Metropolitan Fusion or Folly

The Creation of A Multiple-Nodal Metropolis in Taiyuan, Shanxi, China

by

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of the Requirements for the Degree
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ABSTRACT

Targeted growth is necessary for sustainable urbanization. There is a pattern in China of rapid development due to inflated projections. This creates “ghost towns” and underutilized urban services that don't support the population.

In the case of Taiyuan, this industrial third-tier city of 4.2 million people. A majority of the newer residential services and high-end commercial areas are on the older, eastern side of the city. Since 2007, major urban investments have been made in developing the corridor that leads to the airport, including building a massive hospital, a new sports stadium, and "University City". The intention of the city officials is to encourage a new image of Taiyuan- one that is a tourist destination, one that has a high standard of living for residents. However, the consequences of these major developments might be immense, because of the required shift of community, residents and capital that would be required to sustain these new areas. Much of the new development lacks the reliable and frequent public transit of the more established downtown areas.

Do these investments in medical complexes, sports stadiums and massive shopping centers create new jobs that impact the income disparity, or do these new areas take years to fill, creating vacuums of investment that remove funding from areas with established communities? Can Taiyuan move successfully to a post-industrial economy with these government interventions, or is it too much too soon? By examining demographic data from 2000, 2007, 2009, 2011, and 2013, research on sustainability assessments in Chinese cities (Lu Jia), and translated government publications detailing the urbanization efforts in Taiyuan, I will assess the results of the urbanization changes instituted by the new mayor, Geng Yanbo. My thesis will evaluate the success and failures of these policies and the implications for Taiyuan.

ACKNOWLEDGMENTS

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Deepest thanks go to Evelyn Dolins and Col. Stanley Dolins, who, despite my expulsion from pre-school, believed I could reform. They have graciously accepted that although I did not become the anesthesiologist they hoped for, I've turned out all right.

