undeveloped areas at the periphery of urban areas (Liu 2005). To a large extent, urban expansion is very similar to “urban sprawl”; however, urban expansion places a greater emphasis on the physical process of cities’ growth as a neutral process, while urban sprawl is considered a negative process of urbanization characterized by “the lack of continuity in expansion” (Clawson 1962, Liu 2005, Peiser 1989).

Urban expansion patterns can generally be categorized into four characteristics: concentric expansion, leapfrog expansion, linear expansion and multi-nuclei expansion or their hybrid (Deng 2005). According to Deng (2005), if cities expand in all directions equally (as is common in plains landscapes with few geographic/natural barriers), it is demonstrating concentric expansion. If it shows a scattering expansion pattern, it is leapfrog expansion. If along the main transportation axis, cities usually grow in a linear pattern, which is known as linear expansion. If a city develops more than one center apart from the CBD, this pattern of expansion can be called multi-nuclei expansion. However, in reality, most cities expand in hybrid patterns.

2.4. Gentrification

2.4.1. Traditional Gentrification: 1980-1990s

The term “gentrification” was coined to encapsulate the process during which the “new middle class” would move into a lower-income neighbourhood by purchasing older, historic buildings for the purpose of renovation, ultimately driving up property values and forcing out the original residents (Davidson and Lees 2005). Neil Smith quotes Rush Glass, a sociologist from the 1960s, as saying that: “Once this process [...] starts [...] it goes on rapidly until all or most of the original working-class occupiers are displaced and the whole social character of the district is changed” (Smith 2003, p. 52). When gentrification became a significant topic in urban studies in the 1980s and 1990s, this process was characterized as an inevitable empirical reality that was the result of supply and demand within the free market system. For instance, the early gentrification of Harlem in terms of demographic change, the development of new income brackets, as well as a newfound entrepreneurial spirit. However, within this time period there was a significant shift as anti-gentrification attitudes in the 1980s forced states to withdraw subsidies supporting the process, which was quickly reversed in the 1990s, leading to new partnerships between “private capital and the local state” (Smith 2003, 441).

Gentrification in the 1980s was a private, individualistic process characterized by “junk bonds, stretch limousines, and television evangelism,” all of which are representative of the era’s “grand excess” (Lueck 1991). Within this economic context gentrification is a success: vacancy rates in larger commercial buildings of downtown New York fell from 22.8%

in 1993 to 8.2% in 1998. However, during the 1990s as the public sector reinserted itself into the process, the social polarization it created became apparent: the “new middle class” was unwilling to live alongside the poor.

2.4.2. New-Build Gentrification

Traditionally, gentrification was conducted by a series of individuals with disposable incomes who were attracted to inexpensive historic buildings in poorer neighbourhoods, but beginning in the 1990s gentrification moved toward state-led, new-build initiatives. These programs were designed to reinvigorate brownfields,² abandoned buildings, and decaying neighbourhoods. In an attempt to attract the ‘economically sustainable’ class, a state invests in creating a gentrified landscape that ultimately results in the displacement of the original, lower-income residents. This displacement process spills over into adjacent communities as the regeneration process proceeds at the same time as this land also becomes prime real estate (Davidson and Lees 2005). While traditional gentrification directly displaces marginalized populations in physical terms, ‘new-build gentrification’ often also results in indirect displacement since it constructs a neighbourhood identity that is unwelcoming to the original residents. New-build gentrification is conducted by a higher socioeconomic class of people and this changes to whom an area belongs, how it should look, and how its residents should behave. In essence, gentrification is no longer unilaterally seen (at least, in academia) as “a natural process governed by the logic of free market exchanges and individuals’ rights to private property – processes outside the bounds of anybody’s control” (Mazer and Rankin

² Brownfields are abandoned or underused industrial and commercial facilities available for re-use.

2011, 832). More recently, gentrification has been acknowledged as a complicated process in which the state's desire to 'clean up' the inner city directly effects the original populations negatively because it removes their sense of ownership over the area. For example, in 1999, the UK Department of the Environment, Transport and the Regions stated its intention to revitalize Britain's cities: "The Urban Task Force will identify causes of urban decline [...] and practical solutions to bring people back into our cities, towns, and urban neighbourhoods. It will establish a new vision for urban regeneration...We have lost control of our towns and cities, allowing them to become spoilt by poor design, economic dispersal, and social polarization" (Smith 2003, p. 50). This is characteristic of the new-build gentrification because it is a state-led initiative to revitalize cities by enticing a presumably 'more desirable' class of people (the middle class) to move back from the suburbs.

Copenhagen's Inner Vesterbro district underwent such an urban renewal process, and despite the municipality's attempts to include the original residents in the planning process, these socioeconomically vulnerable people were ultimately displaced because new-build gentrification is antithetical to their lifestyle. Although generous government grants were used to rehabilitate old buildings in this district to minimize the trauma, the branding of Inner Vesterbro as 'revitalized' attracted the 'creative' class of people who have the social and economic resources required to remake an area in their image. Gentrification plunges the city into a "space war" as the middle-class moves to retake it and the original residents fight for their right to a neighbourhood.

Toronto's Downtown West has also experienced this type of "space war" while it was

undergoing gentrification, which can be described as the fact that the original residents are “dislocated from the social spaces of neighbourhoods even as they continue to physically inhabit these neighbourhoods” (Mazer and Rankin 2011, 822). Interviews conducted with people affected by the Parkdale Pilot Project, which was designed to regulate the illegal housing used by psychiatric survivors, demonstrated how the intangible consequences of gentrification can be as alienating as physical displacement. Feelings of judgment, shaming, harassment, and a decreased sense of security were prevalent amongst the original residents, creating the sense that social mixing in these neighbourhoods is quite limited: two classes of people exist side by side without any meaningful interaction (Mazer and Rankin 2011).

2.4.3. Causes of Gentrification

Gentrification is a complex process that not only involves public initiatives, private sector interests, and so-called ‘class war’, but also a variety of other social issues. First, emancipatory theory sees gentrification as the process of creating tolerance. For instance, as the gay and lesbian community seeks to meet its unique needs and as changing feminist ideals restructure the traditional family unit, they often turn to the inner city as a place where tolerance can be created (Lees 2000, 393). Thus, the identity politics of gender and sexuality are closely linked to gentrification, but the way in which these interact with one another, as well as with other factors like race and ethnicity, have not yet been adequately fleshed out in the relevant literature.

Second, the idea of the new middle class influencing gentrification is closely related to the idea of the emancipatory city. They see it as a place where they can create a new

culture of tolerance that is inherently different from that seen in the older middle class neighbourhoods. However, when this “creative class” restructures an area in their image, they create a space that is exclusionary to those without their access to education, liberal ideas, and disposable incomes. It results in the “space war” seen in Copenhagen and Toronto as two groups fight for the right to the inner city” (Mazer and Rankin 2011). Third, Neil Smith best explains the idea of the revanchist city. Under this model gentrification is depicted as a spatialized war on the lower-income class by the middle-classes to retake the city (Mazer and Rankin 2011).

Another theme, ethnic minority gentrification, is very much unexplored, and new research in this field could shed interesting light on processes of gentrification. Ley (2008) suggests that immigration is also a prevalent influence on gentrification, especially for Canadian cities, but little research has been done to substantiate this. His attempts to use quantitative data revealed that there is a negative correlation between immigration and gentrification, although qualitative data reinforces this hypothesis. Ley points to immigrants’ tendency to first rent housing before moving to privately owned accommodations, thus creating a lag in statistics. As time passes, the availability of quantitative data to substantiate the idea that immigration is inextricably linked with the gentrification process will likely increase.

2.5. Urban Socio-spatial Study in China

China has undergone transition from a centrally-planned economy to a market-oriented economy and this has led to important socioeconomic changes. Rural-urban

and intra-city disparities are emerging as consequences of China's urban and economic transition. In addition, new mechanisms of housing allocation through real estate companies are creating new forms of spatial or area-based marginalization that further accentuate income and social inequalities, which in turn increased the complexity of social space.

2.5.1. Land and Housing Reform & Urban-Rural Migration Policy

Before the land and Housing Reform, there was no official real estate market in China (Gu 2005). During that era, public housing fell into two categories: housing directly managed by local government administrations, and housing managed by state-owned enterprises for their employees and families. This form of land and housing management and allocation experienced several problems, including housing shortages, heavy government financial burdens, and urban zoning issues (Wang and Murie 1996). In order to solve these problems and achieve the desired goal of "housing for all", China began processing laws and regulations to permit transferring, leasing, and mortgaging private rights to property (Gu 2005). One of these entailed ending the allocation of welfare housing in 1998 and establishing a market-oriented urban housing system (Wang 2001). The open housing policy led to increasing rates of housing construction (Tan et al. 2005) and both internal migration and international immigration, which are important drivers of urban expansion (Alberti et al. 2003, Knox and McCarthy 2005).

Compared with capitalist countries, migration in China is different due to the unique Household Registration System (Hukou, 户口), which is a tool of public control that limits the population's geographic mobility (Chen et al. 2011). The Hukou system separates annual

urban population growth into two parts: the natural growth of the existing urban population, and the net urban migration resulting from urban household registration transformation. After 1978, the policy of the Hukou System was relaxed, resulting in increased migration, especially from rural to urban areas (Ma 2002, Shen 1996, Zhou and Ma 2003).

2.5.2. Empirical Studies on Urban Social Space Structure in China

The importance of social factors to the organization of urban space began to attract attention from the academic community in the late 1980s. Yu's (1986) study on the urban social space in downtown Shanghai revealed that the main factors involved in the formation of its urban social space were population density and cultural career structure. This was the first case study about urban social space in China, and it was also the first one to quantitatively examine Chinese cities' socio-spatial structure (Yu 1986). After Yu's study, the quantitative analysis based on massive data became widely accepted. Gan (1986), on the other hand, studied Beijing's urban structure and its historic and cultural background in his doctoral dissertation. Then Xu et al. (1989) explained Guangzhou's urban socio-spatial structure model and its mechanisms based on the housing census data and the commuting survey of urban residents, and identified five main factors affecting Guangzhou's social space: population density, culture and technology, the ratio of workers to officers, the quality of living spaces, and family circle. Their proposition of an oval concentric model for Guangzhou's urban space led to the conclusion that the most pertinent mechanisms that led to its formation were the history of urban development, land use pattern, and the residence

allocation system. A few years later, Yang (1992) applied census data from 1985³ to 1990 to study Beijing's socio-spatial structure. After that, many scholars began to apply census data to their research regarding the urban socio-spatial structures of Beijing, Shanghai and Guangzhou (Gu 1997, Wu 2000, Yeh and Wu 1995, Zheng et al. 1995). Zheng et al. (1995) analyzed Guangzhou's urban social space using a factorial ecology approach using the fourth census in 1990. In comparison to the results of their previous analysis, they found that the evolution of Guangzhou's urban social space from 1989-1994 could be best explained by its governmental policies, urban development history, and natural environment. However, due to inadequate or incomplete data from this period, these studies only partially reflect the target cities' social space (Wu 2002).

After the mid-1990s, research on urban social space shifted its focus to urban residence differential, social polarization, and social inequality (Gu 2005, Wu 2002). In Chai's case study of Lanzhou (1996), he discussed the urban social structure based on the Danwei.⁴ In 1997, Gu et al. (1997) discussed the evolution of Beijing's social spatial structure. In the same year, Xiu and Xia (1997) concluded that the most significant factors dominating the formation of urban social space in Chinese cities were population density, socioeconomic status, and ethnicity.

Since 2000, the study of urban social space has become more extensive. With the

³ PRC has launched national censuses 6 times since its establishment, in the years 1953, 1964, 1982, 1990, 2000 and 2010. The 1985 census was a 1% sample survey, rather than a full census.

⁴ The danwei which loosely translates to "unit" or 'work unit', has historically been the most important link between people and the state, providing employment, housing, comprehensive social services, and facilitating mass mobilization campaigns of the CCP (Dittmer and Xiaobo 1996, Gaudreau 2013).

release of the 5th population census, more scholars have examined Chinese cities, the methodology for applying factor analysis to Chinese cities has become more developed, and various publications are now available. Gu et al. (2005) used the neighbourhood level data obtained from a 1998 survey to conduct a social area analysis in Beijing. According to the results, social, economic, and ethnic factors were of some importance, but the most prominent factor in the formation of a new urban social space in transitional Beijing was land use intensity. In light of the census, Feng and Zhou (2003), by combining PCA and cluster analysis, compared this situation to Beijing in the 1980s and analyzed new features of the city's demographic distribution through the 1990s. They argued that Beijing's social space was organized in a concentric model, and that heterogeneity was very significant. In 2005, Wu et al. studied Nanchang, and argued that the four main social dimensions of housing conditions, education and occupation, household and migration. Taking Shanghai as a case study, Xuan et al. (2006) pointed out five main factors shaping the city's hybrid sociospatial model: aged population and migration, income, housing conditions, commerce and non-agricultural population and allocated houses. Xu et al. (2009) examined the social space in Nanjing using the 2000 census and concluded that migration, non-agricultural population, housing conditions, education and occupations, and unemployment rate are the five social dimensions impact Nanjing's social landscape representatively. Zhang et al. (2012) extended this research to Urumqi and found that minority status was the most important factor in Urumqi's social space in 2000, followed by education, workers and retired population, administrative people, migration and agricultural population.

CHAPTER 3. RESEARCH OBJECTIVE AND CONCEPTUAL FRAMEWORK

3.1. RESEARCH OBJECTIVE/QUESTIONS

As mentioned in the literature review, the number of studies on Tianjin's transformation from an urban ecological perspective are few. Therefore, in order to understand the increasingly multi-faceted nature of social space and its change, this research has as its objective to understand the different urban socio-spatial patterns and their mechanisms, in the case of Tianjin, in three distinctive economic contexts: centrally-planned economy (1980s), market transition economy (1990s) and market-oriented economy (2000s).

In order to fulfill the objectives of the study, this research will address the following questions:

- a) What urban socio-spatial patterns are evident in Tianjin in the context of the three economic systems? What transformation patterns emerge from these?
- b) What are the mechanisms that have existed for the patterns of Tianjin's urban socio-spatial transformation? How have they interacted with each other?

This thesis will answer the above two questions by inspecting the urbanization process of Tianjin over the past three decades. In order to sufficiently answer the above questions, the dimensions related to this research are identified in the conceptual framework below.

3.2. CONCEPTUAL FRAMEWORK

This research will explain how processes of economic change in the region have manifested themselves in specific urban socio-spatial patterns. Chronologically, there are

three stages in the development of economic systems in China as figure 6 showed. The first one is identified as centrally-planned economy (1980s);⁵ the second is the market under the economic transition (1990s) from the centrally-planned economy; and the third is a market-oriented economy (2000s).⁶ Economic transformation was accompanied by four particular adjustment policies that impacted the behavior of individual households and, by extension, the whole city. The Hukou phenomenon is a strict household registration system used by Chinese government to control migration and resource allocation. Reforms to this household registration policy made it more flexible and made it easier for people to migrate. The migration of people from rural to urban areas strongly influenced the growth of the urban population and increased the complexity of the urban socio-spatial structure. The second of these policies to be changed was the housing allocation system, which dictated residential location on the basis of one's employment and located production/working units nearby. Under the housing allocation system, people of similar professional and educational backgrounds lived close to each other, and as a result the socio-spatial structure in Tianjin was comparatively simple. The execution of the Housing Reform policy resulted in the establishment of a real estate market, which increased individuals' choices about their location of residence. The inner urban spatial structure was reorganized dramatically, resulting in spatial segregation and aggregation. The third reform was the Land Use Policy

⁵ A centrally-planned economy is an economic system in which decisions regarding production and investment are embodied in a plan formulated by a central authority, usually by a public body such as a government agency. Planned economies are usually categorized as a particular variant of socialism.

⁶ A market economy is an economy in which decisions regarding investment, production and distribution are based on supply and demand, and prices of goods and services are determined in a free price system.

Adjustment, which made compensation for land use decisions the norm. After it was executed, old industrial areas in urban spaces faced the challenge of land use replacement due to relatively high land values in urban areas. The final policy was the Urban Planning Adjustment, which was the main tool for government to control urban structure. With the adjustment of urban function area planning and land use replacement, the total urban structure was changed dramatically.

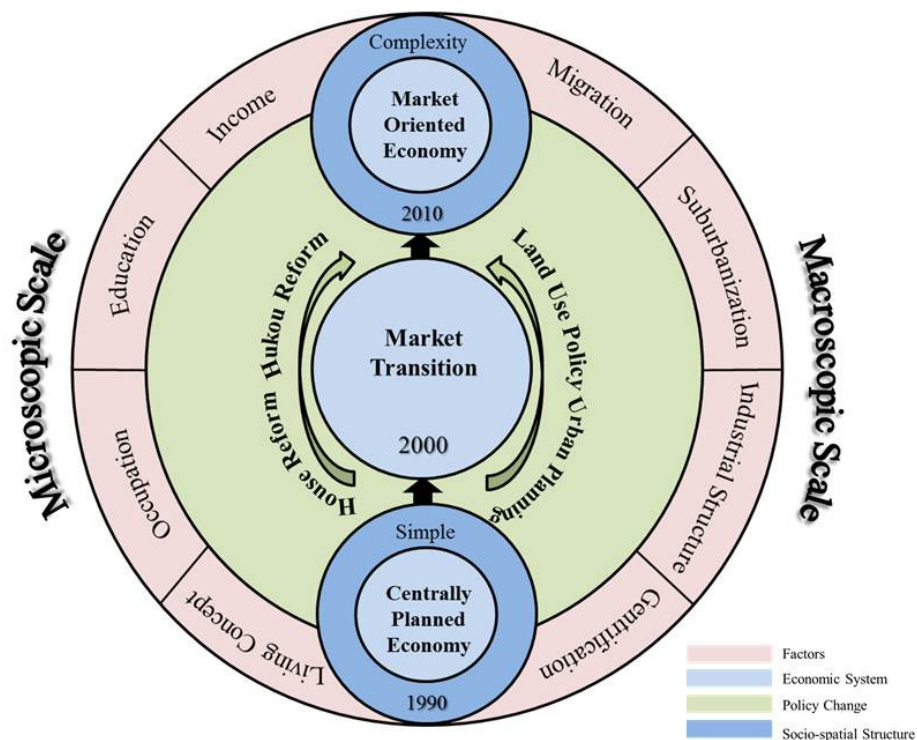


Figure 6. Conceptual Framework

These four policies impacted cities on both the macroscopic (overall city-wide scale) and microscopic levels (individual scale). On the macroscopic scale, four aspects of social phenomena changed: 1) more migration from rural to urban areas; 2) significant suburbanization; 3) transformation of the urban industrial structure and 4) gentrification process in urban core. At the microscopic level, the economic transformation and adjustment policies increased incomes and income stratification among residents; increased the complexity of professional differentiation; residents' educational level increased and more small families emerged. For the purposes of this research, these two scales of analysis are considered the influencing factors that cause overall urban social spatial pattern change. This thesis will investigate the following hypothesis by taking Tianjin as a case study. The hypothesis is that, ultimately, transformation from a centrally-planned to a market-oriented economy in Tianjin was accompanied by adjustment policies that impacted cities at the household and city-wide level and have produced a significantly distinct form of socio-spatial organization in recent years.

3.3. Organization of Thesis

The thesis is organized into five chapters including the prior introduction, literature review, and research objective/conceptual framework chapters. The fourth chapter comprises a paper in preparation for submission to the journal of Urban Studies. The data and methods used for the analysis has been described in the paper. Some tables were omitted from the text of the article, in order to satisfy the stylistic criteria for manuscript submission of the journal. These are, however, referred to in the footnotes and are provided in the appendices of the

thesis for consultation.

The concluding chapter summarizes the major findings and conclusions drawn from this research. It discusses the major theoretical and empirical contributions of this study, outlining the limitations and highlighting directions for future research.

CHAPTER 4.

Spatio-Temporal Transformation of the Urban Social Landscape in Tianjin, China

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4.1. ABSTRACT

China's economic reforms of 1978, which led to the country's transition from a centrally-planned to a market-oriented economy, ushered in a phase of accelerated urbanization. Influenced by the economic transition and taking advantage of its privileged geographic and historic position, Tianjin has seen dramatic changes in its social landscape during the last three decades. Given this context, this study aims at understanding the different urban socio-spatial patterns of Tianjin and their mechanisms in three distinctive economic contexts by adapting both statistical and spatial approaches. Due to increasing population mobility caused by the economic reforms, the urban social landscape of Tianjin has become increasingly multifaceted, characterized by a "one axis, two nuclei" urban morphology. The rise of the Binhai New Area (TBNA) in the southeast is creating a dual-core urban social structure in Tianjin, with its traditional Urban Core located in the center of the city. In terms of the Urban Core's expansion and population movements southeast toward the TBNA, an asymmetric suburbanization process is evident in Tianjin. Meanwhile, an additional population shift toward Beijing in the northwest is significant during 2000-2010, illustrating the changing relationship between these two neighbouring municipalities. By integrating itself with Beijing, Tianjin has not only recovered from under Beijing's shadow during the centrally-planned economy period, but is also benefitting from Beijing in order to flourish.

4.2. INTRODUCTION

Today's world is rapidly urbanizing. Currently, more than half the world's population is urban. Developed countries such as the Canada and UK achieved urbanization rates of greater than 50% as early as the 1900s, while this same process has only begun much later in developing countries than in developed countries. It is predicted that by 2050, more than 97% of the world's population will be urban, while 93% of urban growth will take place in Asia and Africa (UN DESA 2011). In many parts of the world, the rapid nature of urbanization has begun to show signs of strain: infrastructure maintenance in developing countries is lagging behind urban growth, causing a lack of suitable housing and facilities. In addition, there has been a shocking increase in socioeconomic stratification, and thus social inequality, especially with regards to living space. China officially became an urbanized country in 2012; at the same time the country's Gini index is greater than the global average at 0.474 (National Bureau of Statistics of the People's Republic of China), which indicates significant social inequality. A series of social problems are emerging in China that have attracted increasing interest in studying urban social space within urban geography.

Among these theories of social space, the emergence of the Chicago School in 1920s was a milestone, because it provided a unique perspective for studying spatial segregation and aggregation, which is commonly known as "Urban Ecology"⁷ (Grove and Burch 1997).

⁷ The argument followed that cities were like environments found in nature, governed by many of the same forces of Darwinian evolution that affected natural ecosystems (Park 1925). Viewing the city as an organism with its own metabolic processes, Park (1925) posited that the spatially and territorially distributed movement of human beings (in other words, "spatial relationship") is formed through processes of competition and selection.

Through different processes such as concentration, centralization, segregation, invasion, and succession, the Burgess zonal model, the Chicago School's most significant and well-known product, was chartered (Burgess 1925, Grove and Burch 1997).

Three classic models of urban social spatial structure emerged out of the Chicago School with increased levels of complexity.⁸ These studies provide evidence that urban spatial structures have many social and spatial distribution models. However, the classic models were limited in that they only summarized partial characteristics of urban spatial differential. Many subsequent critics used a combination of these models to provide a more accurate explanation of the modern urban structure. After the Second World War, Dickinson (1947) proposed a theory that optimized the concentric model for European cities, and Erickson (1954) combined the three classical models together to propose a combined theory. However, although these studies have addressed many of the shortcomings of the three classic models, it is still the case that they only take certain perspectives and attempt to define the pattern of a certain type urban structure and its land use. None of the models above explain the full extent of the urban spatial structure in a constantly changing subjective world. Thus, the most effective approach is to connect the specific situations and combine these theories together to explain the modern urban structure.

In the 1960s, following the Chicago School's approach, factorial ecology provided a new method to study urban socio-spatial structure.⁹ It was initiated by Shevky and Williams

⁸ Three classic models: The Concentric Zone model by Burgess (1925), Hoyt's Sector model (1939), and the Multiple-nuclei model by Harris and Ullman (1945).

⁹ The factorial ecology approach is widely applied to the studies of urban socio-spatial structure because it

(1949) in a study of Los Angeles, and was later elaborated on by Shevky and Bell (1955) in a study of San Francisco (Gu 2005). This approach developed a three-dimensional model (consisting of socioeconomic status, family status and ethnic status) to describe how urban populations differ in industrial societies. The three dimensions respectively match the sector patterns, concentric patterns, and multiple nuclei patterns of social areas. They were the first to formulate quantitative social area analysis systematically.¹⁰ However, the increasingly complex and differentiated demographic, cultural, political and technological environment of contemporary cities limits the potential of factorial ecology. The classification of the city into sectors, zones and clusters associated with socio-economic status, family status and ethnicity does not accurately describe patterns of urban land use in all cities (Lo 2007). Furthermore, this study is essentially static and cannot describe the process by which land use changes, such as the arrival of immigrants, new dimensions of occupation, and increasing social inequalities (Knox 2006). In light of these criticisms, geographers and sociologists have begun to develop a variety of analytical techniques to the study of cities.

Before the 1960s, scholars such as Herbert (1967) adapted Shevky and Bell's method of studying social spaces in San Francisco and Newcastle (UK). With the development of factorial analysis, Bell has begun and continued to focus on research developments in more than 10 US cities (Bell 1955). Their studies show that all the studied cities during that period

represents the complexity of urban social by space.

¹⁰ Using cities in North America as examples, they explained three major dimensions of urban structure: (a) socioeconomic status (economic status or social rank); (b) family status (familism or stage in life-cycle); and (c) ethnic status (ethnicity or minority groups). These dimensions work together to reflect the historical and geographical contexts in which the city was developed. Finally, it has been found that each dimension or factor displays a distinct spatial pattern which researchers have related to the classic land use models (Murdie 1969).

share a common social space model. During the 1960s and 1970s, scholars examined Western countries' models more closely. Apart from the three dimensions concluded by previous studies, several other dimensions such as sex, age, rural population density and housing vacancy rate, have also been examined by studies on cities in the US, UK, Canada and Australia (Anderson and Bean 1961, Berry and Tennant 1965, Carey 1966, Jones 1961, McElrath 1962, Murdie 1961, Schmid and Tagashira 1964, Sweetser 1962). At the beginning of the 1980s, as the number of cities being studied increased, a more spatio-temporal method was adapted: different years' data were widely adapted to illustrate different periods' social spaces (Davies and Murdie 1991, Hunter 1982, Perle 1981). During the same period, aside from Western cities, several non-Western cities began to attract more attention, such as Moscow, Hong Kong and Guangzhou (China) (Anthony et al. 1995, Lo 2005, Rowland 1992, Vasilyev and Parivalova 1984).

In contrast to Western countries, cities in Communist or former Soviet states are predicated on egalitarianism, with relatively homogenous societies. However, in these socialist cities, urban inequalities and differentiated social areas can still be widely observed (French and Hamilton 1987, Szelenyi 1983, Weclawowicz 1979) although these inequalities are not based on residents' economic status. With the dissolution of Soviet Union, the economy has been restructured in former Soviet countries. Many socialist regimes transitioned to market economies, and "many features of socialist urban development are now decaying rapidly" (Szelenyi 1996, p. 288). The built environment in the post-socialist countries has changed (Szelenyi 1996). Scholars commented that "the post-socialist city will

be a city of greater sociospatial differentiation” (Wu 2002, p. 1593) although the transitional economies are diverse. Such transitions have led to revival in the study of Urban Ecology in post-socialist cities, such as Puebla (Helene 2006); Warsaw (Regulska 2000), Ho Chi Minh (Smith and Scarpaci 2000), Havana (Scarpaci 2000), and Prague and Erfurt (Regulska 2000). These cities have particularly similar attributes, such as a poor inner-city and residential segregation (Scarpaci 2000). According to the research conducted in these cities, the re-emergence of commercial activities in central cities, gentrification, housing differentiation, selective mobility among residents, and the uneven distribution of manual workers and professionals are the main factors causing the transformation of socialist countries’ spatial landscape (Sykora 1999).

Among these transitioned socialist countries, China’s economic reforms in 1978 ushered in a phase of accelerated urbanization, and transition from a centrally-planned economy to a market-oriented economy (Han 2012). Rural-urban and intra-city disparities have emerged as consequences of China’s urban and economic transition (Wu 2002). The country’s social landscape changed dramatically.

However, in China, the social attribution of urban space didn't attract much attention from the academic community until the late 1980s. Yu’s (1986) study on the urban social space in downtown Shanghai revealed that the main factors involved in the formation of its urban social space were population density and cultural career structure. This was the first case study about urban social space in China, and it was also the first one to quantitatively examine Chinese cities’ socio-spatial structure (Yu 1986). After Yu’s study, the quantitative

analysis based on massive data became widely accepted. Gan (1986), on the other hand, studied Beijing's urban structure and its historic and cultural background in his doctoral dissertation. Then Xu et al. (1989) explained Guangzhou's urban socio-spatial structure model and its mechanisms based on the housing census data and the commuting survey of urban residents, and identified five main factors affecting Guangzhou's social space: population density, culture and technology, the ratio of workers to officers, the quality of living spaces, and family circle. Their proposition of an oval concentric model for Guangzhou's urban space led to the conclusion that the most pertinent mechanisms that led to its formation were the history of urban development, land use pattern, and the residence allocation system. A few years later, Yang (1992) applied census data from 1985¹¹ to 1990 to study Beijing's socio-spatial structure. After that, many scholars began to apply census data to their research regarding the urban socio-spatial structures of Beijing, Shanghai and Guangzhou (Gu 1997, Wu 2002, Yeh and Wu 1995, Zheng et al. 1995). Zheng et al. (1995) analyzed Guangzhou's urban social space using a factorial ecology approach using the fourth census in 1990. In comparison to the results of their previous analysis, they found that the evolution of Guangzhou's urban social space from 1989-1994 could be best explained by its governmental policies, urban development history, and natural environment. However, due to inadequate or incomplete data from this period, these studies only partially reflect the target cities' social space (Wu 2002).

¹¹ The PRC has launched the national census 6 times since its establishment, in 1953, 1964, 1982, 1990, 2000 and 2010. The 1985 census data here refers to a 1% sample survey, rather than a full census.

After the mid-1990s, research on urban social space shifted its focus to urban residence differential, social polarization, and social inequality (Gu 2005, Wu 2002). In Chai's case study of Lanzhou (1996), he discussed the urban social structure based on the Danwei.¹² In 1997, Gu et al. (1997) discussed the evolution of Beijing's social spatial structure. In the same year, Xiu and Xia (1997) concluded that the most significant factors dominating the formation of urban social space in Chinese cities were population density, socioeconomic status, and ethnicity.

Since 2000, the study of urban social space has become more extensive. With the release of the 5th population census, more scholars have examined Chinese cities, and since this time application of factor analysis methods to Chinese cities have increased, and various publications and research are now available. Gu et al. (2005) used the neighbourhood level data obtained from a 1998 survey to conduct a social area analysis in Beijing. According to the results, social, economic, and ethnic factors were of some importance, but the most prominent factor in the formation of a new urban social space in transitional Beijing was land use intensity. In light of the census, Feng and Zhou (2003), by combining PCA and cluster analysis, compared this situation to Beijing in the 1980s and analyzed new features of the city's demographic distribution through the 1990s. They argued that Beijing's social space was organized in a concentric model, and that heterogeneity was very significant (Feng and Zhou 2003). In 2005, Wu et al. studied Nanchang, and argued that the four main social

¹² The danwei which loosely translates to "unit" or 'work unit', has historically been the most important link between people and the state, providing employment, housing, comprehensive social services, and facilitating mass mobilization campaigns of the CCP (Dittmer and Xiaobo 1996, Gaudreau 2013).

dimensions of housing conditions, education and occupation, household and migration. Taking Shanghai as a case study, Xuan et al. (2006) pointed out five main factors shaping the city's hybrid sociospatial model: aged population and migration, income, housing conditions, commerce and non-agricultural population and allocated houses. Xu et al. (2009) examined the social space in Nanjing using the 2000 census and concluded that migration, non-agricultural population, housing conditions, education and occupations, and unemployment rate are the five social dimensions that impact Nanjing's social landscape representatively. Zhang et al. (2012) extended this research to Urumqi. They found that minority status was the most important factor in Urumqi's social space in 2000, followed by education, workers and retired population, administrative people, migration and agricultural population.

Reviewing the available literature on urban growth in China, it can be concluded that migration, housing conditions, education, occupation and aged population are the common social dimensions shared among the Chinese cities during the transition. However, the entirety of the social space transformation from the centrally-planned economy to the market-oriented economy cannot be fully examined using a single period or two-period studies, which is quite significant for understanding the social space change pattern before it is introduced as advice for government policy making. In order to fill the gap in the literature by applying the factorial ecology approach, this research aims to comprehensively understand the different urban socio-spatial patterns and their mechanisms within the three

distinctive economic contexts¹³ by taking Tianjin, which has not been studied extensively, as a case study.

¹³ The three economic contexts refer to “centrally-planned economy”, “the transitional economy from centrally-planned to market-oriented one” and “market-oriented economy”.

4.3. TIANJIN PROFILE

Tianjin, located in the North China Plain, northwest of the Bohai Gulf in the Yellow Sea, is one of four provincial-level municipalities in the People's Republic of China (PRC).¹⁴ Neighbouring the nation's capital of Beijing to the southeast (only 120km), Tianjin is surrounded by Hebei province. As a traditional commercial and industrial center in Northern China, Tianjin is an important juncture that connects China's northeast to Japan and Korea.

Tianjin possesses an area of 11,920 km² with a population of 14.1 million as of 2012 (Tianjin Year Book 2013). It is a heavily urbanized city, with 82% of its population living in urban areas, which occupy 605 km² of the city's territory. Tianjin has experienced rapid development since the economic reforms of 1978, and particularly after 2000. Since 2011, Tianjin's annual GDP growth has been highest among all of China's cities. In spite of this recent growth, Tianjin has experienced cycles of rapid and stagnant development throughout its history, and have shaped its urban landscape today.

4.3.1. Tianjin in History

The opening of the Grand Canal¹⁵ during the Sui Dynasty (581-618) prompted the establishment of Tianjin as a trading center as well as a garrison town serving as the gateway to Beijing. Originally, a rectangular city wall was constructed for commercial activities and defense (Figure 7). It was the first urban landscape formed in Tianjin, which was relatively open and unprotected outside of the boundaries of the fortress walls. Taking advantage of its

¹⁴ The four provincial-level municipalities of the PRC are Beijing, Shanghai, Tianjin and Chongqing.

¹⁵ The Grand Canal is the longest canal in the world. It starts at Beijing, passing through Tianjin and Hebei, Shandong, Jiangsu, and Zhejiang Provinces to the city of Hangzhou.

geographical location, Tianjin soon became the leading economic center in Northern China. Generally speaking, Tianjin's development flourished during this period, all of which would change following the invasion of China by Western nations.

Tianjin's prosperity declined during the mid-19th century. When the British and French forced China to sign the "Treaties of Tianjin"¹⁶ in 1858 after their successful gunboat diplomacy campaign, Tianjin was formally opened to foreign trade and a concession area of 15.57 km² was built by 1902 (3.5 times larger than the built-up area, and 10 times larger than the old city area) (Figure 7).¹⁷ These concessions contributed to greater urban construction and the evolution of municipal governance in Tianjin, which significantly impacted the Chinese government led by Yuan Shikai.¹⁸ In light of Western urban planning occurring in the concessions, the government of Tianjin decided to develop a new urban area beside the old city (Figure 7).¹⁹ Some administrative departments were moved to this new area, making it the political center of Tianjin (the economic center remained in the concessions). Some industries were also constructed in this new area, leading to Tianjin's gradual transition from a commercial city into a more industrialized one.

¹⁶ Several documents were signed known as "Treaties of Tianjin" in 1858 by the Second French Empire, United Kingdom, Russian Empire, and the United States. It ended the first part of the Second Opium War (1856-1860) and permitted Western emissaries and Christian missionaries in Beijing, while also legalizing the import of opium.

¹⁷ Britain and France were the first two countries to build concessions in Tianjin. Similar concessions were given to Japan, Germany, Russia, Austria-Hungary, Italy, and Belgium between 1895 and 1902.

¹⁸ Yuan, Shikai (1859-1916) was a Chinese general, politician and emperor during the late Qing Dynasty. He was the first President of the Republic of China. During the period of Tianjin's new urban area construction, he was the viceroy of China.

¹⁹ The old city area, concessions, and new urban area are all located in current Urban Core defined in this study.

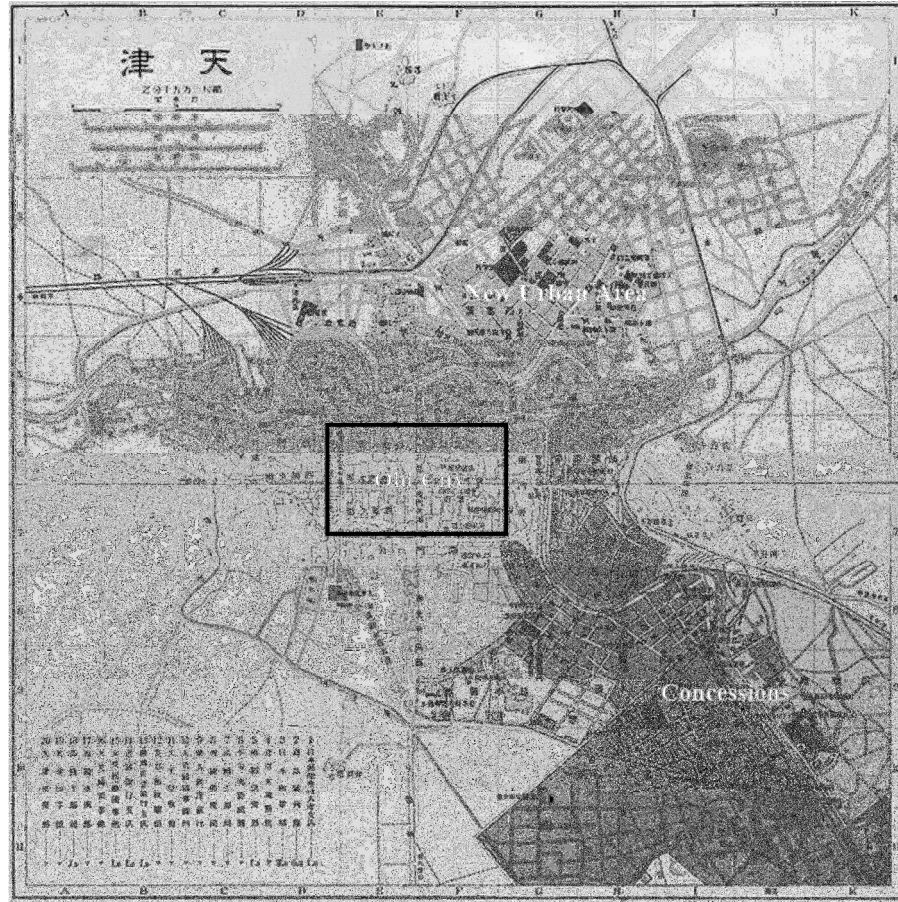


Figure 7. The Location of the Tianjin Old City, Concessions, and New Urban Area

(Source: http://zh.wikipedia.org/wiki/File:Tianjin_20051107.jpg)

During this time, the social space pattern of Tianjin was best characterized as being “the rich in the concession, the high-class in the new urban area, the low-income in the old city and the poorest in the urban fringe.” There was also political instability due to internal and external upheaval, making Tianjin’s social space and urban morphology chaotic. The establishment of the PRC in 1949 and the onset of the Chinese Communist Party’s governance changed the city dramatically.

4.3.2. Socialist Tianjin

At the beginning of the Maoist era (1949), Tianjin was the second-largest economic

center of China, which occupied a prominent position in areas such as industrial production, exports, and state revenue. When the PRC was first established, the central government focused on developing Tianjin as an industrial city: 12 industrial areas were built, with each one representing a different division of industry. However, in the 1950s, the central government decided to “restrict coastal area development and focusing on inner city development.”²⁰ This policy shift was complemented by an emphasis on Beijing’s development, which negatively affected Tianjin’s status. In 1958, Tianjin was officially demoted from a provincial-level city to the capital city of Hebei Province, signalling a freeze in funding for the city’s development. Responding to the erosion of its economic and urban status, the central government reduced the number of planned road systems for Tianjin from 3 ring roads and 18 radiate roads to 2 and 16, respectively. Because of China’s centrally-planned economy during this period, housing in Tianjin was also affected by this freeze in development. The housing policy only permitted the development of workers’ housing estates, which were in close proximity to the factories where residents were employed. Thus, many industrial areas, located in what is now known as the Urban Core, achieved a tight physical integration of land uses during that time. The urban landscape was segregated but stable, with very little population movement during this time.

²⁰ This was caused by Mao’s response to changing local, national and international environments, especially national defense and the emergence of Beijing. During the First Five-Year Plan period (1953–1957), under the influence of the socialist ideology and the Soviet model of industrialization, China’s industrialization program emphasized establishing new industrial centers in the interior provinces and recovering traditional industrial bases in the coastal region, with an emphasis on Shanghai and Liaoning. Meanwhile, with Chinese policy to transform capitalist consumer cities into socialist, independent, industrial cities, and the emphasis on the construction of Beijing as the national capital, massive investment went to the latter, which quickly strengthened its industrial base.

The discovery of oil in Dagang (a coastal district in Tianjin) and the construction of the Dagang Oilfield in 1964 helped Tianjin sustain itself during this period of stagnation and recover its provincial-level municipality status (1967). Meanwhile, China's industrialization policies shifted to the coastal cities again, which positioned Tianjin as "a base for energy production and related manufacturing industries (Leitmann 1994)." However, the development of Tianjin remained suspended from 1966-1976 due to the Great Cultural Revolution²¹ and the 1976 Tangshan earthquake, the latter of which exacerbated the situation. Almost all the housing constructed in the city was destroyed or damaged: citizens had to live in temporary homes for almost 4 years. However, just two years later, the economic reforms of 1978 began Tianjin's road towards restoration and development.

4.3.3 Urban Reform Tianjin

With the economic reforms of 1978, the country began to emphasize decentralization, marketization, and globalization (Wei and Jia 2003). Tianjin was greatly influenced by this triple transition. This is especially evident after the urban reforms of 1984, during which time the 14 coastal cities were opened up to foreign states.²² As one of these coastal cities, Tianjin received preferential policies leading to the establishment of the Tianjin Economic-Technological Development Area (TEDA) (Figure 8), which acted as a gateway to the global economy. From then on, Tianjin began its ambitious development and urban

²¹ The Great Cultural Revolution was a social-political movement that took place in the People's Republic of China from 1966. Set into motion by Mao Zedong, then Chairman of the Communist Party of China, its stated goal was to enforce communism in the country by removing capitalist, traditional and cultural elements from Chinese society, and to impose Maoist orthodoxy within the Party.

²² The 14 coastal cities are: Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang, and Beihai.

transformation into the city it is today.

With the redefined nature of the city as “a comprehensive industrial base with advanced technologies, an open multi-functional economic center and a port city (Zhang 2010)” in 1986, Tianjin’s development emphasized two directions: concentrating on development of the coastal area and reconstructing the urban area.

The Creation of the Coastal Area

The origin of Tianjin’s coastal area was formed by marine regression. Before 1984, this area was mainly a stretch of desolate salt marsh (with the exception of Dagang Oilfield). The establishment of the TEDA in 1984 was a development initiative to shape the area into what it appears now in present-day. In 1991, the government of Tianjin began to develop the “Tianjin Duty-Free District (TDFD)” at the Tianjin Port to attract more enterprises and investment. In 1994, on the basis of the TEDA and TDFD, the Tianjin government decided to integrate the three coastal districts (Dagang District, Tanggu District, and Hangu District) to form the Tianjin Binhai New Area (TBNA) (Figure 8).²³ It aimed to “adequately develop the TBNA as the industrial base of Tianjin in ten years” (the 12th People’s Congress Conference of Tianjin 1994). Therefore, these industrial enterprises, which used to be situated in the Urban Core, gradually moved to the TBNA in concurrence with the city’s developmental strategy to move eastward. The fastest heavy industrial growth in equipment for transportation, construction and electronics, and the greatest light industrial growth in

²³ In Chinese, “Binhai” means “coast”. Since these three districts are all located along the coast, this integrated area was named “Binhai.”

consumer electronics had been observed in the TBNA.

In the first ten years of its development (1995-2005), the TBNA experienced exponential growth. The community's GDP in 2005 was almost 10 times greater than its value in 1995 while annual GDP growth was 20%. The fast economic growth and industrial development produced a large number of job opportunities, which led to a massive migration of people to the TBNA. In 2005, the development of the TBNA was upgraded to the National Development Strategy as well as the National Eleventh Five Year Plan, which can be viewed as a milestone for the TBNA's development, as it officially ended its period of independent development. In 2006, the central government gave top priority to the TBNA for financial development, and consequently, a large number of construction programs were allocated to Tianjin. As of 2009, 202 industrial projects with 228 billion RMB worth of investment were established in the TBNA. In 2009, the TBNA officially announced the abolition of administrative committees for its three separated districts to put them directly under the area government. By the end of 2013, nine functional zones were constructed in the TBNA (Figure 8).²⁴ Like a pearl shining along the Bohai Ocean, the TBNA rose, and continues to rise, as "China's third economic growth pole,"²⁵ and is bringing new vitality to all of Tianjin and its future development.

²⁴ They are: Advanced Manufacturing Zone, Airport-based Industrial Zone, Binhai High-tech Industrial Development Zone, Seaport based Industrial Zone, Nangang Industrial Zone, Seaport Logistics Zone, Coastal Leisure & Tourism Zone, Sino-Singapore Tianjin Eco-City and the Yujiapu Financial District.

²⁵ The three economic growth poles in China are Shanghai, Guangzhou, and Tianjin.



Figure 8. TEDA, TDFD, Functional Zones in the TBNA

(Source: <http://www.bhswjl.com/newsread65.html>)

The Rehabilitation of the Urban Core

Along with the rise of the TBNA as an industrial center, the traditional Urban Core has also undergone dramatic transformation. Due to stagnation during the Maoist era and the Tangshan earthquake in 1976, Tianjin's Urban Core was chaotic between 1978-1993, with a combination of government administration, commercial activities, industries and residences. With the eastward migration of industrial enterprises out of the Urban Core after urban reforms, this area began to develop as a modern political, commercial and cultural center to help transform Tianjin into a globalized city.