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CHAPTER 1

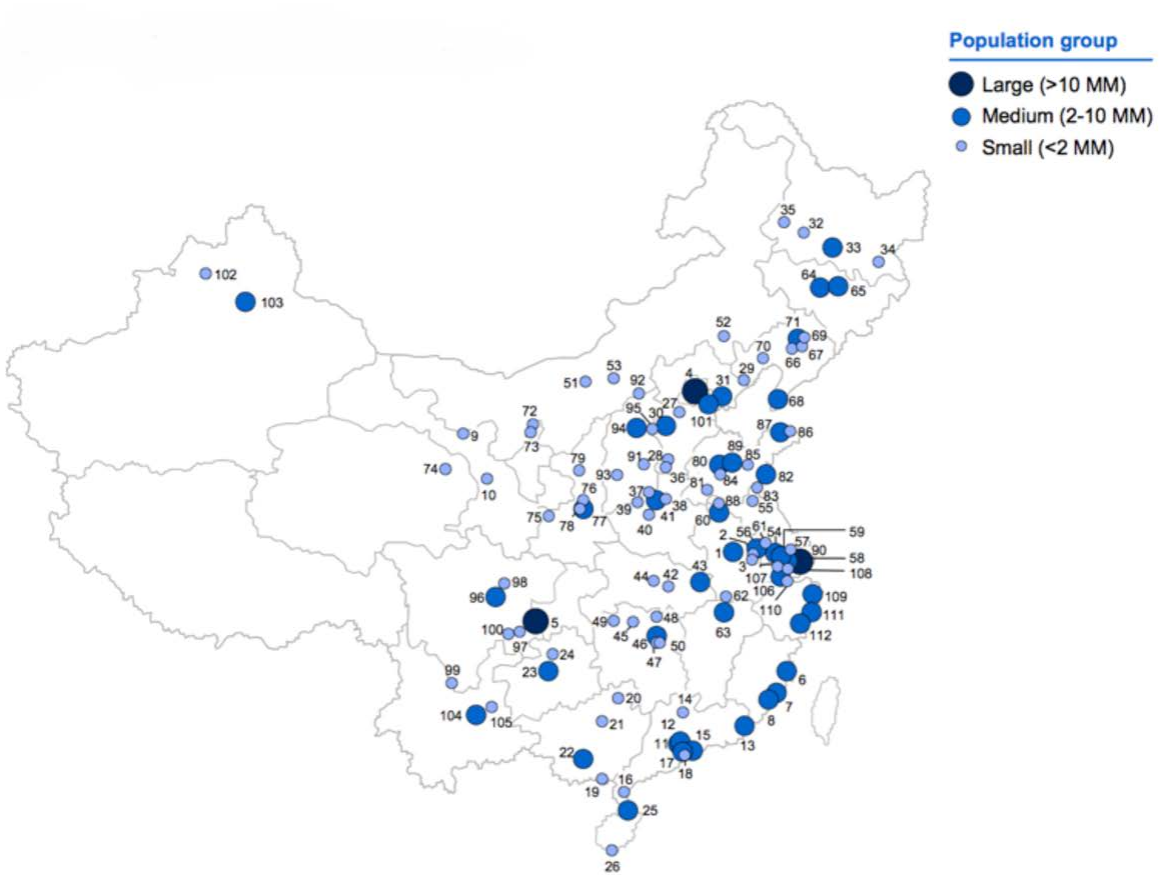
INTRODUCTION

Chinese urbanization dawned in China at the end of the 1970s, when the nation's population was just 18% urban.[i] With Deng Xiaopeng's rise to power and the Special Economic Zones, everything changed rapidly; rampant industrialization ensued, exposing the country to Western ideas and tastes, and at the turn of the century a massive push towards college education occurred. Now over half the population, approximately 700 million people, live in cities. It took Japan 30 years, the U.S. 80 years and Britain 120 years to achieve urban majorities, but China has done it in 22 years (see Figure 1, page 2)[ii]. The structure of Chinese cities and their form has consequences for the next few decades.

Where the U.S. has ten cities with a population over 1 million in their metropolitan cores, China has more than 90 such cities (city propers). With the exception of Lhasa, the capital of Tibet, *every* provincial capital is a municipality with a current population of over 1 million. Forecasts indicate over 220 such cities by 2030, with 23 cities harboring a population of more than 5 million people.[iii] China will be adding more people to its urban population *than the entire current population of the United States* by 2030.[iv] Until China's population levels off (a mixture of the one-child household, financial pressure, and changing personal preferences) in 2030, these cities of 1 million plus in aggregate are expected to grow approximately 3.4% per year (see Figure 2, page 3)[v].

This means a full *1 billion* Chinese residents will be urban. Thus, China's economic and political destinies lie deeply intertwined with its urban realities and the outcomes of planning its cities.

112 Cities in the 2011 Urban Sustainability Index and their Population Sizes



Anhui
1 Hefei
2 Ma'anshan
3 Wuhu

Beijing
4 Beijing

Chongqing
5 Chongqing

Fujian
6 Fuzhou
7 Quanzhou
8 Xiamen

Gansu
9 Jinchang
10 Lanzhou

Guangdong
11 Foshan
12 Guangzhou
13 Shantou
14 Shaoguan
15 Shenzhen
16 Zhanjiang
17 Zhongshan
18 Zhuhai

Guangxi
19 Beihai
20 Guilin
21 Liuzhou
22 Nanning

Guizhou
23 Guiyang
24 Zunyi

Hainan
25 Haikou
26 Sanya

Hebei
27 Baoding
28 Handan
29 Qinhuangdao
30 Shijiazhuang
31 Tangshan

Heilongjiang
32 Daqing
33 Harbin
34 Mudanjiang
35 Qiqihar

Henan
36 Anyang
37 Jiaozuo
38 Kaifeng
39 Luoyang
40 Pingdingshan
41 Zhengzhou

Hubei
42 Jingzhou
43 Wuhan
44 Yichang

Hunan
45 Changde
46 Changsha
47 Xiangtan
48 Yueyang
49 Zhangjiajie
50 Zhuzhou

Inner Mongolia
51 Baotou
52 Chifeng
53 Hohhot

Jiangsu
54 Changzhou
55 Lianyungang
56 Nanjing
57 Nantong
58 Suzhou
59 Wuxi
60 Xuzhou
61 Yangzhou