By 1992, the transition from a centrally-planned economy to a market-oriented economy caused a loosening of the Hukou system in Tianjin, allowing Chinese residents to move more freely into the city to find jobs. The migratory trends during this time showed an influx of residents in Tianjin as a result of these changes. The proportion of the population that was migratory increased significantly from 5% in 1995 to 28% in 2012 (Tianjin Year Book 1996, 2013). In 1998, the emergence of a real estate market allowed residents to freely choose where they wished to live, leading to a massive internal population exchange. In this context, the government of Tianjin divided the development of Tianjin's Urban Core into two parts: the reconstruction of the central Urban Core (Heping District and partial Hexi District, which were historically part of the concessions) for political, financial, and cultural activities; and the development of a new peripheral area (adjacent to the Inner Suburb) as a residential district for the influx of migrant workers. This reconstruction and new development greatly influenced Tianjin's urban morphology.

The Urban Core used to be the most disorderly area in Tianjin. Over more than 140 years of development that have largely lacked planning, this area was characterized as the densest area of the city with extremely poor living conditions.²⁶ In 1993, the government of Tianjin began a 10-year project to reconstruct the central Urban Core as the city's commercial and financial center, with high-end residences. During the rehabilitation, 730,000 m² of the poorly constructed and old houses were removed and its former residents

²⁶ In the area, several families lived off one internal courtyard and it was common for three generations to live in one house. The average living space was just 2 m² per person.

moved to the peripheral area (Figure 9). With several residential zones built along the periphery of the Urban Core, the suburban area began to attract attention for development from the government in 1995 (Figure 10).



Figure 9. Reconstruction of Old City Area

(Source: <http://bbs.enorth.com.cn/thread-4058390-1-1.html>)



Figure 10. Residential Zones Built Along the Periphery

(Source: www.chinahouse.gov.cn)

In addition to the above changes, the Tianjin government has also made many efforts to develop the city's infrastructure. High-speed railways were constructed in 2008 to connect Beijing and Tianjin through the latter's downtown area. These railway projects have brought

more opportunities for external communication for Tianjin. In 2012, three subway lines were opened, which increased daily commute numbers and connectivity between the Urban Core and the suburbs significantly.

In sum, Tianjin has developed at an incredible speed after the economic reforms of the post-socialist era. Compared to its historical urban landscape, today's structure is unrecognizable. What are the mechanisms leading to such development? How did they interact with each other to influence Tianjin's social urban landscape, and its evolution during the three different economic systems (centrally-planned economy, market-oriented economy and the transitional economy period)? This study will seek to answer the above questions using quantitative methods.

4.4. RESEARCH DESIGN

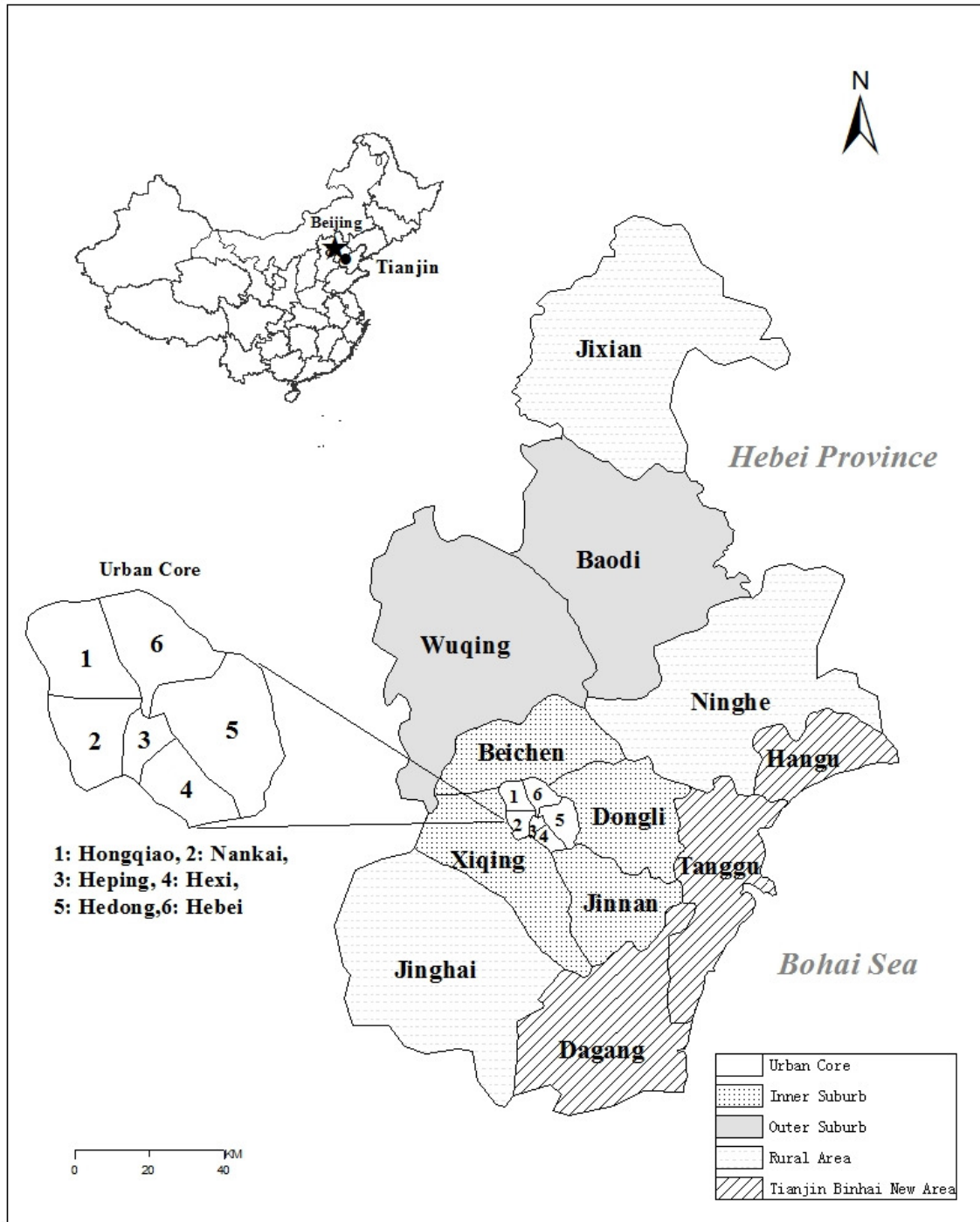
4.4.1. Study Area Selection

Similar to other large Chinese cities, the Tianjin Municipality includes one major urban core, several suburbs and large rural territories. Additionally, there is a large open coastal zone in southeast Tianjin. Being one of China's provincial-level municipalities, there are three prefectural level subdivisions in Tianjin: sub-provincial-level new area, district, and county.²⁷ Currently, Tianjin is comprised of 18 administrative subdivisions,²⁸ divided into four categories in this study: The Urban Core (Heping District, Hedong District, Hexi District, Nankai District, Hebei District and Hongqiao District); the Inner Suburb (Dongli District, Xiqing District, Jinnan District, and Beichen District); the Outer Suburb (Wuqing District and Baodi District); and the coastal region, known as the TBNA (sub-provincial-level new area);²⁹ in addition to the three counties (Jinghai, Ninghe, and Jixian). The three counties are not included in this research for their rural status. In sum, the overall study area constitutes 7378 km² (Figure 11).

²⁷ "District" refers to mostly urban or suburban in municipalities; "county" refers to the areas mainly occupied by rural territories.

²⁸ The current administrative sub-divisions of Tianjin were classified in 1992. Before 1992, Wuqing and Baodi were classified as counties. In order to accelerate the urban development in Tianjin, the city government decided to reclassify these two regions as districts. Meanwhile, the four Inner Suburb districts: Dongjiao, Xijiao, Nanjiao, and Beijiao were renamed to Dongli, Xiqing, Jinnan, and Beichen respectively. Please refer to Appendix 1 for a table showing the adjustment of Tianjin's administrative divisions from 1980-2010.

²⁹ It's used to be composed of Tanggu, Hangu, and Dagang, but was consolidated into one district in 2009.



Projection: Regional Conformal Projection (China)
Software: ArcGIS 10.0

Source: Chinadataonline (www.chinadataonline.org)
Ziwei Liu

Figure 11. Geographical Locations and Administrative Divisions of Tianjin

4.4.2. Data Resources

Since the establishment of the PRC, five censuses have been conducted in 1953, 1964, 1982, 1990, 2000, and 2010.³⁰ Considering that 1992 was the year that Tianjin officially transferred from a centrally-planned economy to a market-oriented economy the 1990, 2000, and 2010 census have been selected to examine the influences of the three different economic contexts preceding each of these censuses, respectively. In order to examine Tianjin's social space as accurately as possible, the neighbourhood-level data from the censuses has been selected because it provides the smallest units of study.³¹ In total, 196 neighbourhoods are included in the 1990 census, while 228 neighbourhoods are selected in the 2000 and 2010 censuses. Other statistical data was used to inform the analysis that was extracted from Tianjin's Year Books from 1980-2013, available online. All GIS data is collected from Chinadataonline (www.chinadataonline.org).

4.4.3. Variable Selection

With reference to past literature's variable selection on the subject of China (Gu 2005, Han 2012, Zhang 2009), 20 social variables from 7 categories have been selected for the 1980s analysis; 24 social variables from 8 categories are used in the 1990s analysis, and 22 social variables from 8 categories in the 2000s analysis (Table 1).³²

³⁰ In 1987, the government announced that the fourth national census would take place in 1990 and that there would be one every ten years thereafter.

³¹ "Neighbourhood" (*Jiedao*, 街道, also known as "sub-district") is the smallest administrative sub-division in China, which encompasses 2,000 to 10,000 families each.

³² Some variables of the original data file that are divided into smaller segments (such as 1-4) have been regrouped into one bigger variable in order to obtain the significant analysis results (such as 15-64).

Table 1. Variable Selection, 1980s, 1990s, and 2000s, Tianjin

Social Aspect	Variables	1980s	1990s	2000s
Population and Demographic Structure	Age group 0-14	√	√	√
	Age group 15-64	√	√	√
	Age group 65+	√	√	√
	Non-agricultural population	√	√	√
Family Structure	Family with 1-3 persons	√	√	√
	Family with more than 4 persons	√	√	√
Marital Status	Singled population	√	√	√
	Married population	√	√	√
	Divorced and widowed population	√	√	√
Mobility	Temporary population	√	√	√
	Permanent population	√	√	√
Education Level	Basic education level	√	√	√
	Higher education level	√	√	√
	Illiteracy rate	√	√	√
Occupation	Primary industry worker	√	√	√
	Secondary industry worker	√	√	√
	Tertiary industry worker	√	√	√
	Unemployed rate	√	√	√
Ethnic Minority	Han population	√	√	√
	Minorities	√	√	√
Economic status	Lower expenditure on houses		√	
	Higher expenditure on houses		√	
	Lower monthly rent		√	√
	Higher monthly rent		√	√

* √ means this period has these social variables

4.4.4. Analysis Methods

In order to understand Tianjin's urban social landscapes both spatially and temporally, this study is carried out by integrating statistical and spatial approaches. The statistical approach refers to factor analysis, or more specifically, Principal Component

Analysis (PCA), which will identify the primary social dimensions for further spatial analysis. The spatial analysis includes three parts: visualizing PCA results, testing the multiple regression results to fit the spatial pattern to zonal or sectoral models, and analyzing the social areas by the cluster analysis.

Figure 12 shows how these statistical and spatial analyses will be carried out in detail. First, PCA is used to statistically illustrate the primary social dimensions that shape Tianjin's social landscape in the 1980s, 1990s, and 2000s. In order to reveal the geographic distribution of these social dimensions, each neighbourhood's factor score extracted from PCA will be mapped. After this step, each social dimension in each study period will have a thematic map to show its spatial pattern. However, it is difficult to compare several thematic maps with intricate details to show the evolution pattern of Tianjin's social space; thus, a more conceptual and systematic approach is needed. Therefore, the multiple regression method has been applied to help simplify the thematic maps by modelling them to either zonal, sectoral or multi-nuclei models to make the comparison more straightforward. Although the models from multiple regression can provide an effective comparison among the social dimensions in the different periods; however, the spatial relationships of all the social dimensions in one period are not clear. In order to examine the social dimensions' spatial patterns topologically, a cluster analysis will be applied. Neighbourhoods dominated by the same social dimension will be clustered into same social category, also known as social area. By mapping and comparing these categories, Tianjin's social landscapes and their evolution patterns will be summarized.

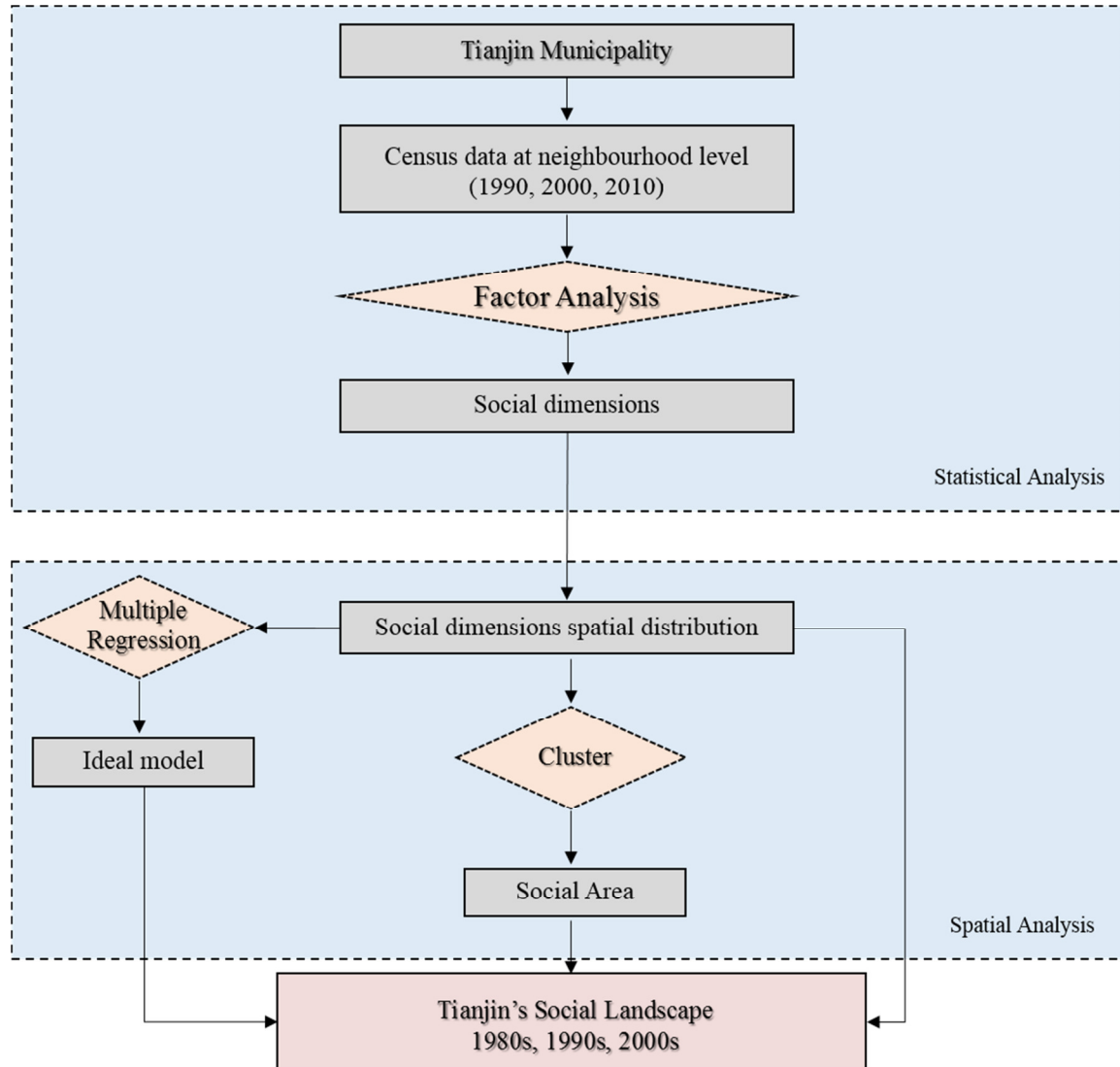


Figure 12. Flowchart of the Methodology

Therefore, in order to more effectively carry out the research by following the above designed methods, the methodologies of the three analyses (PCA, multiple regression, and cluster analysis) will be explained in detail in the following sections.

Principal Component Analysis (PCA)

Factorial ecology theory adopts the factor analysis approach to study urban spatial structures. The overall city social space is reflected by several factors such as social,

economic, demographic and housing areas (Knox 2006, Murdie 1969). Factorial ecology tries to “establish sets of basic dimensions (factors) in socio-ecological differentiation, as well as to reach empirical generalizations about these dimensions and to develop a theory of socio-ecological structure and change in terms of the dimensions” (Janson 1980, Murdie 1969). Factor analysis is employed in the data reduction process to identify a small number of factors to explain variances in the original data file, which is usually composed of a much larger number of variables (Hair et al. 2005). The Principal Components extraction method is adopted in the factor analysis to reduce the number of variables of the data file. Usually, a small number of components are calculated to represent the most amount of variation in the original variables. For this study, Principal Component Analysis (PCA) is used to identify these factors (principal components).

In order to run a valid factor analysis, six requirements of the PCA must be met (Child 2006, Ferguson and Cox 1993): 1) Variables must be all numerical and standardized (all the data has been normalized to percentage or density over areas); 2) The ratio of observations to variables must be greater than 5; 3) The correlation matrix for the variables must contain more than 2 correlations of 0.30 or greater; 4) Variables with measures of sampling adequacy less than 0.50 must be removed; 5) The overall measure of sampling adequacy by Kaiser-Meyer-Olkin must be higher than 0.50; and 6) The Bartlett test of sphericity must be statistically significant. In this research, the variables from the 1990, 2000 and 2010 censuses have been all normalized into percentages for the most effective implementation of PCA. Moreover, because of the high correlation seen among the same

social variables (for example, temporary population and permanent population), and due to the inefficiency of mapping each variable individually, one of these highly correlated variables (correlation coefficient greater than 0.8) are removed (Han 2012). Moreover, the popular Varimax rotation technique has been used to maximize the loading of a variable on one factor and minimize the loadings on all others to interpret and label different components more distinctively (Cao and Villeneuve 1998).

When running the PCA, it is more preferable to use fewer components to interpret the majority of the total variance in the process of deciding the number of components that will be included in the final analysis. Thus, in this research, only components with Eigenvalues greater than 1.0 have been extracted from the PCA results (Griffith and Amrhein 1997). In addition, a trade-off has been made between the cumulative variance, the scree plot, and factors' interpretability. To determine which variables are presented by the selected factors, only the variables with absolute factor loadings greater than 0.5 have been selected (Cao et Villeneuve 1998).

Multiple regressions

Three conceptual morphologies are widely adopted for explaining social dimensions' spatial patterns, which are the zonal, sectoral, and multi-nuclei models (Gu et al. 2005). The multiple regression method effectively examines whether the ideal zonal model or the sectoral model better fits Tianjin's social dimensions' spatial patterns (Cadwallader 1981, 1996).

To examine the zonal pattern, the study area has been divided into three concentric zones: the Urban Core, the surrounding Inner Suburb, and the outside zones. Based on the administrative boundaries of the different districts, this is then coded by two dummy variables (x_2 and x_3). Similarly, in order to test the sectoral pattern, three additional dummy variables (y_2 , y_3 and y_4) have been used to code the four sectors (NE, SE, SW and NW). See Table 2 for descriptions of zones and sectors (Gu et al. 2005).

Table 2. Divisions of Zones and Sectors in Tianjin

Label		Division	Codes
Zone	Urban core	Centroids inside urban core	$x_2=x_3=0$
	Inner Suburb	Centroids between urban core and Inner Suburb	$x_2=1, x_3=0$
	Others	Centroids outside of Inner Suburb	$x_2=0, x_3=1$
Sector	NE	East Hebei, East Beichen, North Dongli, Baodi and Hangu	$y_2=y_3=y_4=0$
	SE	Hexi, Hedong, East Xiqing, Jinnan, Tanggu and Dagang	$y_2=1, y_3=y_4=0$
	SW	Nankai, Heping and Xiqing	$y_3=1, y_2=y_4=0$
	NW	Hongqiao, West Hebei, West Beichen and Wuqing	$y_4=1, y_2=y_3=0$

For testing the zonal structure, the regression model is:

$$F_i = b_1 + b_2 x_2 + b_3 x_3$$

In this model, F_i is the score of a component ($i=1, 2$ and 3), b_1 is the average factor score in zone 1, and the coefficient b_2 and b_3 is the difference of the average factor score between zone 1 and zone 2, or zone 2 and zone 3 respectively.

Meanwhile, the regression model for testing the sectoral model is:

$$F_i = c_1 + c_2 y_2 + c_3 y_3 + c_4 y_4$$

The notations have similar interpretations the as zonal model (Cadwallader 1981, 1996, Gu et al. 2005).

For determining if the zonal model or sectoral model is a better fit, R^2 extracted from the regression model has been examined: the more significant R^2 is (closer to 1), the better the fit. An individual t-statistic has also been tested to show whether the coefficient is statistically significant or if a zone or sector is significantly different from the reference zone or sector. Also, whether or not the coefficient is positive or negative determines if the model is a positive or negative fit. Furthermore, the conceptual models of each factor have been drawn out.

Cluster analysis

Cluster analysis is a technique of grouping a set of objectives into the same category as a way of ‘clustering’ similar objectives into the same category (Bailey 1994). In other words, it is a data mining approach that can be used in many fields, including pattern recognition, image analysis, and information retrieval, etc. However, the cluster analysis itself is not an algorithm; it optimizes its cluster result by adapting various algorithms that vary in their notion of what constitutes a cluster and how to efficiently distinguish them (Roy and Bhattacharyya 2005).

Common cluster groups include ones with small distances between the cluster members, dense areas in the data space, intervals, and particular statistical distributions (Bailey 1994). To set the clustering algorithms and parameters appropriately, such as the distance function, a density threshold or the number of expected clusters, has to be set. This

is due to the fact that different individual data sets and their intended uses of the clustering results will give the method a high variance level. Therefore, it is necessary to modify the data and parameters prior to processing until it achieves the desired results (Kleinberg 2002).

The objective of using the cluster analysis for this research is to identify Tianjin's social area types in the three study periods as well as illustrate the topological relationship among different social areas. Furthermore, the Hierarchical Cluster method, a widely accepted method for the research on this subject referring to previous studies, has been used to cluster the factor scores discerned from the PCA (Wu et al. 2005, Xuan et al. 2006, Zhou et al. 2006).³³ After several trials between the cluster numbers and the clustered neighbourhoods, the Squared Euclidean Distance³⁴ and Ward's method³⁵ have been chosen as the notion to classify each neighbourhood according to each time period. The extracted clusters have been then labeled by comparing the root mean square with the mean of the clustered neighbourhoods' factor scores.

Visualizing Results

As explained previously, the results of the PCA as well as the cluster analysis need to be mapped in order to complete a spatial analysis. ArcGIS 10.0 is the tool used in this research to achieve this goal. Since the PCA provides numerical values while the cluster

³³ The Hierarchical Clustering is a method of cluster analysis which seeks to build a hierarchy of clusters in data mining process. It arranges the items in a hierarchy with a treelike structure based on the distance or similarity between them.

³⁴ Euclidean Distance is the "ordinary" distance between two points that one would measure with a ruler. This Euclidean Distance can be squared in order to place progressively greater weight on objects that are farther apart.

³⁵ Ward's method is a criterion applied in hierarchical cluster analysis for choosing the pair of clusters to merge at each step is based on the optimal value of an objective function, which could be "any function that reflects the investigator's purpose (Ward 1963)."

analysis provides category numbers (1, 2, 3...), the data files of PCA results and cluster analysis results are different. Thus, by joining the results table to the study area's geographical map in shapefile format, the “Quantities” and “Categories” methods are respectively adapted to spatially realize the visualization.

4.5. ANALYSIS AND RESULTS

As the research design indicates, PCA and multiple regression methods were implemented to study the evolution of Tianjin's social space, both in statistical and spatial terms; while cluster analysis was adapted to analyze the urban social landscape topologically. This section will explain the results of the analysis in detail.

4.5.1. PCA Statistical Results

4.5.1.1. Modelling Results

As the research design indicated, the dimensions that impact Tianjin's social space are identified using factorial ecology. By ranking the uncorrelated factors extracted from PCA by the proportion of the total interpreted variance, Tianjin's internal social structure in the 1980s, 1990s and 2000s at the neighborhood level as well as the transformation pattern have been identified.

The result of the PCA is shown in Table 3. The 1980s model extracted four factors with 15 selected variables, which accounts for 76.795% of the total variance. The 1990s model, however, explains 75.081% of the total variance using four extracted factors with 17 selected variables. The 2000s model retained five extracted factors to explain 68.809% of the total variance with 16 selected variables. Therefore, in the 1980s and 1990s, the number of extracted factors is the same (4), while the overall explanatory power is reduced slightly. When it comes to the 2000s, the number of factors increased to 5; however, the overall explanatory power continued to decrease.

Figure 13 shows the explanatory proportions of the factors comparing the 1980s, 1990s and 2000s. It is evident that in the 1980s, the first factor, is absolutely predominant in shaping Tianjin's social landscape as it accounts for almost half of the variance (44.009%). The proportions from factor two to factor four decreased sharply compared to the first factor (representing 12.810%, 10.993% and 8.983% respectively) and these three factors have a slight declining tendency of approximately 2%. A significant drop is seen in the 1980s' proportions interpreted by selected factors. In the 1990s, from Figure 13, the significance of the four selected factors for explaining the city's social landscape is almost even, especially the first three factors (around 20%). In other words, there are no sudden spikes or drops in significance for the proportions of the social factors during the 1990s. A decade later, in 2000s, the decline in proportions across the first four factors can be seen once more, similar to the pattern seen in the 1980s, although to a lesser extent (Figure 13). In the 2000s, the first factor is significantly less dominant than it was in the 1980s (measuring 22.794% compared to 14.127% of the second factor). In other words, it is a dominant factor in comparative, but not in absolute terms.

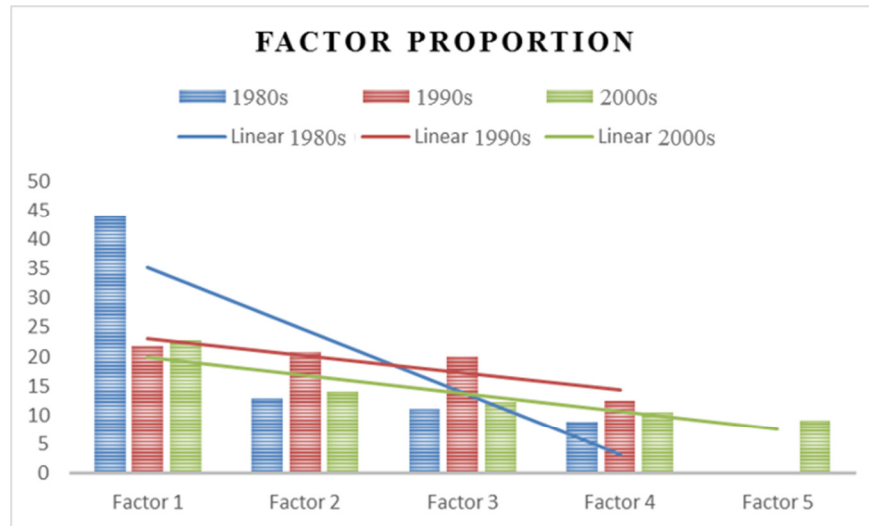


Figure 13. Factor Proportion

In summary, the changes seen such as the increase in selected factors' numbers, the decline in total explanatory power, and the absence of an absolutely dominant social factor, suggest that Tianjin's urban social landscape is becoming more difficult to represent and explain with limited variables in the decade-long intervals: it is becoming more complicated.

Table 3. Factor Matrix of the Factor Analysis, 1980s, 1990s, and 2000s, Tianjin

Year		1980s				1990s				2000s				
Aspect	Variable (%)	F1	F2	F3	F4	F1	F2	F3	F4	F1	F2	F3	F4	F5
Demographic Structure	Age group 15-64	0.184	0.256	0.777	-0.110	0.797	0.212	0.390	0.237	-0.127	0.010	0.779	0.229	0.243
	Age group 65 and over	0.047	0.125	-0.875	-0.027	-0.488	0.761	0.130	-0.086	0.775	0.371	-0.144	0.001	0.095
	Non-agricultural population	0.957	-0.005	0.087	0.050	0.392	0.706	0.510	-0.024	0.793	-0.262	-0.029	0.309	0.221
Family Structure	Family with One to Three Persons	0.857	0.042	0.035	0.095	0.642	0.546	0.407	-0.027	0.659	0.075	0.526	0.128	-0.162
Marital Status	Married rate	0.822	-0.243	0.036	-0.347	-0.035	0.002	-0.046	-0.926	0.322	0.761	-0.061	0.251	-0.115
	Single rate	-0.114	0.873	-0.081	-0.150	0.345	0.153	0.344	0.750	0.252	-0.308	0.670	-0.281	-0.082
Mobility	Temporary population	0.112	0.857	0.168	0.122	0.763	0.260	0.237	0.171	-0.083	-0.045	-0.010	-0.170	0.855
Education Level	Higher education level	0.918	0.038	0.064	0.022	0.257	0.608	0.685	0.153	0.603	-0.535	0.040	0.123	0.073
	Illiteracy rate	-0.787	-0.096	0.002	-0.121	-0.082	-0.278	-0.593	-0.350	0.007	0.807	-0.138	-0.148	-0.048
Occupation	Secondary industry workers	0.838	0.088	0.070	0.042	0.795	0.043	0.065	0.060	-0.573	-0.269	0.578	0.021	-0.207
	Tertiary industry workers	0.890	-0.064	-0.001	0.064	0.393	0.415	0.631	0.035	0.411	-0.201	0.036	0.610	0.091
	Unemployment rate	0.612	-0.044	0.044	-0.221	0.395	0.781	0.185	-0.006	0.611	0.124	0.037	0.158	-0.084
Ethnic Minority	Minority	0.046	-0.042	-0.059	0.957	0.257	0.591	-0.097	0.254	0.308	-0.124	0.092	0.295	0.556
Economic Status	Higher monthly rent					0.015	-0.152	0.617	0.368	0.094	0.092	0.038	0.780	-0.077
	Higher expenditure on houses					0.232	0.084	0.758	-0.047					
Cumulative (%)		44.009	56.819	67.812	76.795	21.843	42.669	62.628	75.081	22.794	36.922	49.247	59.702	68.809
Proportion (%)		44.009	12.810	10.993	8.983	21.843	20.826	19.959	12.453	22.794	14.127	12.325	10.455	9.107

4.5.1.2. Social Dimensions of Tianjin

In this section, the factors extracted from the three periods' PCA will be explained in detail to help identify the social dimensions explaining Tianjin's social space.

1980s Tianjin

- 1) In total, four main social dimensions (factors) are retained by PCA in the 1980s. The first factor was by far the most important one, explaining 44.006% of the total variance. It includes eight variables: non-agricultural population, population living in a 1-3 person family, married population, highly educated population, illiterate population, secondary and tertiary workers, and unemployed population. During this decade, the variables with the highest factor loadings are non-agricultural population (0.957) and highly-educated population (0.918). Since the factor loadings of all eight variables are positive except the illiteracy rate, this first factor represents the highly-educated urban population. Most of these people are employed in secondary and tertiary sector jobs. These populations live in one-to-three-person family, and consequently, the marriage rate is relatively high among these populations.
- 2) This factor accounted for 12.810% of the total variance and included two variables: temporary population (0.857) and single people (0.873). The factor loadings of both variables are positive, so thus this factor represents the highly mobile single population. The mobility of these populations as well as the neighbourhood dynamics is relatively high.
- 3) This factor accounted for 10.993% of the total variance and included two variables: the population aged 65+ (retired population) (-0.875) and the population of people aged 15-64

(labour force) (0.777). The factor loading of retired population is negative while labour force is positive, which may indicate that this factor represents the working age population.

4) This factor accounted for 8.983% of the total variance and included only one variable: minority population. The factor loading of the variable is positive (0.957), which indicates that this factor is representative of the minorities in Tianjin in the 1980s.

1990s Tianjin

1) Four factors are selected from 1990s PCA. The first factor was the most important one in shaping Tianjin's social landscape in the 1990s, explaining 21.843% of the total variance. It includes four variables: the 15-64 population (0.797), secondary industry workers (0.795), temporary population (0.763) and population living in a 1-3 person family (0.642). There are no significant differences between the factor loadings of the variables. Since the factor loadings of all these variables are positive, this factor represents the floating secondary sector labor force. Most of these populations' family structures follow the most common arrangement: a 1-3 person family.

2) This factor accounted for 20.826% of the total variance and included four variables: unemployment rate (0.781), 65+ aged population (0.761), non-agricultural population (0.706), and minorities (0.591). Again, all of the factor loadings for these variables are positive; therefore, this factor represents the retired population, some of which belong to ethnic minority groups.

3) This factor accounted for 19.959% of the total variance and included five variables: population living in the houses with higher expenditure (0.758), higher education level

population (0.617), tertiary workers (0.631), population living in higher rent houses (0.617) and illiteracy rate (-0.593). The factor loadings of all these variables are positive except illiteracy, which demonstrates that this factor represents a higher socio-economic status population. These populations are usually highly-educated and work tertiary industry jobs.

4) This factor accounted for 12.453% of the total variance and included two variables: married population (-0.926) and single population (0.750). The factor loadings of single population is positive while of the married population is negative. Evidently, this factor refers to the single population.

2000s Tianjin

1) For the 2000s, five factors work together to explain Tianjin's social space. The first factor is the most important one, explaining 22.794% of the total variance. It includes five variables: non-agricultural population (0.793), retired population (0.775), population living in a family with 1-3 persons (0.659), highly educated population (0.603), and the unemployment rate (0.611). Since the factor loadings of all these variables are positive, it is the highly-educated retired urban populations that are represented in this factor.

2) This factor accounted for 14.127% of the total variance and included two variables: married population (0.761) and illiteracy rate (0.807). The factor loadings of both variables are positive. This factor clearly represents the illiterate married population.

3) This factor accounted for 12.325% of the total variance and included three variables: people aged 15-64 (0.779), the single population (0.670) and secondary industry workers (0.578). Among the factor loadings of these variables, all are positive. This factor represents

the secondary sector labour force. In conjunction, the marriage rate of these populations is low.

4) This factor accounted for 10.455% of the total variance and included two variables: population living in higher rent houses (0.780) and tertiary sector workers (0.610). The factor loadings of both variables are positive. This factor represents populations working in the tertiary sector who prefer to rent higher quality houses with better living conditions. The economic status and mobility of these populations are high.

5) This factor accounted for 9.107% of the total variance and included two variables: temporary population (0.855) and ethnic minorities (0.556). The factor loadings of both variables are positive, and thus this factor represents highly mobile ethnic minorities.

4.5.1.3. Transformation of Social Dimensions in Tianjin

As discussed before, the social dimensions represented by the factors labeled under the same number are different in the three periods. Table 4 summarizes the change in social dimensions during the three decades. In spite of the great transformation, some social dimensions are similar in the 1980s, 1990s and 2000s. According to the table, the second-most significant factor during the 1980s, the highly mobile population, resurfaces during the 2000s, albeit at a lower level of significance (factor 5). Secondary industry workers, which are illustrated by the first factor in the 1990s, remain significant as factor 3 in the 2000s. Lastly, the elderly population is the second-most significant factor in the 1990s, and actually increases in importance in the 2000s. This social transformation has been caused

by the re-arrangement of the social variables, among which some significant ones have been selected to further examine in the following section.

Table 4. Factors in 1980s, 1990s, and 2000s, Tianjin

	1980s	1990s	2000s
Factor 1	Non-agricultural Population	Secondary Industry Workers	Elderly Aged Population
Factor 2	High Mobile Population	Elderly Aged Population	Married Population
Factor 3	Labor Force Population	Highly Socio-economic Status Population	Secondary Industry Workers
Factor 4	Ethnic Minorities	Single Population	Tertiary Industry Workers
Factor 5	N/A	N/A	High Mobile Population

4.5.1.4. Transformation of Social Dimensions in Tianjin

Secondary Industry Workers & Tertiary Industry Workers

Based on the 1980s PCA results, both secondary and tertiary industry workers are presented in the same factor, with factor loadings of 0.838 and 0.890 respectively (Table 3). In the 1990s, results showed that the factor loadings of both factors decreased (0.795 for secondary industry workers and 0.631 for tertiary industry workers). In the 2000s, the decreasing trends of both factors continued, declining to 0.578 for secondary industry workers and 0.610 for the tertiary industry. It is also evident that the decline in factor loading for secondary industry workers is sharper than that of tertiary industry workers. With regards to explaining Tianjin's social space in a chronological manner, both factors have declined in significance.

Temporary Population

In the 1980s (Table 3), the temporary population had the factor loading of 0.857 while in the 1990s result, its factor loading dropped to 0.763. From 2000-2010, the factor loading of the temporary population has risen again to 0.855, showing its increasing significance.

Elderly Population & Working Age Population

From the 1980s PCA results (Table 3), the factor loading of the elderly population is negative, at -0.875. At the same time, the working age population (15-64 population) held a positive factor loading of 0.777. In the next 20 years, the significance of the elderly population on Tianjin's social space increased dramatically. The factor loading of these populations increased from the beginning -0.875 to 0.761 in 1990s and continued to increase to 0.775 (Table 3). The elderly population became a determining factor in Tianjin's social space. For the working age population, from 1980s-1990s, its factor loading as well as its significance increased slightly to 0.797; while this number dropped to 0.779 in 2000s.

Besides the above discussed shifts, changes in social dimensions and variables have also affected spatial patterns for each respective decade: this will be the focus of the next section.

4.5.2. PCA Spatial Results

This section will examine the spatial distribution of the factors in Tianjin in order to analyze the city's social space. It first maps the extracted factors' scores from PCA to reveal the geographic transformation patterns of Tianjin's social landscape in each period. A

comparison of spatial patterns of different periods with similar factors also has been made to illustrate Tianjin's socio-spatial transformation. Then, in order to provide a clearer comparison of similar patterns, a multiple regression method has been applied using the factor scores obtained from PCA to simplify the map into comparable ideal models.³⁶ In the following step, the cluster analysis approach has been adapted to help integrate the main social dimensions discussed in the previous sections into one map to show, and then compare, the distribution of social areas in Tianjin in each period.³⁷

4.5.2.1. Social Space Pattern in 1980s

1) According to the PCA results from the 1980s, four factors were selected. The most dominant factor in the 1980s is the non-agricultural population, most of which is distributed in the Urban Core and the surrounding Inner Suburb (Figure 14 A). A neighbourhood in Xiqing District adjacent to the southwest end of the Urban Core has a high factor score as well. The population is also concentrated in northeast Dagang, northwest Tanggu and center Hangu. There is a low population density for the people in the Outer Suburb and south and east Dagang District. Based on the results of multiple regression, they best categorize the city into a zonal model due to its high population concentration in the center, and a gradual decline in conjunction to distance away from the center.

2) Overall, the spatial distribution of the second factor, the highly mobile population, has a light social differentiation (Figure 14 B). The most distinct one can be observed in the Inner

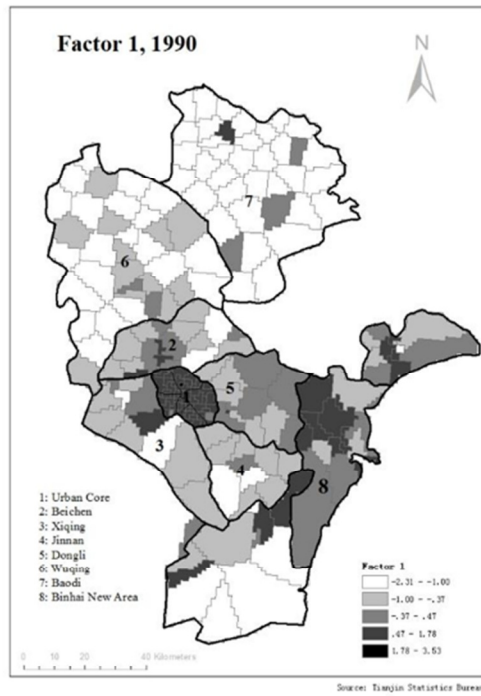
³⁶ Detailed multiple regression results can be found in Appendix 2.

³⁷ Detailed cluster analysis results can be found in Appendix 3.

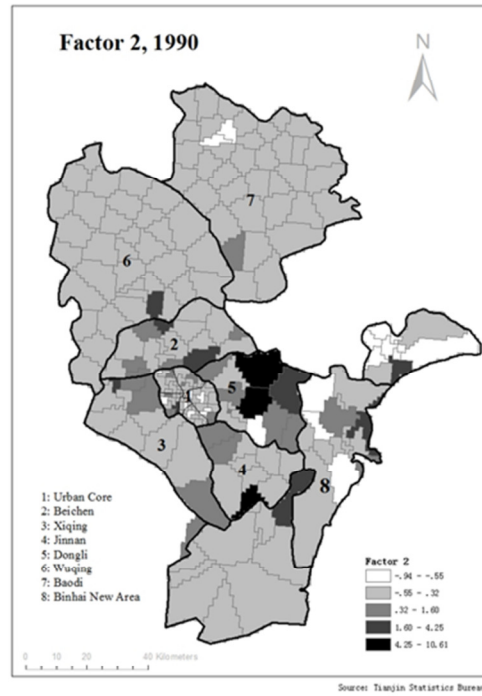
Suburb and the coastal area (TBNA): the population is most dense in north Dongli District and a neighbourhood in south Jinnan District. Generally speaking, the neighbourhoods with relatively higher factor scores are located in the Inner Suburb. The neighbourhoods with relatively lower factor scores are in TBNA and the Urban Core. It can still be categorized as a zonal circle, but the Inner Suburb has the highest population density.

3) The third-most dominant social dimension of Tianjin in the 1980s is the working age population. From its spatial pattern shown in Figure 14 C, it can be seen that the people are distributed in a balanced manner in Tianjin's overall social space. However, there are several neighbourhoods in Dongli District with the lowest factor scores (the center Dongli District has the highest factor score). The neighbourhoods with relatively high factor scores are mostly seen in southwest Tianjin, or more specifically, the TBNA. This can be best described as a multi-nuclei model due to its scattered density patterns.

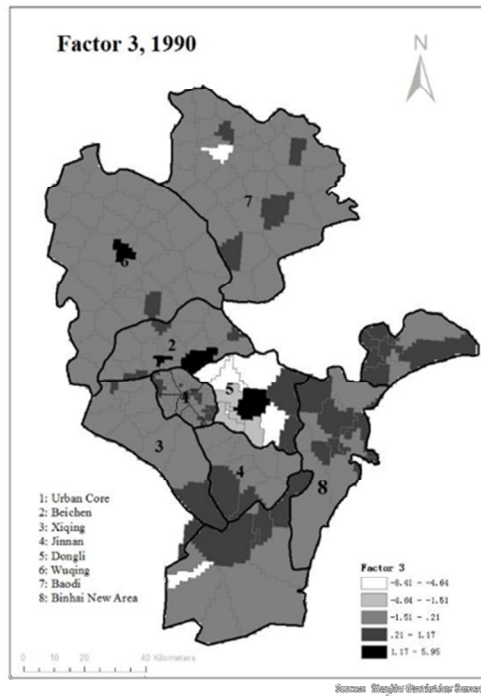
4) The last factor, which represents ethnic minorities, shows a scattered spatial distribution pattern (Figure 14 D), like a mosaic. Two areas have relatively high factor scores: the first one is from the center to north Urban Core, and also some neighbourhoods that extend into south Beichen District; the other one is along the boundary line between the TBNA and Jinnan District and Dongli District. This also falls under the multi-nuclei model because of its scattered nature.