Jiangxi
62 Jiujiang
63 Nanchang

Jilin
64 Changchun
65 Jilin

Liaoning
66 Anshan
67 Benxi
68 Dalian
69 Fushun
70 Jinzhou
71 Shenyang

Ningxia
72 Shizuishan
73 Yinchuan

Qinghai
74 Xining

Shaanxi
75 Baoji
76 Tongchuan
77 Xi'an
78 Xianyang
79 Yan'an

Shandong
80 Jinan
81 Jining
82 Qingdao
83 Rizhao
84 Tai'an
85 Weifang
86 Weihai
87 Yantai
88 Zaozhuang
89 Zibo

Shanghai
90 Shanghai

Shanxi
91 Changzhi
92 Datong
93 Linfen
94 Taiyuan
95 Yangquan

Sichuan
96 Chengdu
97 Luzhou
98 Mianyang
99 Panzhihua
100 Yibin

Tianjin
101 Tianjin

Xinjiang
102 Karamay
103 Urumqi

Yunnan
104 Kunming
105 Qujing

Zhejiang
106 Hangzhou
107 Huzhou
108 Jiaxing
109 Ningbo
110 Shaoxing
111 Taizhou
112 Wenzhou

Figure 1: China Population Trends & Growth, 112 Cities. McKinsey Global Institute[vi]

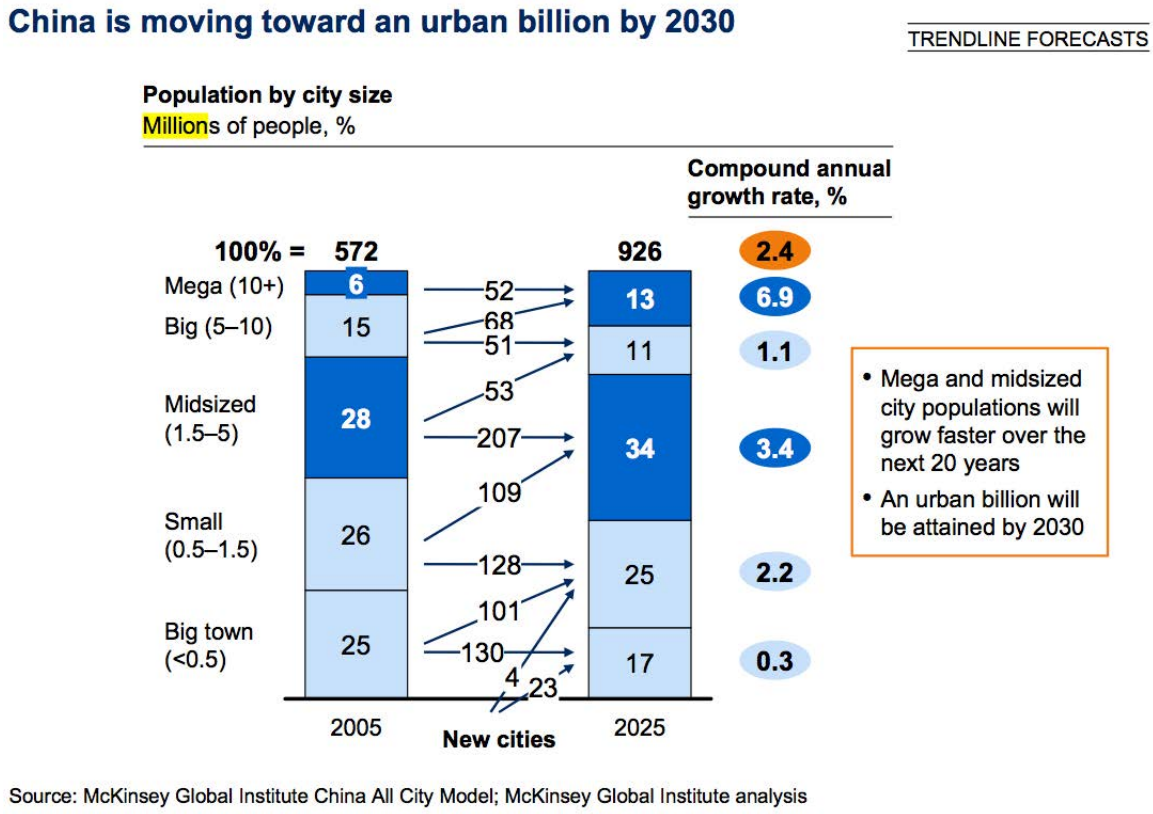


Figure 2: Population by City Size. McKinsey Global Institute[vii]

Such rapid expansion of cities comes with a host of problematic implications. With a billion urban residents, how to provide services? How to encourage economic growth without creating long, traffic-spawning commutes and destroying available green space? When urban residents are choking on their air, how can China make these cities livable and as well as efficient? And with so many cities racing to become larger, how do "small" Chinese cities of just a few million- deep in the shadows of their massive Shanghai, Beijing, and Shenzhen brethren -stay competitive and relevant?

CHAPTER 2

CONTEXT

National Context

A one-party political system enables a top-down planning approach and control that few developed nations can match. The National Development and Reform Commission focuses on megapolitan systems and major transportation corridors as their development model in order to create a "corridor network" of provincial capitals, all connected by high-speed rail and expressways.

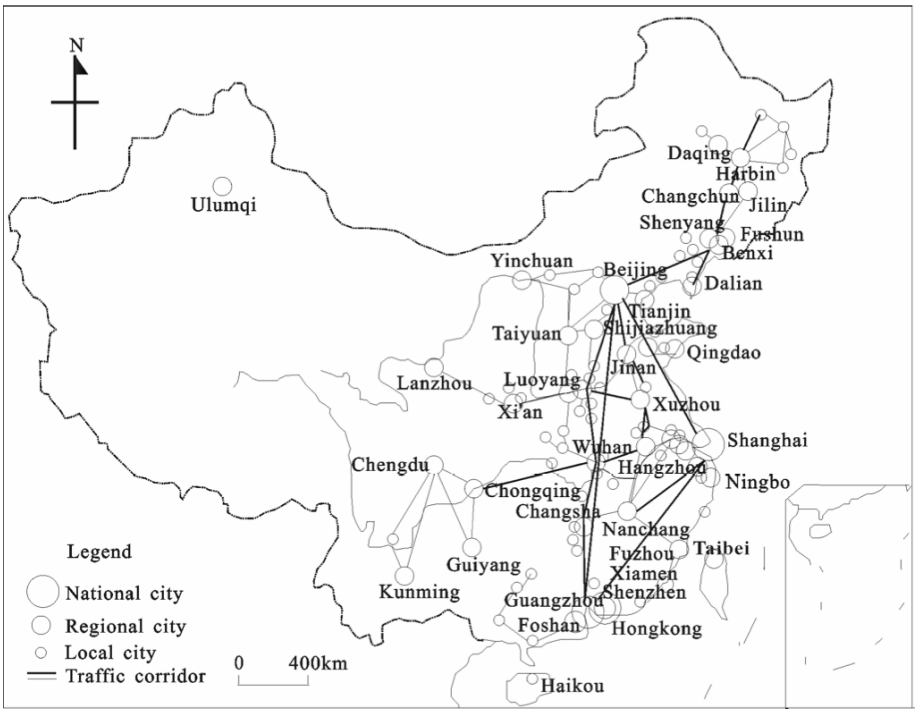


Figure 3: Corridor group network of Chinese urban agglomeration, national scale.[viii] Taiyuan is not connected to a nationally recognized traffic corridor.

The government pursues this model because of the "mutually beneficial symbiosis" of urban agglomeration.[ix] When pursued correctly, two or more cities can benefit from the effects of agglomerative economies. This includes a greater labor pool, shared transport logistics for industries, benefits in transport infrastructure, investment, and technology for residents, and more efficient use of resources. With cities that are

hubs and junctions for multiple train lines, like Beijing or Wuhan (see Figure 4), expanding the train network only adds to their attractiveness for residents and productivity as participants in the economy. However, while this may strengthen smaller cities near traditionally strong economies like Shenzhen, Beijing, and Shanghai (which all benefit from coastal dominance[x]), it can further marginalize places like Taiyuan.