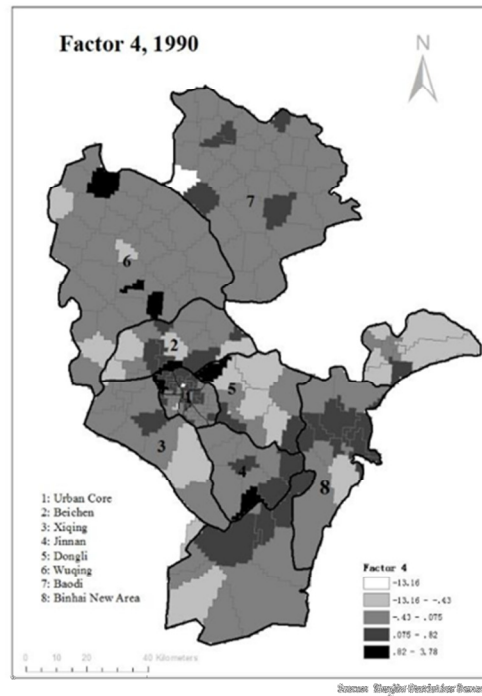
Factor 1: Non-agricultural Population A



Factor 2: High Mobile Population B



Factor 3: Labour Force Population C



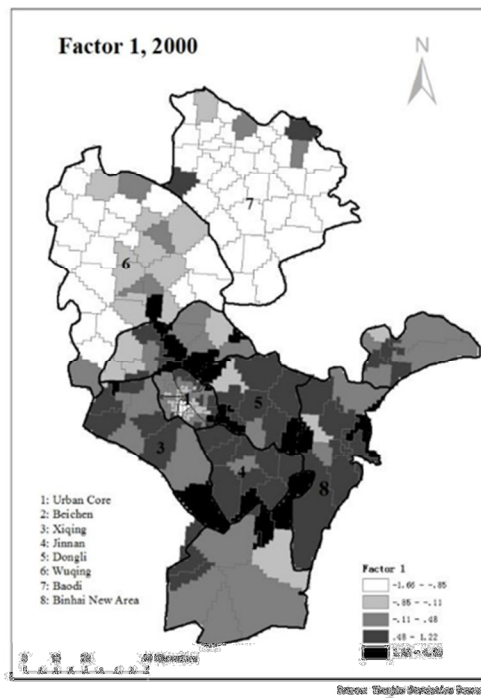
Factor 4: Ethnic Minorities D

Figure 14. Spatial Distribution of Factor Scores, 1980s

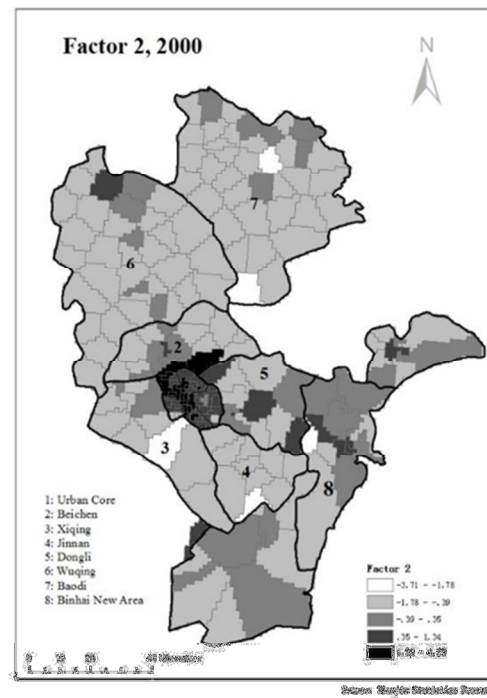
4.5.2.2 Social Space Pattern in the 1990s

- 1) In the 1990s analysis, four factors are extracted from PCA. The first factor of 1990s is migrant secondary industry workers. The first factor in the 1980s formed a concentric spatial pattern, while the 1990s' Urban Core displayed one that had a sparser population in the center, which means that the farther from the urban center, the higher the density was of these populations. It is obvious that the two Outer Suburbs have the lowest factor score. In contrast, the high density areas are in Dongli and Jinnan Districts and Tanggu District in TNBA (Figure 15 A). The high density population in southeast Tianjin reveals a sectoral model.
- 2) The second factor, elderly population, is found mainly in the Urban Core and in some neighbourhoods right above the north Inner Suburb (Beichen) (Figure 15 B). One neighbourhood in Xiqing District, which has the high factor score of migrant secondary industry workers, had the lowest factor scores for this factor. This falls under the zonal model.
- 3) The third factor of the 1990s illustrates socio-economic status. Neighbourhoods found in the Urban Core and part of the Xiqing District had higher factor scores for this factor (Figure 15 C). In Tianjin's general social space, the northern half had higher factor score neighbourhoods than the southern half. This also falls under the zonal mode, which is different from what was observed in developed capitalist countries.
- 4) The single population is the last factor extracted from 1990s PCA result. With a relatively high concentration in Baodi District, the overall spatial pattern of this factor is

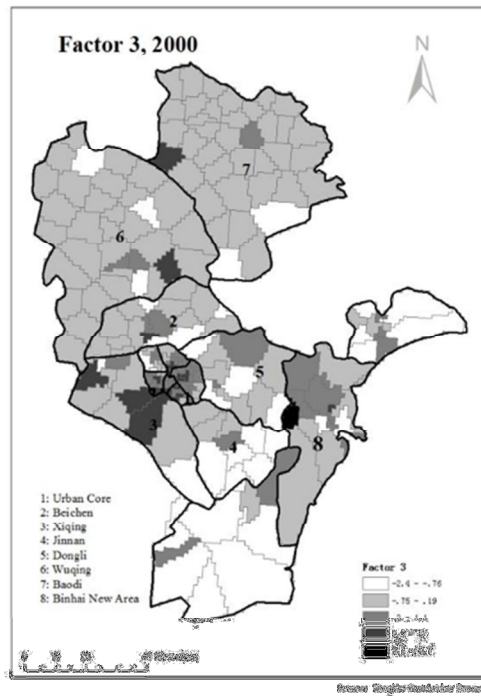
scattered (Figure 15 D). Neighbourhoods in south Dagang District, which belongs to the TBNA, had the lowest population density. Logically, this factor best resembles a multi-nuclei model.



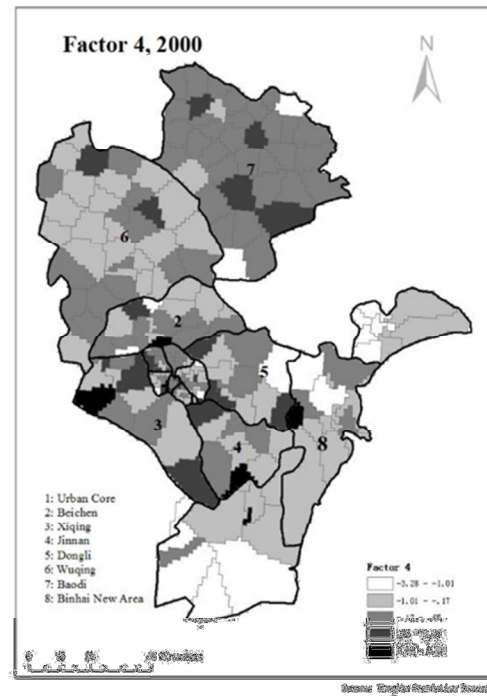
Factor 1: Secondary Industry Worker A



Factor 2: Elderly Aged Population B



Factor 3: Highly Socio-economic Status Population C



Factor 4: Singled Population D

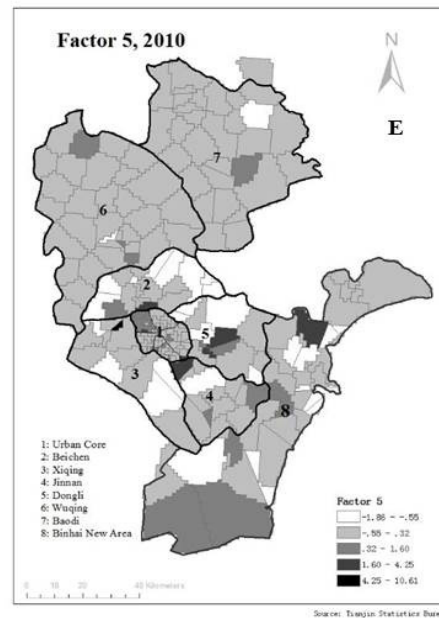
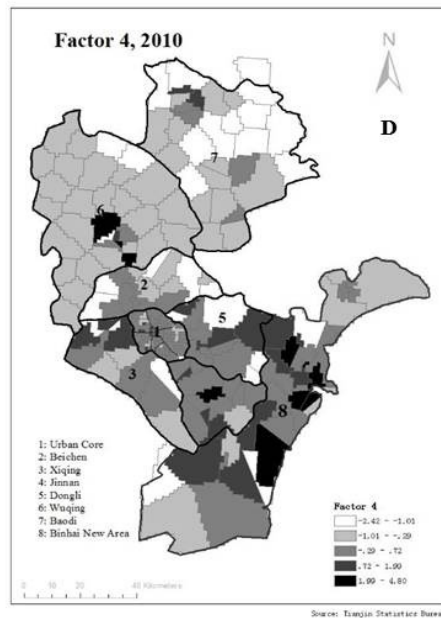
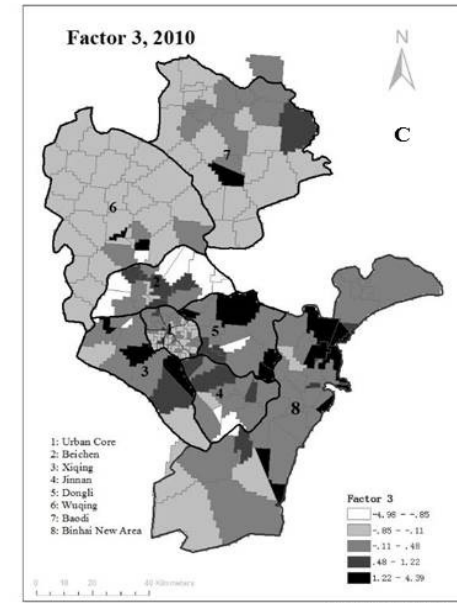
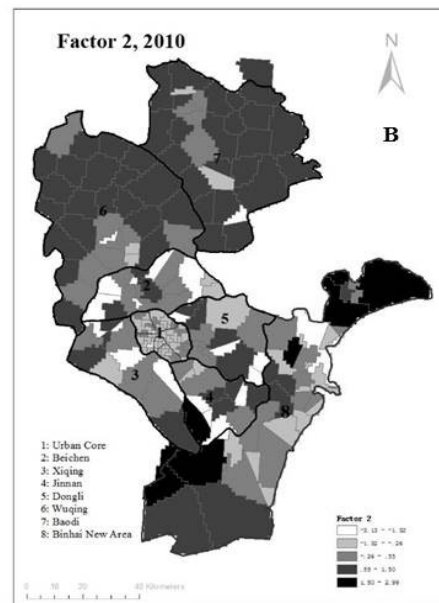
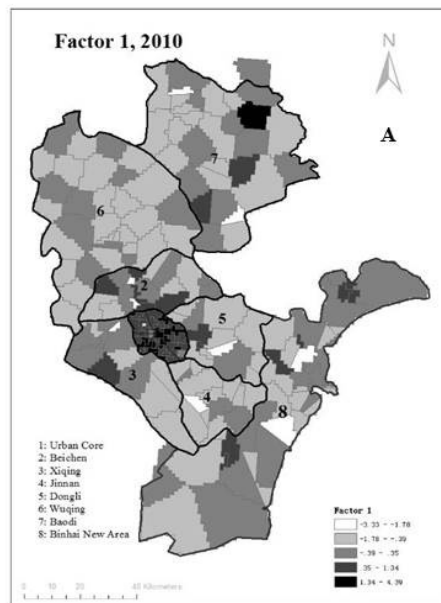
Figure 15. Spatial Distribution of Factor Scores, 1990s

4.5.2.3 Social Space Pattern in the 2000s

- 1) Five factors are selected from the 2000s PCA. The elderly population has become the first factor in the 2000s (it is the second factor in 1990s). The population lives mainly in the Urban Core, which is identical to the pattern evident in the prior decade (Figure 16 A). However, compared to the spatial pattern of the 1990s, the spatial distribution of these populations has become more dynamic: a more scattered pattern is seen in the Outer and Inner Suburbs. The neighbourhoods with the lowest factor score in the 1990s attracted a generally retired population during that decade. In terms of its ideal model, it is identical to its classification from the 1990s: it is a zonal model.
- 2) The married population is the second factor extracted from PCA in the 2000s. In the Urban Core, the population density of these populations is relatively low (Figure 16 B). The spatial pattern of this factor is quite scattered in the Inner Suburb. In the Outer Suburb, it has a high concentration of this population, as well as in the Dagang District and the north Hangu District. It is a zonal model, but with the population density more concentrated in the Inner Suburb.
- 3) The third factor in the 2000s is secondary industry workers. In general, there is a higher concentration of this population in the north than the southeast (Figure 16 C). More specifically, they are mostly located in the three Inner Suburbs, excluding northwest and northeast Beichen District. The population density is higher in the north Urban Core compared to the south. The TBNA also shows a high concentration. This can be described as a sectoral model, though it has extended to the northwest, compared to the prior decade.

4) The forth factor, which represents tertiary industry workers, shows a scattered spatial pattern (Figure 16 D). In the Urban Core, it has a relatively high factor score. In the TBNA, the neighbourhoods' factor scores are generally high, but there are still several neighbourhoods with low factor scores. Most of the low scoring neighbourhoods are in the Outer Suburb. Although the overall pattern is scattered, it is obvious that southeast Tianjin has a high concentration of tertiary industry workers. It is best categorized as a sectoral model, with the population most concentrated in the southeast.

5) The spatial pattern of the last factor, the highly mobile population, is generally balanced overall, though with a scattered Inner Suburb (Figure 16 E). It can be seen that the neighbourhoods with low factor scores are radial in the Inner Suburb. The distribution of this factor is more balanced in the Outer Suburb and the Urban Core than in the Inner Suburb and the TBNA. Compared to its distribution in the 1980s, there tends to be a greater concentration towards the northwest part of the Urban Core, or more specifically, the Hongqiao District. The population changes are the most obvious in the Inner Suburb. This is best described under the multi-nuclei model, though it is more predominantly populated in the southeast.



Factor 1: Elderly Aged Population

Factor 2: Married Population

Factor 3: Secondary Industry Worker

Factor 4: Tertiary Industry Worker

Factor 5: High Mobile Population

Figure 16. Spatial Distribution of Factor Scores, 2000s

4.5.2.4 Transformation of Social Space Patterns

From the above analysis, mapping the factor scores obtained from the PCA analysis have generally shown that the last three decades have seen the most transformation of Tianjin's social space in the Inner Suburb and the TBNA. The Outer Suburb is relatively stable and it has not seen significant change. The Urban Core, shows a more uniform transformation pattern compared to the dynamic and scattered changes seen in Inner Suburb and the TBNA.

In sum, Tianjin's social space has become much more dynamic and complex, and the following sections will provide a more in-depth analysis of these changes by explaining the progression of the ideal models extracted by the multiple regression.

4.5.2.5 The Evolution of Social Spatial Patterns

Expanding from the above analysis, the social spatial patterns will be compared to show the transformation of Tianjin's social landscape by using the ideal models. This will help to provide a more conceptual and systematic approach. It is difficult to compare several maps with detailed information. Thus, the ideal models will help simplify the maps to make comparisons more straightforward.

Figure 17 shows all the extracted models as well as how they related with each other among different periods through the rearrangement of the variables in the models. In this figure, the rows represent all the factor models for that particular decade; the columns represent the ideal models for the first factor, second factor, and so forth; and the arrows represent the movement of variables' positions in the rearrangement process. The black arrow represents the variable rearrangement process out of the first factor; the red arrow shows the process out of the second factor; the blue arrow is for the third factor's rearrangement; and the purple one is for the last factor's. This figure helps to identify the exchange of variables

as well as the relationships between factors among different periods. A pattern of decentralization is evident across all factors over the course of the three decades, which speaks to the increasing complexity of socio-spatial patterns in the urban landscape.

The first factor of the 1980s shows a significant decentralization during the 1980s-1990s. The variables included in the 1980s' first factor separate into the four factors during the 1990s. The two main variables represented by the 1980s' first factor (non-agricultural population and highly educated population) move to the second factor and the third factor in 1990s, respectively. The spatial models of the second and third factors in the 1990s show a similar zonal pattern to the first factor in the 1980s. Among the variables represented by the second factor in the 1980s, the temporary population moves to the first factor in the 1990s with its spatial model transferring from a zonal one to a sectoral one. The working age population, which is mainly represented by the third factor in the 1980s, shifts to the first factor in the 1990s, with its spatial model changing from a multi-nuclei one to a sectoral one. The ethnic minority variable, which was present in the last factor during the 1980s as a multi-nuclei model, moves to the second factor in the 1990s in a zonal model.

Such changings are also seen from the 1990s to the 2000s. The most significant variable represented by the first factor during the 1990s, secondary industry worker, moves to the third factor in the 2000s, and extends its geographic area of concentration within the city from the southeast to both the southeast and the northwest, though retaining the sectoral model present in the first factor from the 1990s. The temporary population separates from the first factor in the 1990s to form the fifth factor in the 2000s, showing a more scattered pattern. The elderly population increases in significance, from the second factor in the 1990s to the first one in the 2000s. Both the 1990s' second factor and the 2000s' first factor display the zonal model. The third factor in the 1990s shows the most dramatic change: the highly

educated population shifts to the first factor in 2000s remaining in the zonal model, and the illiterate variable is rearranged into the second factor, with the spatial model changing from a zonal one to a sectoral one. The higher monthly rent and the tertiary industry worker variables transfer to the fourth factor in the 2000s, showing a sectoral pattern. The single population in the fourth factor in the 1990s shifts to the third factor in the 2000s, changing from a multi-nuclei model to a sectoral one.

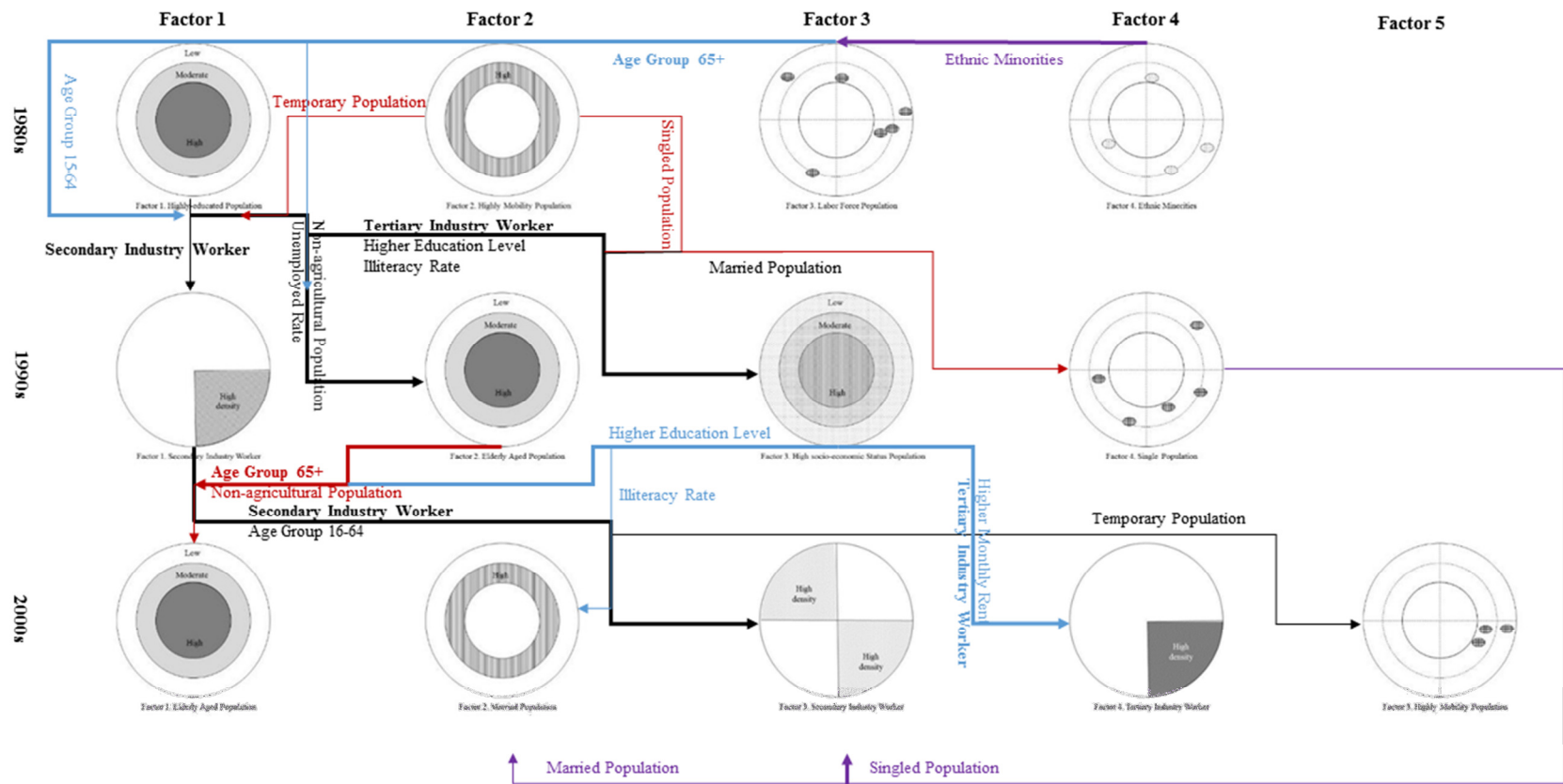


Figure 17. Transformation of Ideal Models, 1980s, 1990s, and 2000s

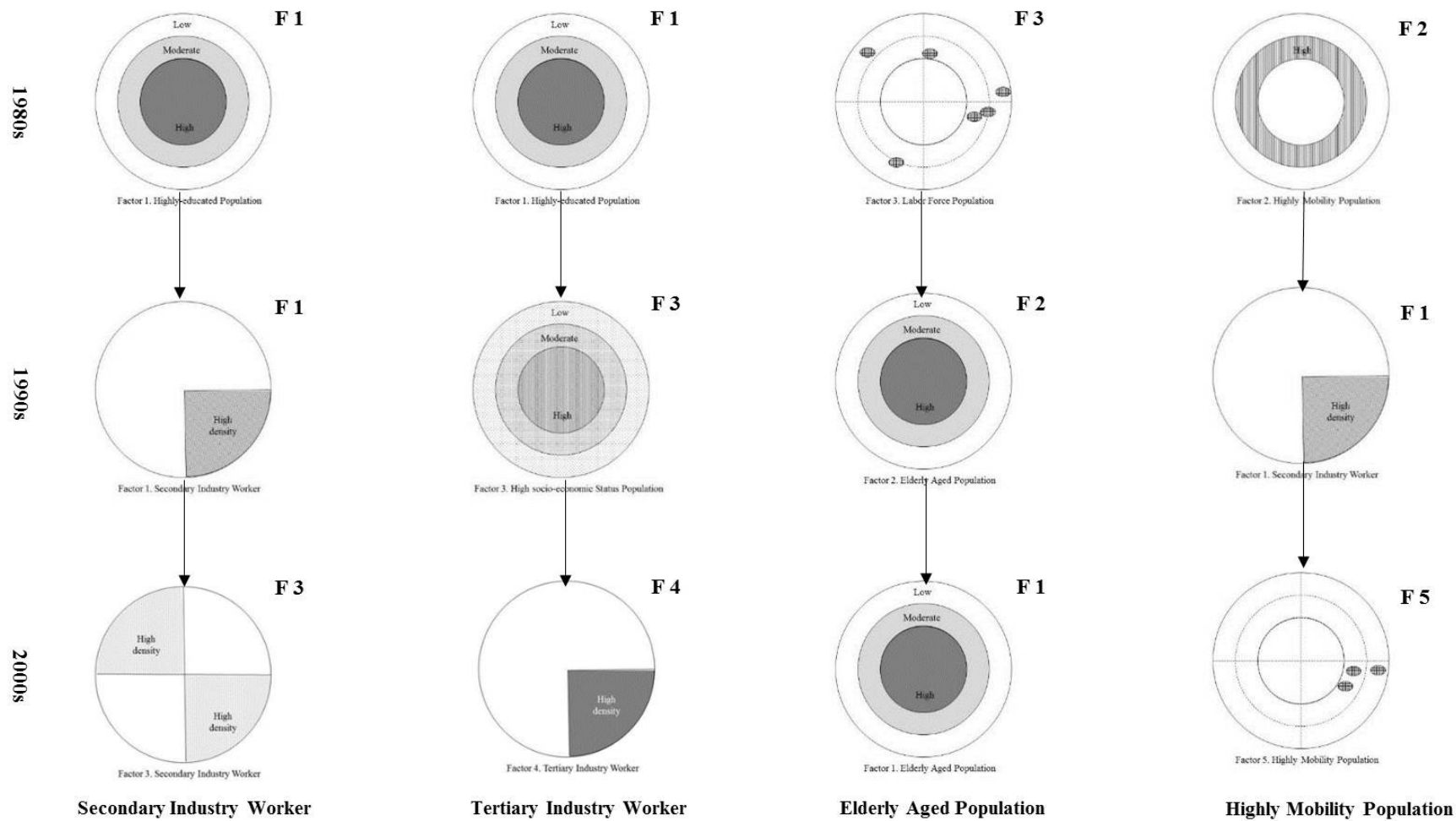


Figure 18. Spatial Evolution of Factors

Among all these transformations, four social dimensions have seen particularly significant change. Figure 18 shows the changes in spatial models from the 1980s to the 2000s for secondary industry workers, tertiary industry workers, the elderly and the highly mobile variables. The columns indicate the ideal models of each social dimension from the 1980s-2000s, while the rows represent these decades.

Changes to the Secondary industry workers factor

In the 1980s, the secondary industry worker factor was included alongside other variables as a zonal model, but in the 1990s, this became an independent factor above the rest. In addition, the social distribution patterns became more sectoral than zonal, with the population concentrated in the southeast portion of the city. In the 2000s, it is still an independent factor, and still a sectoral model, but the distribution has slowly extended toward the northwest.

Changes to the “Tertiary Industry Workers” factor

For the tertiary industry worker factor, there has been a process of transformation wherein during the 1980s and 1990s, the factors included with tertiary industry workers formed a zonal model in conjunction with other variables,³⁸ but into the 2000s, it became an independent factor and shifted to a sectoral model, with the population more concentrated in the southeast area, also known as the TNBA.

In sum, both the secondary industry workers and tertiary industry workers are defined by their occupational categories. Hence, it is highly conclusive that the spatial pattern of residents' occupations in Tianjin matches the sector pattern.

³⁸ One important note, however, is that the variables alongside the tertiary industry workers of the 1990s concentric model changed from the 1980s model.

Changes to the “Elderly Aged Population” factor

The elderly population displayed a multi-nuclei model with the highest concentration in the east side of the city during the 1980s. However, in the 1990s and 2000s, it became an independent factor and a zonal model with the highest population density in the Urban Core.

Changes to the “High Mobile population” factor

The highly mobile population formed a zonal model with the highest population density in the Inner Suburb during the 1980s. In the 1990s, it formed a sectoral model. Then, in the 2000s, the spatial pattern became scattered. The highly mobile population has seen many changes over the past two decades.

Although the previous discussions have provided a description of the spatial distribution patterns’ evolution, they have been shown on separate maps. The following section will explore these spatial distribution patterns on a single map using the cluster analysis.

4.5.3. Cluster Analysis of Social Areas in Tianjin

By adopting the cluster analysis, based on the factor score, the neighbourhoods that share the same main social dimensions have been clustered in the same category. The categories were then plotted onto a geographic map, producing a visualization of the distribution of social areas for each period topologically. In order to see the different social areas’ distributions, this section will conclude with a comparison of the three periods.

4.5.3.1. Social Areas of 1980s Tianjin

Four categories of social areas were extracted from cluster analysis of Tianjin during the 1980s. They are the highly educated urban population, the Han population, agricultural population with low education levels, and the elderly. The highly educated urban

population is mainly distributed in three areas: the Urban Core, center to east Beichen and a southeast extension into Tanggu District, and an area between the TBNA and Jinnan District (Figure 19 A). The Han population is mainly distributed in the Urban Core. Agricultural population with low education levels are concentrated in the Inner and Outer Suburb and the TBNA, which has the furthest reach compared to other categories that are concentrated in smaller areas. The elderly are primarily located in the suburbs of Dongli District.

4.5.3.2. Social Areas of 1990s Tianjin

During the 1990s, the main social area categories from the cluster analysis are the elderly, low socioeconomic status population, the single population, and the agricultural population. The elderly can be mostly found in the Urban Core and several neighbourhoods in the TBNA (Figure 19 B). The low socioeconomic status population makes up the majority of the population in the Inner Suburb and the TBNA. Much of the single population chooses to live in the Inner Suburb, in close proximity to the Urban Core. The agricultural population is generally found in the Outer Suburbs.

4.5.3.3. Social Areas of 2000s Tianjin

In the 2000s, the main social area categories are the elderly, secondary industry workers, the married population, the highly mobile population, and primary and tertiary industry workers. The overall social distribution pattern is very scattered (Figure 19 C). The elderly can be found mostly in the Urban Core, the peripheral area surrounding it, and the TBNA. Secondary industry workers are mostly seen in the Suburbs and the TBNA. The married population is concentrated in the Outer Suburbs and the areas between the southeast Inner Suburb and the TBNA. Two areas of the Urban Core have seen a high population density of the highly mobile population. Primary and tertiary industry workers are mostly seen in the northern part of the Beichen District.

4.5.3.4. Comparison of Social Areas

In the 1980s, a single category encompasses the Inner and Outer Suburbs: the agricultural population. However, from the 1990s onward, each Suburb has a distinct category: the Outer Suburb almost exclusively consists of the agricultural population, while Inner Suburb hosts a more urbanized population. In the 2000s, the distribution of social areas becomes dynamic, with an exception for the Urban Core, as it remains uniform during this time period. In the 1980s the Urban Core was mostly occupied by a well-educated urban population, while the elderly resided in the Inner Suburb. In the 1990s, the elderly concentrated in the Urban Core. By the 2000s, the elderly saturated the Urban Core, trends can be seen with regards to movement to the Inner Suburb and the periphery as well. Furthermore, in both the 1980s and 1990s, the social areas occupied in the southeast Inner Suburb and the TBNA in each period are the same. However, in the 2000s, there has become a distinctive difference between the two, revealing rapid development of the TBNA.

Generally during these three decades, the Urban Core has been comprised of the following social groups: the urban population, the elderly, and the highly educated. The agricultural population, who dominated the Inner Suburb in the 1980s, have been replaced by a population with a low socioeconomic status. The elderly population also dispersed from the Urban Core to the peripheries and the suburbs. In the 2000s, the social areas were very dynamic compared to the previous two periods, but still predominantly populated by secondary industry workers. The TBNA used to be a rural area with an agricultural population in the 1980s, but it has evolved into a more secondary industry sector over the years.

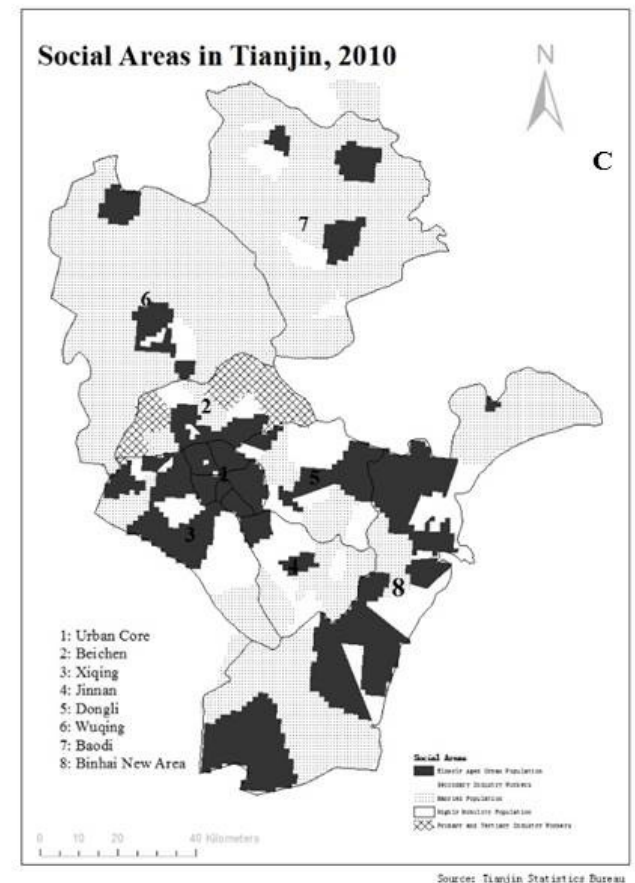
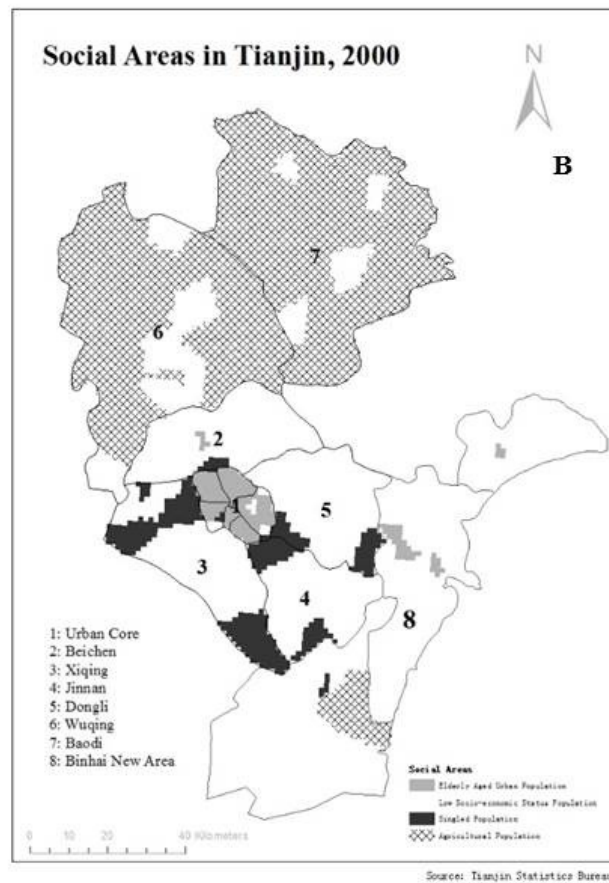
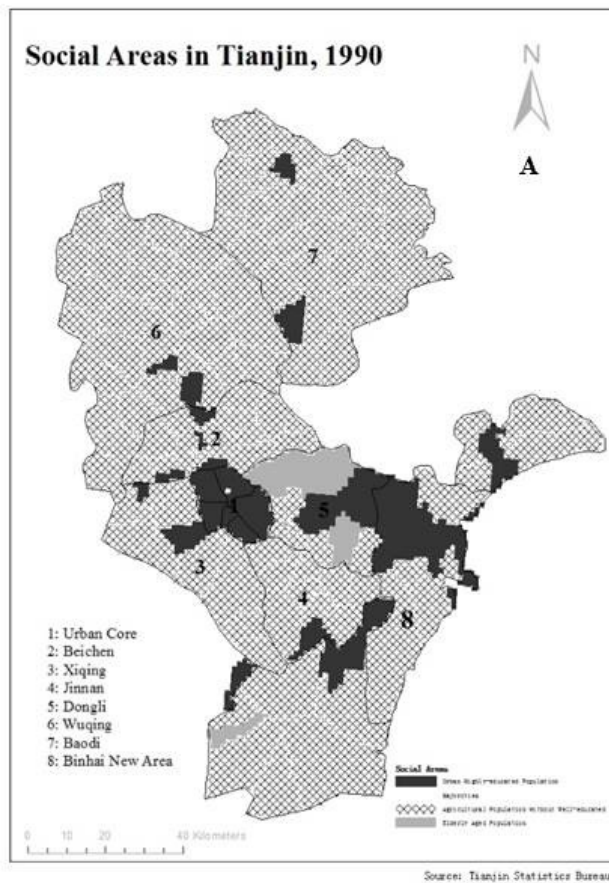


Figure 19. Social Areas in Tianjin, 1980s, 1990s, and 2000s

4.6. THE REMODELING OF TIANJIN'S URBAN SOCIAL LANDSCAPE

The economic reforms of 1978 resulted in a massive transformation of the social landscape of China's cities. This phenomenon is especially evident after the country shifted from a centrally-planned to a market-oriented economy. Tianjin, one of the four provincial-level municipalities in China, has also been influenced by this economic transition. In the 1980s every aspect of the city as well as its social space were planned by the central government. Therefore, the social factors, which are intensively controlled by central government, are distinctive in shaping the social structure of Tianjin. During the planned economy period, occupation (divided between the primary, secondary and tertiary sectors) was the primary determinant of housing allocations by the government. As such, during this period, the government exercised extensive control over the allocation of urban space, in contrast to patterns of social stratification common in capitalist countries (Wu 2002). Due to the "nonmarket allocation of housing" system,³⁹ social segregation was primarily shaped by residents' occupation as a "cellular structure".⁴⁰ After the economic system transition, the relative significance of factors such as occupation in determining Tianjin's social space declined, due to an increase in individual choices respecting housing. The commodification of real estate, caused by Housing Reform, contributed to these changes.⁴¹ Social dimensions influenced by market mechanisms, such as socioeconomic status, became more prominent in determining the social space. Migration has always been important in determining Chinese cities' social space (Gu et al. 2003, Wu et al. 2005, Xu et

³⁹ Most of the urban residents were housed in publicly owned shelters and were allocated by their work-units (the industries or private sectors they are working for) under the centrally-planned economy (Wu 2002). Due to the government centralization, the locations of their work-units were decided by the central government.

⁴⁰ Through work-unit based housing provision, workplace and residence were linked to form self-contained workplace compounds. Residents belongs to the same work-unit were living together.

⁴¹ The replacement process from unit allocated houses to commercial houses caused the increasing internal and external population flow, which led the social structure transformation in the city.

al. 2009, Xuan et al. 2006, Zhang et al. 2012); and Tianjin is no exception: under the market-oriented economy, migration played a central role in changing the social space with the influx of both agricultural workers and high-level technicians, which increased the working age population in the social space. The policy change of Hukou contributed to such changes greatly.⁴² Influenced by policy changes in response to economic transition, Tianjin's social space formation has varied, resulting in a unique urban development pattern.

4.6.1. A Distinctive “Dual-core” City

In transferring from a centrally-planned to a market-oriented economy, a “dual-core” urban structure has gradually emerged in Tianjin's urban growth. The first of these is the Urban Core, which has historically had a dense population;⁴³ while the coastal area, which is known as the TBNA, is also experiencing high population growth and is gradually forming the second core of Tianjin.

From the spatial analysis, the Urban Core is always the area with the greatest population concentration while the TBNA possesses the most dynamic urban growth. There is also a significant pattern that the centroid of Tianjin's social space has been moving southeast toward the coastal areas. The TBNA is showing its “pulling” role in driving Tianjin's urban development southeast toward the coast. Thus, the TBNA is becoming a new growth pole in Tianjin.

To demonstrate such findings in further detail, population changes in both the Urban Core and the TBNA have been measured according to Yearbook data from 1980-2010 in Tianjin every five years (Table 5). The population in Urban Core has increased from

⁴² Household Registration System (Hukou, 户口) is a tool of public control that limits the population's geographic mobility (Chen et al. 2011). Relaxation of this system has happened since the 1990s. A provision was made to allow the rural resident to buy "temporary urban residency permits" so the resident could work legally within the cities.

⁴³ By 2010, the average population density in Tianjin is 837 person/km²; while in Urban Core, it is 22,333 person/km².

302,650,000 to 434,580,000 in the last 30 years. By 2010, constituting less than 2% of the total area of the city, the Urban Core contained more than 30% of the total population. During the same period, the population in the TBNA increased from 73,700,000 in 1980 to 248,250,000 in 2010. Its proportion in Tianjin's total population has increased from less than 10% in 1980 to approximately 20% in 2010, showing an average annual growth of 6% (the one in Urban Core is 1.45%). These two areas have evolved as two separate population concentration zones.

Table 5. Population in Urban Core, TBNA, 1980-2010 (in tens of thousands)

Year	Urban Core	Annual Growth (%)	TBNA	Annual Growth (%)
1980	302.65		73.7	
1985	333.98	2.07	81.59	2.14
1990	360.2	1.57	88.47	1.69
1995	368.71	0.47	92.77	0.97
2000	374.18	0.30	96.4	0.78
2005	384.57	0.56	101.22	1.00
2010	434.58	2.60	248.25	29.05

After more than 20 years of development, the Urban Core is now playing a role as the financial, business, cultural and political center in the city. As show in Figure 20, in 2010, the tertiary industry workers composed more than 50% of the employed population in Urban Core, which accounted for 48% of the total tertiary sector workers in Tianjin.

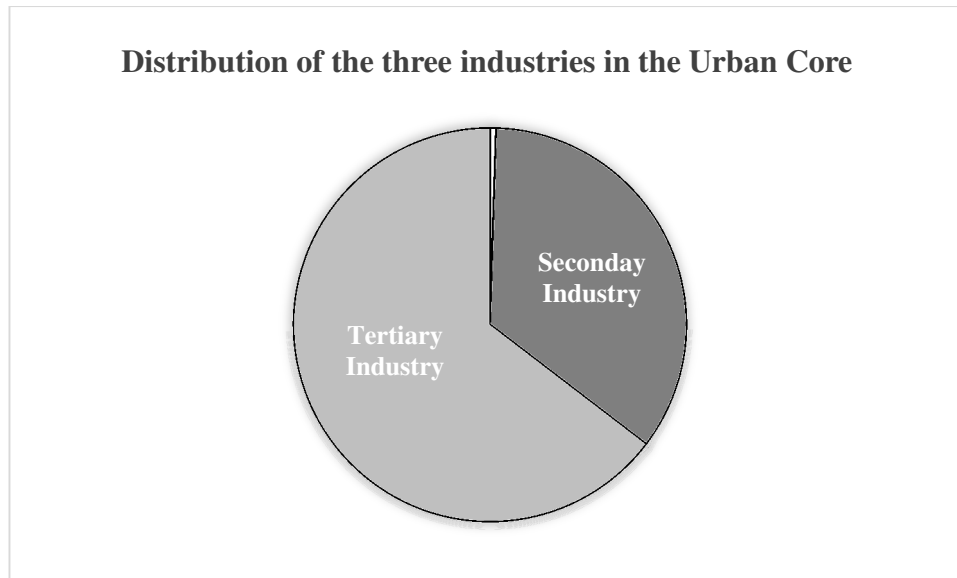


Figure 20. Distribution of the Three Industries in the Urban Core, 2010, Tianjin

This orientation of development in the Urban Core has contributed in the TBNA's growth as a port logistics and industrial center. The initial development of the "Tianjin Economic-Technological Development Area" (TEDA) led to the establishment of the TBNA in 1984. In a prime location along the coast and rich in natural resources,⁴⁴ the TBNA has been promoted as the industrial base of the city. It is important to highlight that aside from traditional secondary industries such as manufacturing, petroleum, petrochemical, and marine chemistry, the TBNA also contains a cluster of high-tech industries (telecommunications, aerospace, aviation, bio-tech and software) as well as tertiary enterprises (logistics, finance, trade, information service and tourism companies). The increased concentration of secondary and tertiary industry workers in the southeast is evidence of these developments in the TBNA. Since 1997, the TBNA was named by the Ministry of Commerce PRC "the most admired industrial park" and "the most attractive

⁴⁴ The TBNA has 700 km² of water and wetlands and a further 1,200 km² of wasteland that is being re-developed into Saline land. It has proven oil resources totalling more than 100 million tons, and 193.7 billion cubic meters (6.84 trillion cubic feet) of natural gas.

investment area” in China, and even Asia as a whole. As of 2010, the GDP of the secondary and tertiary industry reached 99.8% of the total GDP of the TBNA.

The growth of the TBNA increased significantly after 2001, when China officially became a member of the World Trade Organization (WTO). As shown in Figure 21, the proportion of the TBNA’s contribution to the city’s GDP increased from 35.7% to 58.16% from 2001 to 2013. More than half of the GDP growth in Tianjin originates in the TBNA. Furthermore, the TBNA has also attracted massive Foreign Direct Investment (FDI). From 2001-2010, the rate of FDI increased by 46% in the TBNA (Figure 22). Through more than 20 years of development, the TBNA has attracted 4,000 foreign investors from 74 countries and areas. Thus far, 126 companies from the Fortune Global 500 have invested in the area. Flourishing economic development in the TBNA is the catalyst for more dynamic demographic change in Tianjin. The influx of migration to the TBNA is bringing the younger population to the area. According to spatial patterns extracted from the PCA, the 65+ population is mainly located in the Urban Core while the highly mobile population and working age population (15-64) are attracted to the coastal areas. Compared to 2000, the proportion of 65+ population has decreased by 1.53% while the working age population has increased by 10.10% in the TBNA.⁴⁵ The TBNA is leading Tianjin, both in terms of economic growth and in optimizing the city’s demographic structure, by mitigating against an aging society.

⁴⁵ The proportion of 65+ population in Urban Core has increased from 12.26% in 2000 to 15.67% in 2010.