Extensive studies have been undertaken on major cities like Beijing, Shanghai, and Guangzhou, but there is yet room for more research on urban agglomerations, including functional drivers and resulting urban form, especially less researched agglomerations such as Taiyuan. China's 28 city agglomerations cover only 22% of its territory, but encompass "44.4% of the total population, 60.4% of the non-agricultural population, 62.3% of the fixed asset investment, 76.9% of the economy, 77.7% of the industrial production, while providing 67.3% of the financial revenue, 73.1% of imports, 80.4% of exports, 94.2% of the foreign investment and 40.9% of domestically produced food".[xi] Even then, what land within agglomeration boundaries can still be far from arable, or suffer from numerous problems like polluted water sources or depleted water tables.

In essence, this means 20% of the country is home to almost half the people, almost half its food, and three quarters of its means of production. If urban agglomeration is mismanaged, it could lead to a host of negative effects on many stakeholders, including: cross pollution of cities, increased inter-city traffic congestion, energy shortages, food shortages, pollution of food production areas, and the degradation of amenities, facilities, and the environment.[xii]

Taiyuan as an Urban Agglomeration

Taiyuan's drive to expand rapidly is part of China's 12th Five-Year Plan of Urbanization, displayed in Figure 4 as "Taiyuan Cities Agglomeration". Nationally, the agglomeration and corridor method of development is being aggressively pursued. Cities with close geographic ties and existing interconnected infrastructure are grouping together and investing more resources in strengthening these connections.

In the context of the national corridor group network (Figure 3, previous), Taiyuan is a regional city whose major, directly connected partners via high-speed rail are Beijing, Shijiazhuang, and Luoyang. It is remote from the coastal powerhouses of Shanghai, and Guangzhou, but is one of the Central China urban agglomerations (see Figure 5). Central China has 6 urban agglomerations (see Figure 5): Zhongyuan (in Henan), Wuhan (in Hubei), Changzhutan (in Hunan), Huanpoyanghu (in Jiangxi), Wanjiang (in Anhui) and Taiyuan[xiii].