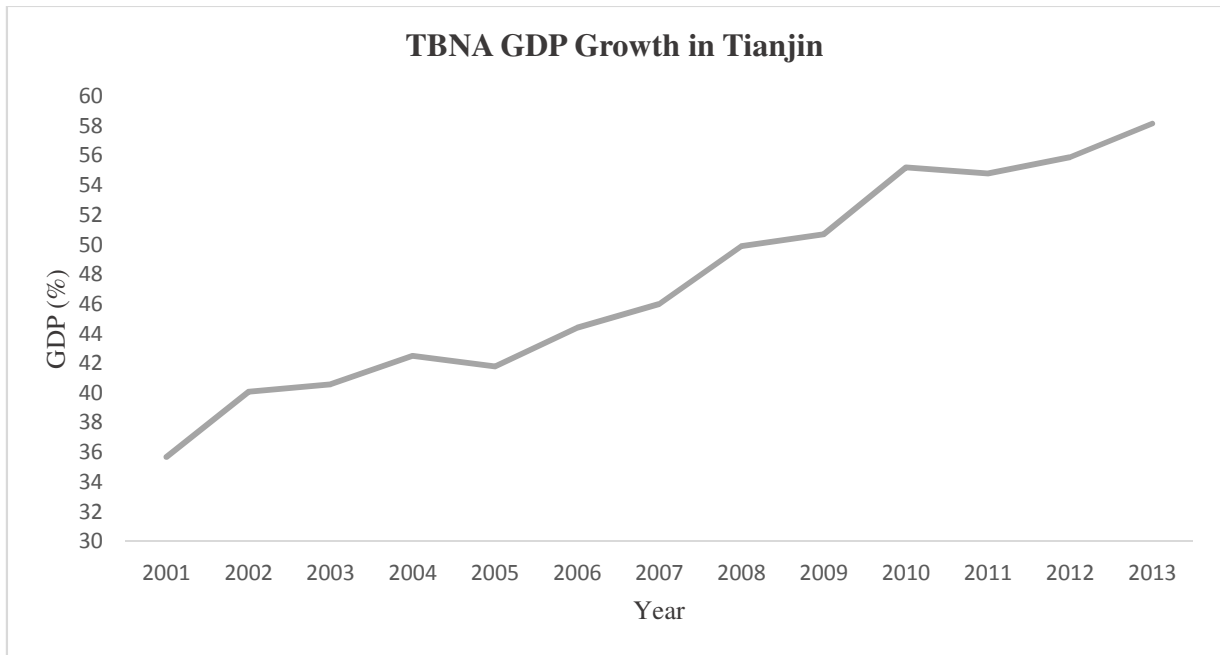


Figure 21. GDP Growth of TBNA as a % of Tianjin

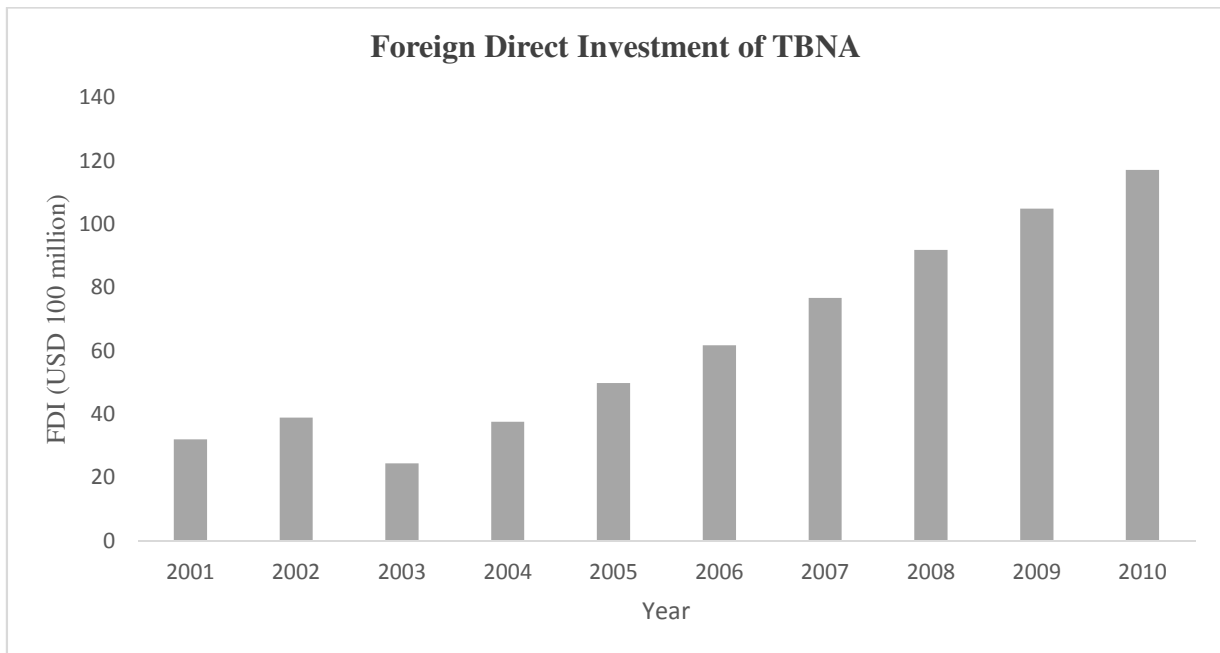


Figure 22. Foreign Direct Investment of TBNA

The policy adjustments coinciding with economic transition in China were essential to the development of Tianjin’s “dual-core” formation as well as the accompanying series of internal structure transformations (Yeh and Wu 1995). Before 1992, due to the strict

population registration system, it was extremely difficult for residents of other provinces (and particularly rural residents) to settle in the city (Han 2012). In 1992, the “Hukou Release” policy allowed both internal and external migration for employment and improved living conditions. As a result, migration to the TBNA increased significantly. As reported by the 6th National Census, the temporary population in the TBNA in 2010 was 124,450,000, which exceeded its registered population (119,780,000). The migration attracted by the TBNA makes up over 40% of the total migration to the city. Undoubtedly, it is one of the substantial mechanisms for the formation of the “dual-core” urban pattern as well as the rise of the TBNA.

The TBNA has emerged as a new urban growth pole in southeast Tianjin by using its new industries to attract highly mobile workers. Along with the traditional Urban Core in central Tianjin, a distinctive dual-core structure is evident. Other areas of Tianjin have also experienced urban transformation, which is evident in its recent suburbanization process.

4.6.2. Urban Sprawl: Asymmetrical Suburbanization

As illustrated in the pattern of Tianjin’s socio-spatial change, the four Inner Suburbs⁴⁶ have also experienced an increase in social dynamism similar to that of the TBNA. The Urban Core’s population growth has declined significantly since the 1990s, although its absolute population remains high (Figure 23). The Inner Suburb’s population growth, alternatively, has increased dramatically since 2000. Thus, suburbanization is increasingly driving Tianjin’s urban development in the last decade (2000-2010).

⁴⁶ The four Inner Suburbs refer to the four districts surrounding the Urban Core, which consist of Dongli District, Jinnan District, Xiqing District, and Beichen District.

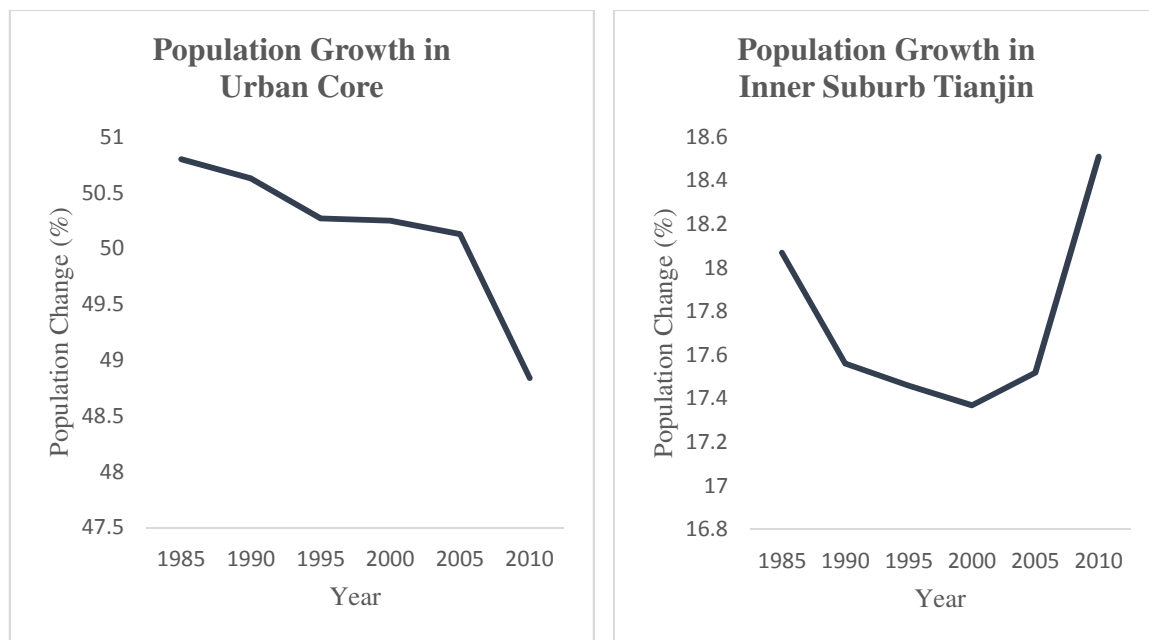


Figure 23. Change in Population Growth in Urban Core vs. Inner Suburb, 1985-2010, Tianjin

The mechanisms involved in the suburbanization process in Tianjin differ from those in Western cities. The dominant one is the establishment of the compensated land use system.⁴⁷ Before the economic reforms of 1978, and as a result of uncompensated land use, there were more incentives for moving to the Urban Core in terms of proximity to better location (Wu 2002), which introduced an influx of population growth in the area. After the introduction of the compensated land use system in the late 1990s, a massive transfer of secondary industries from the Urban Core to the Inner Suburb was evident. Moving with their work units, secondary industry workers became more suburbanized (Liu et al. 2014). Furthermore, the implementation of Housing Reform of the 1990s and real estate development led by the economic transition contributed to these internal structure changes, and made it is possible for people to choose their locations of residence with fewer

⁴⁷ Compensated land use system: the central government provides land use rights to the land user (private sectors or personal use) for a certain period, and the land users pay a land use fee every year or several years to the central government in accordance with the land use provisions. The uncompensated land use is in contrast to compensated land use system.

government restraints (Han 2012, Liu et al.2013). During the first decade after the implementation of the compensated land use and Housing Reform, the suburbanization process was not as significant in Tianjin as it was in other Chinese cities such as Beijing. This may due to the delayed development of the urban transportation system in Tianjin's suburbs. Since the development of the transportation system in the Inner Suburbs in 2001, Tianjin's suburbanization process has become more pronounced (Figure 24). Suburbanization in Tianjin is also related to the construction of large-scale residential areas in the periphery of the suburbs. Responding to the 1996 Master Plan of Tianjin, several residential areas were built in between the Inner Suburb and the Urban Core to decrease population pressure on the Urban Core, which attracted further migration.

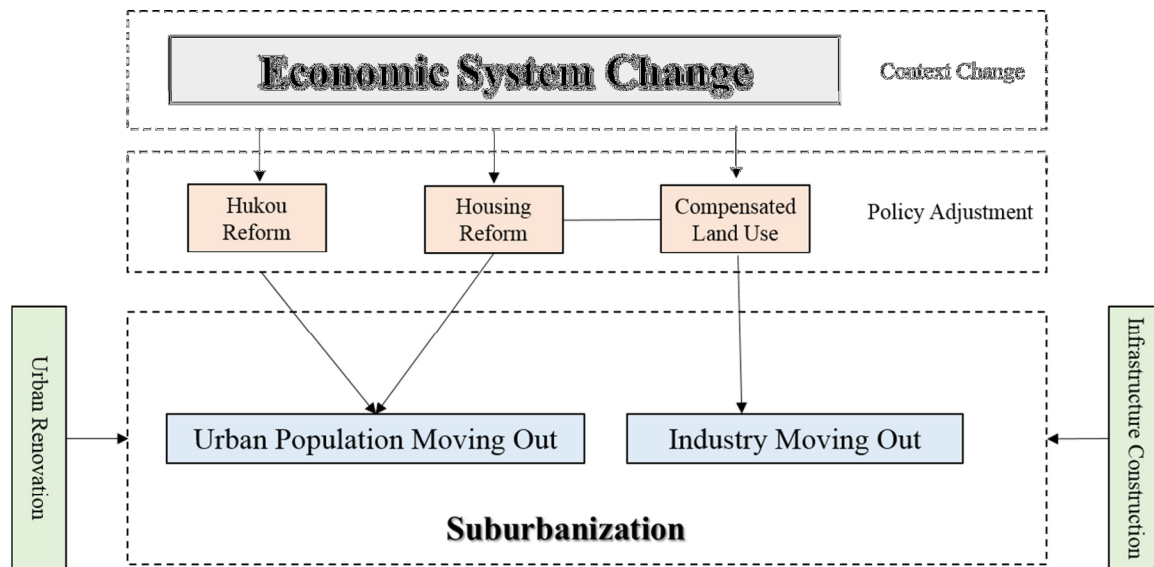


Figure 24. Mechanisms for Tianjin's Suburbanization

However, compared to other cities in China, which experienced more balanced suburban growth, suburban growth in Tianjin is more like asymmetric. The pattern of spatial transformation shows that the most complex change can be seen in the two southeast districts in the Inner Suburbs: Jinnan District and Dongli District. These two districts are oriented toward the TBNA, which have shown much larger population density growth than Xiqing

and Beichen (Figure 25).⁴⁸ This observation is consistent with the transformation pattern of Tianjin's socio-spatial landscape toward the southeast. As discussed in the last section, the TBNA has emerged as the new “Urban Core” in southeast Tianjin. Not only has it been influenced by the urban sprawl of the Urban Core, as have the Xiqing and Beichen Districts, the urban expansion of the TBNA has also played an important role in stimulating the development of the Dongli and Jinnan Districts. Both the increased population and the imbalanced economic growth reflect this influence. In 2010, the GDP growth in Dongli and Jinnan were 13.7% and 17.2% respectively, while those of Xiqing and Beichen Districts were 11.4% and 8.9% respectively. Contrary to other Chinese cities with more balanced suburbanization (Han 2012), the direction of Tianjin's suburbanization is “asymmetrical,” with an emphasis in the southeast.

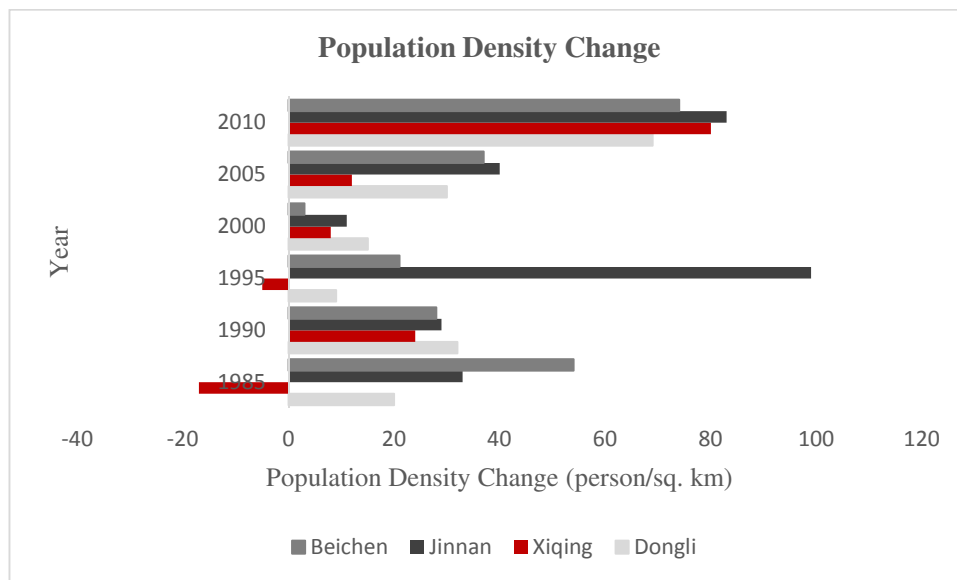


Figure 25. Population Density Change in Inner Suburb, 1985-2010, Tianjin

4.6.3. From under the “Shadows” of Beijing into the limelight

Tianjin, despite being one of China's four provincial level cities, has always had an urban growth rate that has been overshadowed by that of the PRC's capital city, Beijing. Due

⁴⁸ These two districts are located in the southwest and north Urban Core, respectively.

to the central government's investment focus in Beijing among other factors, the speed of Tianjin's urban growth before the first decade of the 21st century was slower than the national average (Wei and Jia 2003). According to Figure 26, from 1990 to 2000, population growth in Tianjin was more gradual than in Beijing, which demonstrates a slower development pattern. The GDP growth of Tianjin is also lagging behind Beijing as shown in Figure 27 (with the exception of 1996). Referring to Han's study on Beijing's social development (2012), between 1990 and 2000, Beijing's urban growth was largely dependent on migration; however, in the same period, the influence of migration on urban growth declined in Tianjin according to the PCA results. As a result, Tianjin is falling behind in competitiveness with regards to human resources compared to Beijing. Furthermore, as discussed previously, it is argued by Han (2012) that a massive suburbanization process has been observed from 1990 to 2000 in Beijing, whereas in Tianjin, such a process is lagging 10 years behind. Generally speaking, in the first two stages of this study, Beijing had a "shadow casting" effect on Tianjin's development.

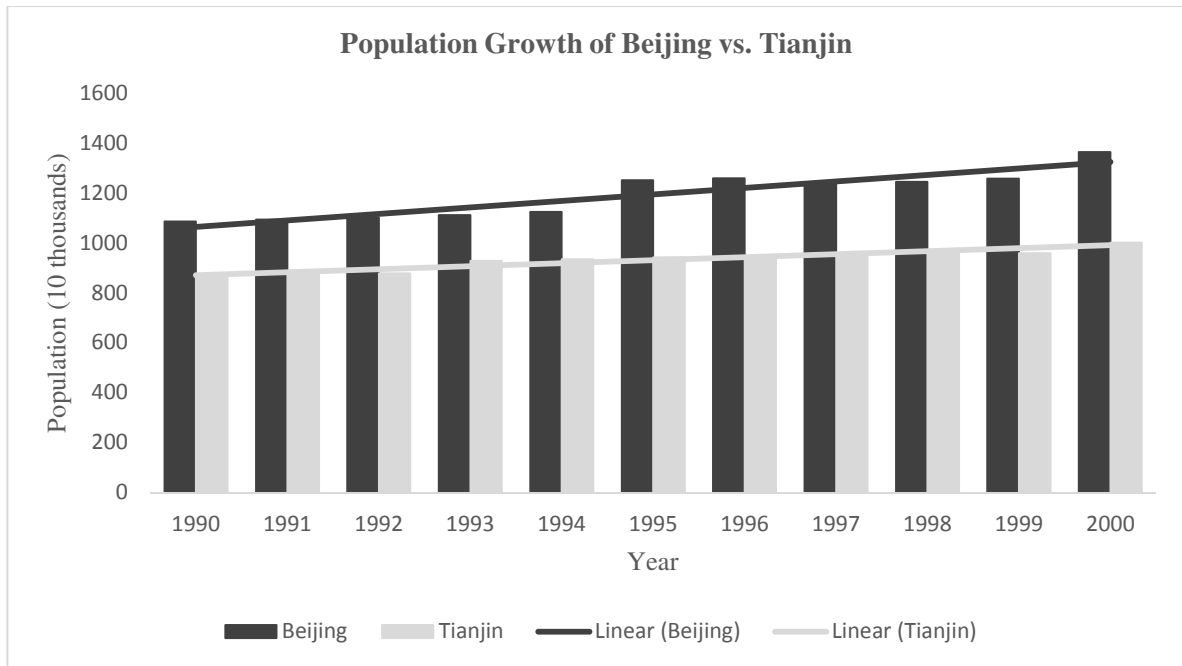


Figure 26. Population Growth of Beijing vs. Tianjin, 1990-2000

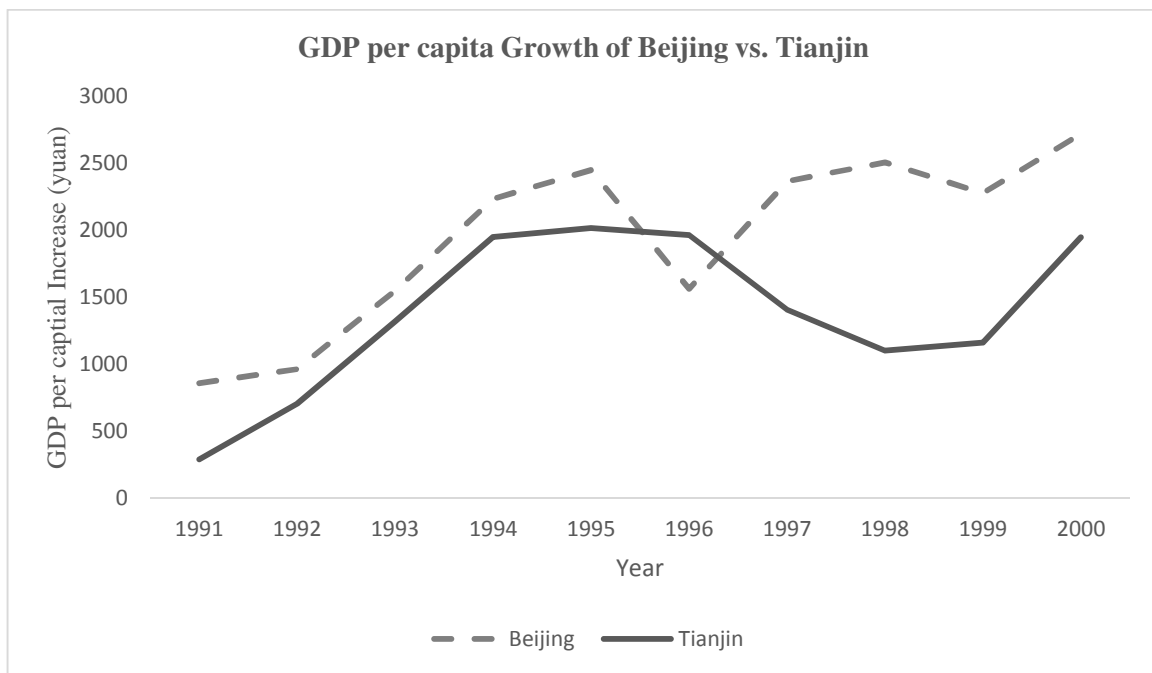


Figure 27. GDP Growth of Beijing vs. Tianjin, 1991-2000 (per capita)

Though the focus of Beijing's development moved from an industrial center to a political and cultural one as early as 1986, it still possessed substantive industries for its developmental needs prior to 2001 (Chan and Yao 1999); and because of its status as the

nation's capital, Beijing benefited heavily from central government investment, while Tianjin was comparatively neglected. However, in 2004 with the signing of the "Langfang Concensus (*Langfang Gongshi*)"⁴⁹ collectively made by Beijing, Tianjin, and Hebei province, these three areas began to integrate their development. By inheriting some of the industries from the capital, Tianjin has begun to gradually emerge from the "shadows" of Beijing. In contrast to Tianjin's decreasing GDP growth from 1990-2000 (Figure 28), GDP growth increased between 2001 and 2008 (Figure 29).⁵⁰ The difference in economic development between Beijing and Tianjin has reduced as well (Figure 30).

⁴⁹ In 12th February 2004, organized by of the National Development and Reform Commission, the leaders of Beijing, Tianjin and Hebei attended a meeting held in the city of Langfang, located between Beijing and Tianjin but belonging to Hebei Province. A number of agreements have been reached to help promoting the integrated development of these three regions.

⁵⁰ Figure 28 shows the GDP growth in Tianjin from 1990-2000. Although the GDP growth has increased from 1990-1994, the overall trend was decrease in this decade. The figure 29 shows the GDP growth from 2001-2008 (just before the hosting of Beijing Olympic Games), although the GDP growth fluctuation was seen, the overall trend was increased.