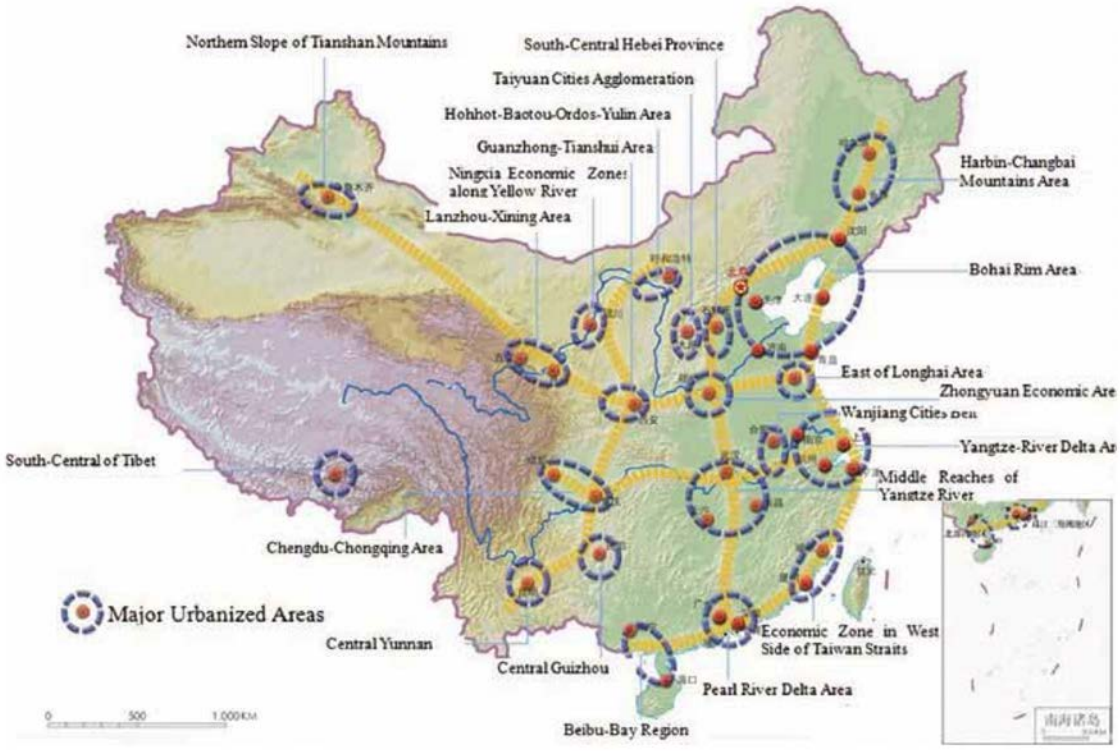


Figure 4: Map of "2 Horizontal, 3 Vertical Axes" Plan, from China's 12th Five Year Plan[xiv]

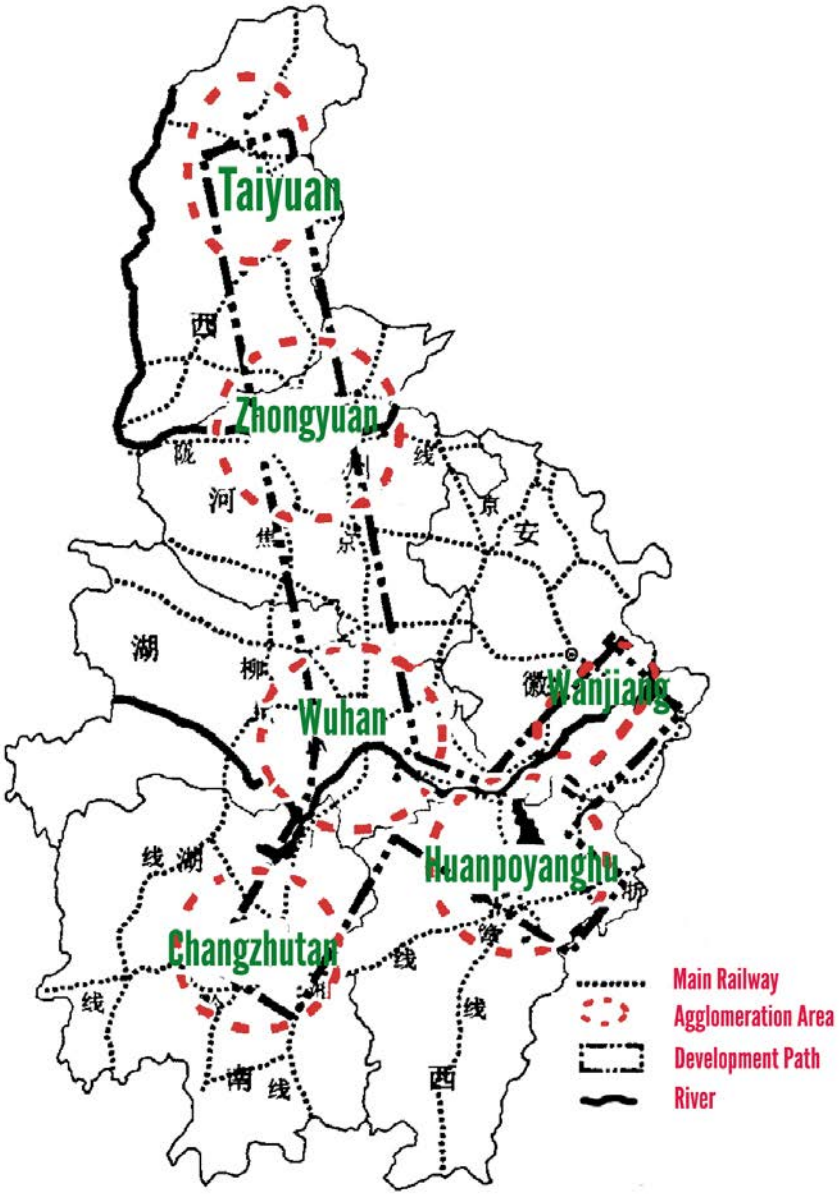


Figure 5: Central China's Urban Agglomerations. Taiyuan is the northernmost, above the Zhengzhou agglomeration. [xv]