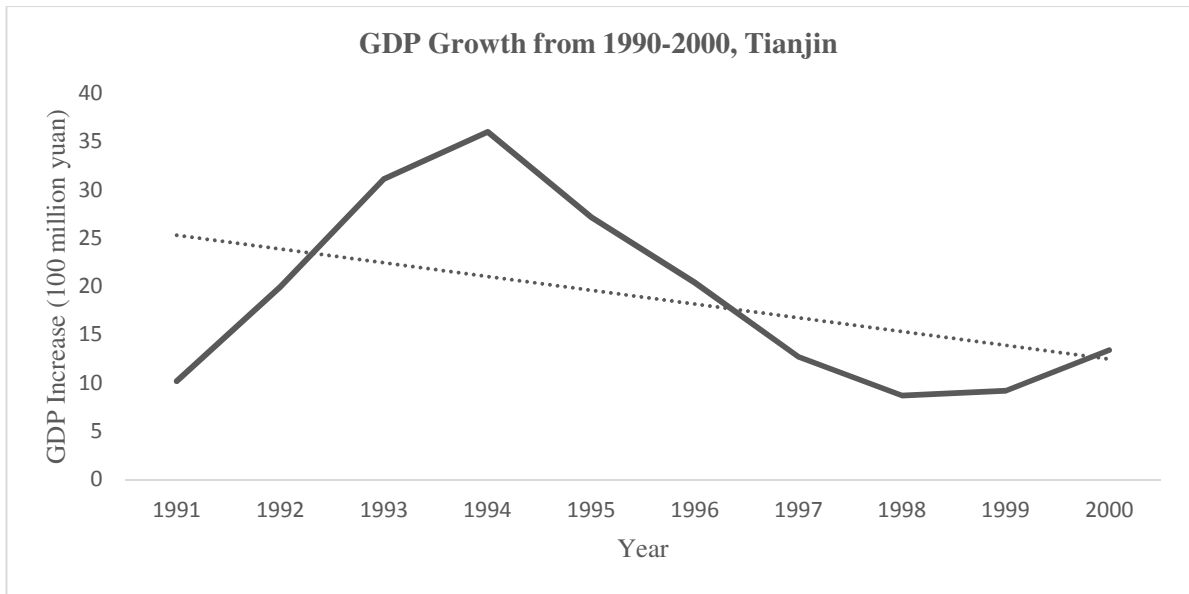


Figure 28. GDP Growth, 1990-2000, Tianjin

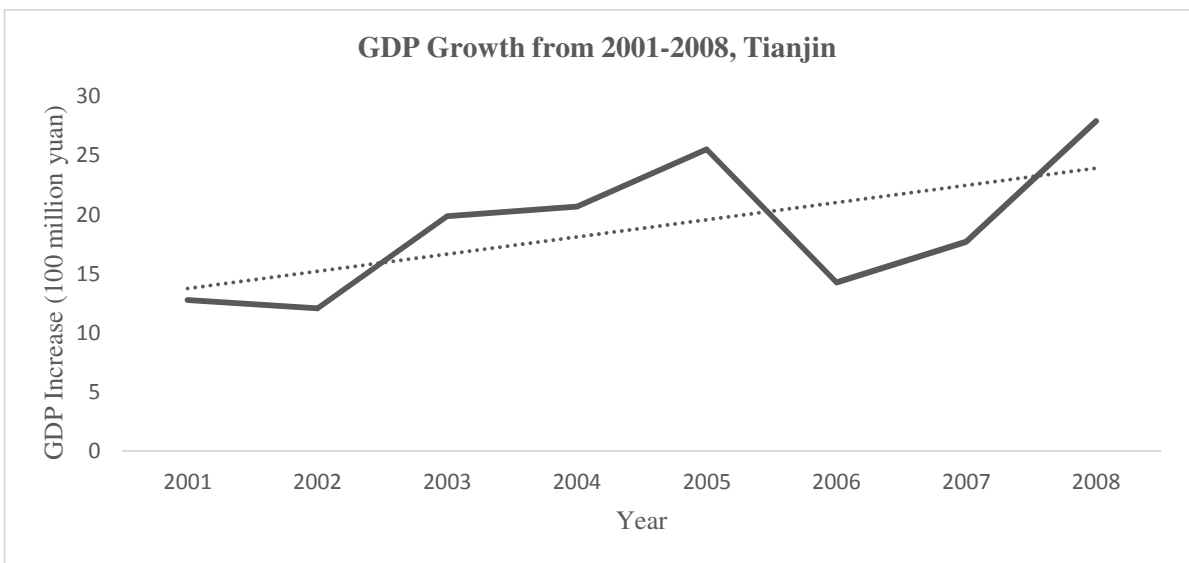


Figure 29. GDP Growth, 2001-2008, Tianjin



Figure 30. GDP Increase of Beijing vs. Tianjin (per capita)

In 2008, the successful hosting of the Olympics in Beijing gave Tianjin an excellent opportunity to develop.⁵¹ Tianjin took advantage of its close proximity to the capital to develop by playing an important role assisting Beijing in hosting the Olympics on soccer. The creation of a high-speed railway connecting the two cities in 2008 shortened travel time between the two cities from 2 hours to just 25 minutes, which accelerated migration to Tianjin (Figure 31). As of 2008, migration to Tianjin exceeded that of Beijing and Shanghai. This has been reinforced by the increasing significance of highly mobile populations, as concluded from the previous PCA analysis. As discussed, the elderly population is having a growing importance on Tianjin's social space by turning the city into an aging society. However, in 2010, people aged 15 - 64 accounted for 86% of the migratory population. This influx of younger people will mitigate against aging in Tianjin. In addition to the high-speed railway, two expressways have also been constructed to increase connectivity between Tianjin and Beijing (Figure 31). As discussed in the spatial analysis, secondary industry

⁵¹ The Beijing Olympic Games took place in Beijing, China, from August 8 to 24, 2008. 102 venues were renovated or constructed in total, with a cost of 19.5 billion yuan.

workers began to migrate toward the northwest, in the direction of Beijing. It may be expected that in conjunction to the southeastward urban growth of the coastal areas, Tianjin will develop in the northwest by taking advantage of convenient transportation routes to Beijing. The two Outer Suburb will change dramatically in the next few years, which will become the new focus for the study Tianjin's social space. Tianjin has not only outgrown Beijing's "shadow," but it has also begun to share in its limelight.



Figure 31. Transportation Between Beijing and Tianjin

(Source: <http://www.tianjinsc.cn/Article/fangchan/201311/26372.html>)

Since 2011, Tianjin's GDP growth has ranked no. one among all Chinese cities. As of 2014, with the central government's new plans to further solidify Beijing's status as a political and cultural center, much of the capital's industrial sector will be relocated to other provinces. Tianjin is the optimal candidate for further industrial development due to its coastal location and high connectivity with Beijing. Furthermore, the integration of Beijing, Tianjin and Hebei provinces is evolving in conjunction with the National Development Strategy, which will benefit Tianjin's future development. In sum, with the connectivity between these

three regions as well as plans to further cultivate Tianjin as a major economic hub, the city is expected to continue its record growth and maintain its status as a globalization city and the economic center of Northern China.

4.7. CONCLUSIONS

This paper has examined Tianjin's urban social landscapes from 1980s to 2000s. The transformation of Tianjin's social landscape during these three decades has also been studied to help identify the pattern of Tianjin's urban growth. These evolutions have been measured using statistical and spatial methods including PCA, multiple regression and cluster analysis.

This paper is the first research in English examining the social landscape of Tianjin, a provincial-level municipality with outstanding economic growth. There is very little published research examining social transformations in Chinese cities, and none exploring this topic in the context of China's economic transition from a centrally-planned economy (1980s) to a market-oriented one (2000s).

Several conclusions can be drawn from this study. First, by analyzing the statistical results extracted from PCA, it is clear that Tianjin's urban social landscape has become increasingly complex over time. Furthermore, the social dimensions of Tianjin's urban landscape have been greatly influenced by China's economic system. Politically sensitive social dimensions, such as occupation, have played more important roles in shaping the city's social landscape under the planned economy, while market sensitive social dimensions, such as socio-economic status, became more significant following economic transition in Tianjin. In terms of policy adjustments emerging out of economic transition, such as the Hukou Release and Housing Reform, Tianjin has seen massive inwards migration, which led to significant socio-spatial landscape change in Tianjin. Although such market-oriented social phenomena are the direct influencing factors directing changes in Tianjin's urban

social landscape, the underlying mechanisms are the central and local governments' policies. Different from Western market-oriented economies, China possesses what is known as a "Socialist Market Economy", an economic model which includes both the state-owned sector and the open-market economy introduced with economic reform. An authoritarian political philosophy remains dominant in China, even with the introduction of capitalist economic processes.

Figure 32 depicts the transformation of Tianjin's urban social landscape. The urban social landscape of Tianjin can be concluded as "one axis, two nuclei".

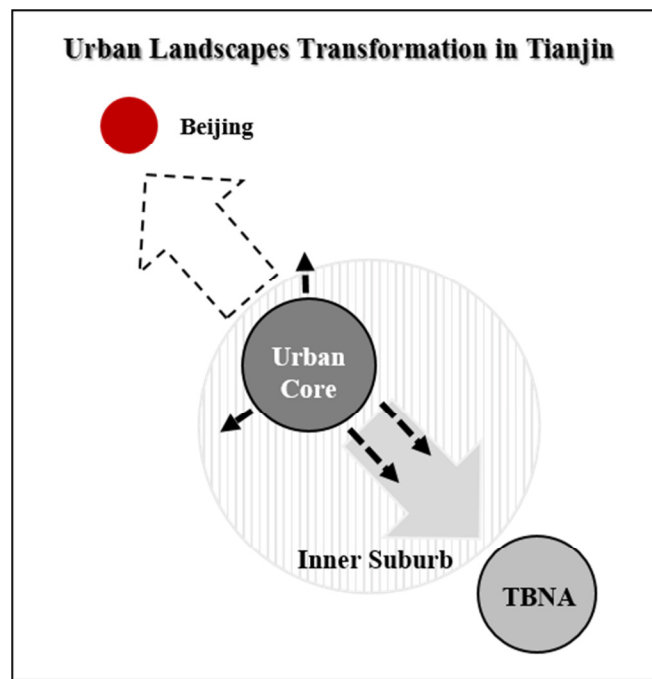


Figure 32. Urban Landscape Transformation in Tianjin

In the last three decades of transformation, a distinctive "dual-core" structure has been observed in Tianjin: Urban Core is considered the first core, while the other one is taking shape in the TBNA. The formation of such urban morphology manifests in terms of a compartmentalized urban social structure with older and tertiary workers concentrated Urban Core, and a more energetic industrial TBNA. Secondly, as a result of policy adjustments

regarding infrastructure and urban rehabilitation projects, a massive suburbanization process occurred in Tianjin in the last 10 years. Having finally recovered from constrained development caused by Beijing prior to 2000, Tianjin is now taking advantage of its close connectivity with China's capital to benefit immensely. The Outer Suburb will be the center of Tianjin's future development.

CHAPTER 5. CONCLUSION

These concluding remarks will provide a review of the research background, objective, and primary findings before highlighting some contributions of the research. Lastly, this section concludes with some research limitations and areas for further research.

5.1. REVIEW OF RESEARCH

Using Tianjin's neighbourhood-level census data collected in 1990, 2000, and 2010, this study has examined the different urban socio-spatial patterns and their evolution as well as the mechanisms under the centrally-planned economy context (1980s), the market transition economy context (1990s), and the market-oriented economy context (2000s). Several issues defined the scope of this research. First, the economic reforms of 1978 ushered in a phase of accelerated urbanization in China. The urbanization rate has increased from 20% in 1980 to 50% in 2012. Such rapid urbanization has led to an increase in socioeconomic stratification, which has contributed to the increasing dynamism in China's urban social landscape. A series of social problems have emerged that give cause for concern within the study of Chinese cities' urban social space. Prior to economic restructuring, the social space was expected to be homogenous due to the socialist ideology and the country's socialist status (Han 2012, Wu 2003). Therefore, the currently observed multifaceted social space is heavily related to the economic transition from a centrally-planned to a market-oriented economic system. However, there has been a general lack of comprehensive study examining the influence of the economic transition of Chinese cities' social space.

In light of the above research gaps, this study had the objective of understanding the different urban socio-spatial patterns and their mechanisms in the case of Tianjin in three distinctive economic contexts: the centrally-planned economy (1980s), the market transition economy (1990s) and the market-oriented economy (2000s).

The research findings have shown that Tianjin's urban socio-spatial patterns have become increasingly multifaceted over the three periods. Under the context of the centrally-planned economy, a predominant social dimension was observed, which contrasts from the more balanced social dimensions seen in the 1990s and 2000s.

The loosening of the Hukou policy, Housing Reform, the promotion and development of coastal areas, and the central government's reclassification of Tianjin's status are the four primary mechanisms for Tianjin's urban social development from the 1980s-2000s. Over this time, Tianjin has gradually developed a distinctive "one axis, two nuclei" social landscape. In variance from the inland cities, its coastal location gave Tianjin a new urban growth pole alongside the traditional Urban Core (Han 2012, Wu et al. 2005, Xu et al. 2009). The dual-core social landscape has also contributed to the asymmetric suburbanization observed in Tianjin. Generally speaking, the centroid of Tianjin's social landscape has moved southeast over time. Furthermore, Tianjin's social landscape has been greatly influenced as an exclusive municipality neighbouring Beijing. The speed of economic growth and transformation speed in Tianjin was much slower than what was seen in Beijing, as well as other mega cities such as Shanghai and Guangzhou. With the recent introduction of the development concept of integrating Beijing, Tianjin, and Hebei province, Tianjin has seen a rapid urban social growth paralleling Beijing's growth. Predictably, northwestern Tianjin will be a new area facing great social change in the future.

5.2. CONTRIBUTIONS OF THE RESEARCH

This thesis makes several contributions relevant to the understanding of urban social landscape transformation after the economic reforms of 1978, which are essential for policy-making aimed at stimulating the urban development among the coastal cities. Specifically, the contributions of this study can be classified into theoretical contributions

and empirical contributions.

5.2.1. Theoretical Contributions

The theoretical contributions of this thesis are related to the conceptual framework for the study. The proposed conceptual model is the first one to hierarchically determine the influencing factors of Chinese cities' social landscape transformation by adapting the different economic structures as the main line, which is distinctive from Western models. This conceptual model was designed for the particular study of China's social landscapes. Potentially, it can be applied to any city facing significant transformation. Such wide applicability and great potential of our conceptual framework suggests the need for future research to shift the focus towards studying the social landscape more systematically, including more factors that have not been included in the models and their relationships thus far.

5.2.2. Empirical Contributions

This research is the first of its kind to adopt the 2010 census to examine the social landscape of Chinese cities. Additionally, this up to date data was used to conduct a holistic study of the Chinese cities' urban social landscapes after the economic reforms of 1978. This will provide a reference for both Tianjin and central governments to better understand how the economic reforms influenced the city's social space after 1978.

This work is also the first in the literature to use Tianjin as a case study, and it provides two key contributions. First, it will help provide references for studies on other coastal cities that have features similar to Tianjin. In 2014, Chinese President Xi Jinping highlighted the strategic importance of integrated development between Beijing, Tianjin, and

Hebei province (also known as the Capital Economic Circle).⁵² This study of Tianjin will help gaining a better understanding of this key municipality's development to serve government policy-making decisions, and will also provide information on the city in relation to Beijing and Hebei province towards the further development of this region.

5.3. RESEARCH LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Though this thesis has made a number of important contributions broadening the understanding of Chinese cities' urban social landscape transformation after the economic reform, there are some minor limitations. First, the variables that were collected have evolved over time: the housing variables from the 1980s do not share the same indicators from the 1990s and 2000s. Thus, some social dimensions in 1980s may not have been detected. These inconsistencies in the data may be cause for some misunderstanding in this research. This limitation is highly related to concerns among Western and Chinese scholars alike about the credibility of Chinese census data. The census in 1990 is considered more credible due to the serious Hukou restrictions during that time which limited population mobility and had citizens registered according to their residential location perfectly. The undercount rate of 1990's census is only 0.7 per thousand; however, when the economic transition began, the Hukou release and Housing Reform increased the volatility of statistical accuracy by separating the registered and actual residences and increasing internal population movements. In order to alleviate this situation, the government implemented a series of measures, including adding the variables on housing conditions, and introducing a short and long form. Although the accuracy of 2000 census is not as good as 1990 with an undercount rate of 1.81%, the margins of error are nonetheless acceptable rates. In 2010, this value dropped to 0.12%.

⁵² The Capital Economic Circle is a developmental priority area proposed by central government.

Second, though the smallest political division is the “neighbourhood,” they are still very dense in population, usually holding 2,000-10,000 families. However, the neighbourhood-level data is the most detailed data that can be accessed, and thus more micro-level changes are undetectable, such as localized gentrification. Gentrification is concluded as a primary factor for internal population replacement process as well as city’s social space change by the previous studies. In China, the scale of gentrification is building-level or community-level, which cannot be reflected by neighbourhood-level data.

In light of aforementioned limitations, it suggested that further field research is necessary for a more in-depth understanding of Tianjin’s urban social landscape. The field research needs to be done on an even smaller scale to provide better insight into the internal transformations occurring in Tianjin’s neighbourhoods. Furthermore, as previously mentioned, Tianjin, Beijing, and Hebei province have all become amalgamated into the Capital Economic Circle. There are numerous studies on Beijing, but not many have been done on Hebei province. Thus, more studies in the future on key cities in Hebei province, such as Tangshan, will help provide a more systematic understanding of the city cluster, which will provide a more comprehensive and relevant set of research for governmental policy-making processes. Furthermore, in comparison to Tianjin, the economic center of Northern China; Shanghai, the economic center of China is very similar in its structure: both cities are coastal cities while Shanghai boasts its Pudong New Area, which is comparable to the Binhai New Area of Tianjin. Both areas were developed under the national strategy, though Shanghai’s area had been developed ten years earlier. In light of these similarities and the different development stages of the cities, it may be interesting and important for scholars to undertake a comparative study of these two cities.

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APPENDIX 1. TIANJIN ADMINISTRATIVE DIVISIONS ADJUSTMENT

Tianjin Administrative Divisions Adjustment, 1990s-2010s

	1990s	2000s	2010s
Urban Core	Heping	Heping	Heping
	Hedong	Hedong	Hedong
	Hexi	Hexi	Hexi
	Nankai	Nankai	Nankai
	Hebei	Hebei	Hebei
	Hongqiao	Hongqiao	Hongqiao
Suburb Area	Dongjiao	Dongli	Dongli
	Nanjiao	Jinnan	Jinnan
	Xijiao	Xiqing	Xiqing
	Bejjiao	Beichen	Beichen
	N/A	Wuqing	Wuqing
	N/A	Baodi	Baodi
Rural Area	Wuqing	Ninghe	Ninghe
	Baodi	Jinghai	Jinghai
	Ninghe	Jixian	Jixian
	Jinghai	N/A	N/A
	Jixian	N/A	N/A
Tianjin Binhai New Area	Tanggu	Tanggu	N/A
	Hangu	Hangu	N/A
	Dagang	Dagang	N/A

APPENDIX 2. MULTIPLE REGRESSION RESULT

1980s Multiple Regression Results

Regression for Detecting Zonal vs. Sectoral Structure, 1980s

Factor		Factor 1	Factor 2	Factor 3	Factor 4
Zonal Model	b1	0.977 (11.144)	-0.105 (-0.880)	0.095 (0.693)	-0.096 (-0.751)
	b2	-1.356 (-10.565)	0.833 (4.786)	-0.569 (-2.844)	0.129 (0.689)
	b3	-1.737 (-15.804)	-0.074 (-0.496)	0.053 (0.309)	-0.006 (-0.038)
	R ²	0.527	0.132	0.046	0.003
Sectoral Model	c1	-0.513 (-5.122)	-0.030 (-0.295)	-0.067 (-0.545)	-0.092 (-0.970)
	c2	0.671 (4.440)	0.297 (1.920)	-0.083 (-0.447)	0.116 (0.807)
	c3	1.033 (5.890)	0.035 (0.195)	0.044 (0.203)	0.034 (0.206)
	c4	0.323 (2.292)	-0.006 (-0.043)	0.179 (1.030)	0.026 (0.195)
	R ²	0.115	0.006	0.007	0.008

1990s Multiple Regression Results

Regression for Detecting Zonal vs. Sectoral Structure, 1990s

Factor		Factor 1	Factor 2	Factor 3	Factor 4
Zonal Model	b1	0.007 (0.058)	1.157 (14.263)	0.702 (6.620)	0.132 (1.142)
	b2	0.010 (0.059)	-1.618 (-15.332)	-1.090 (-7.899)	0.069 (0.455)
	b3	-0.410 (-2.577)	-1.605 (-15.832)	-0.914 (-6.894)	-0.303 (-2.093)
	R²	0.033	0.530	0.202	0.027
Sectoral Model	c1	-0.248 (-2.667)	-0.182 (-1.799)	-0.165 (-1.698)	-0.175 (-1.788)
	c2	0.886 (6.307)	0.175 (1.146)	0.233 (1.582)	0.099 (0.670)
	c3	0.215 (1.320)	0.666 (3.754)	0.982 (5.752)	0.377 (2.202)
	c4	0.065 (0.500)	0.437 (3.068)	0.111 (0.808)	0.207 (1.507)
	R²	0.131	0.048	0.099	0.008

2000s Multiple Regression Results

Regression for Detecting Zonal vs. Sectoral Structure, 2010s

Factor		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Zonal Model	b1	1.104 (12.402)	-0.457 (-4.051)	-0.062 (-0.499)	0.159 (1.282)	0.118 (0.950)
	b2	-1.601 (-12.620)	0.181 (1.124)	0.049 (0.278)	-0.142 (-0.803)	-0.094 (-0.533)
	b3	-1.508 (-13.191)	0.929 (-6.405)	0.111 (0.692)	-0.273 (-1.715)	-0.209 (-1.313)
	R²	0.490	0.179	0.002	0.013	0.008
Sectoral Model	c1	0.018 (0.17)	0.218 (2.083)	-0.109 (-1.031)	-0.286 (-2.808)	-0.139 (-1.344)
	c2	0.054 (0.372)	-0.402 (-2.770)	0.332 (2.272)	0.679 (4.809)	0.140 (0.981)
	c3	0.637 (3.319)	-0.533 (-2.769)	0.291 (1.501)	0.271 (1.448)	0.022 (0.114)
	c4	-0.034 (-0.226)	-0.197 (-1.322)	-0.093 (-0.616)	0.187 (1.291)	0.286 (1.941)
	R²	0.045	0.037	0.035	0.078	0.014

APPENDIX 3. CLUSTER ANALYSIS RESULT

1980s Cluster Analysis Results

Distinguishing characteristics of Tianjin's social areas, 1980s

Social Area	Subdistricts	Statistics	Factor 1	Factor 2	Factor 3	Factor 4
1	62	RMS	0.881	1.439	0.665	0.594
		Mean	0.757	0.381	0.275	0.237
2	1	RMS	3.530	1.018	0.357	13.162
		Mean	3.530	1.018	0.357	-13.162
3	129	RMS	1.078	0.376	0.590	0.362
		Mean	-0.944	-0.135	0.044	-0.159
4	6	RMS	1.046	2.001	5.690	1.212
		Mean	0.102	1.121	-5.539	-0.153

1990s Cluster Analysis Results

Distinguishing characteristics of Tianjin's social areas, 1990s

Social Area	Subdistricts	Statistics	Factor 1	Factor 2	Factor 3	Factor 4
1	60	RMS	0.577	1.468	0.894	0.573
		Mean	-0.047	1.293	0.541	0.020
2	94	RMS	0.880	0.807	1.247	1.029
		Mean	0.622	-0.468	-0.008	-0.392
3	13	RMS	1.689	0.863	0.971	2.683
		Mean	1.294	0.024	-0.661	2.335
4	61	RMS	1.236	0.612	0.521	0.410
		Mean	-1.188	-0.555	-0.379	0.086

2000s Cluster Analysis Results

Distinguishing characteristics of Tianjin's social areas, 2000s

Social Area	Subdistricts	Statistics	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	109	RMS	1.025	0.571	0.307	1.100	0.850
		Mean	0.707	-0.185	-0.017	0.495	0.193
2	41	RMS	1.438	1.237	1.588	0.917	0.606
		Mean	-1.155	-0.951	0.967	-0.040	-0.351
3	70	RMS	0.485	1.155	0.337	0.820	0.268
		Mean	-0.332	1.043	-0.156	-0.604	-0.100
4	1	RMS	2.197	1.324	1.306	1.476	10.615
		Mean	-2.197	-1.324	-1.306	-1.476	10.615
5	7	RMS	0.961	2.192	3.848	1.282	1.487
		Mean	-0.603	-1.787	-3.661	-1.225	-1.461