At a combined population of 39.5 million, Zhongyuan's ability to benefit from agglomeration economies and develop far surpasses Taiyuan's. Compared to the other agglomerations, Taiyuan had one of the smaller total populations and an economy heavily skewed towards heavy industry and resource extraction[xvi]. In 2010 the Shanxi

Academy of Social Sciences pointed out that of the six Central China agglomerations, Taiyuan lagged far behind.[xvii]

Although it seems generous for the National Reform and Development Commission to include a second-tier city as part of their agglomeration strategy, Taiyuan's position as a resource economy and location along rail and highway lines to Beijing make it important to the other five agglomerations in Central China. However, its dependence on its coal and steel industries are also what kept Taiyuan's growth slower than its counterparts. The introduction and implementation of the Taiyuan City Urban Master Plan 2007-2020 has begun to expand Taiyuan's economy and image from just an industrial city to that of a cultural and educational capital, by introducing new and grand elements into the city landscape.

Taiyuan Context

Taiyuan, a prefectural-level city in China (see Figure 6) and the capital of Shanxi province (see Figure 7), is infamous throughout the country for its polluted environment. Shanxi alone provides China with approximately 30% of its coal needs. The industrial-based economy, polluted environment, and lack of amenities have kept Taiyuan as a third-tier city of 4.25 million residents[xviii]. Besides coal mines, steel plants and a historical footnote as the birthplace of the founder of the Tang Dynasty, Taiyuan holds no place of distinction in the pantheon of Chinese cities. Mention of its name throughout the country usually carries a connotation of dismissiveness, and a perception that its future is threatened with water shortages, dust storms, and high rates of childhood respiratory illness. However, in 2006 the city officials unveiled a master plan (2007-2020; updated in 2010, 2012 and 2014) that, if successfully implemented, would alter this national preconception and catapult Taiyuan to become a modern, second-tier city.

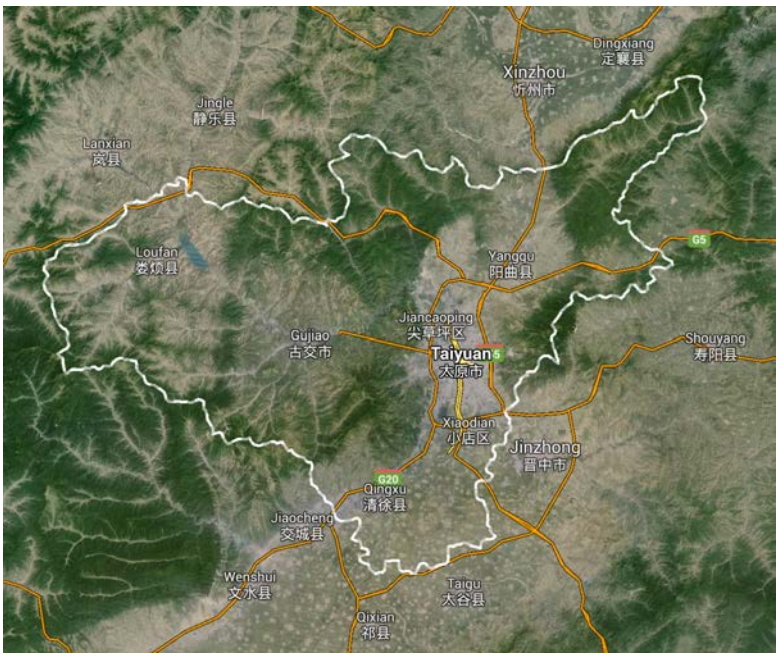


Figure 6: Taiyuan's borders, located in north-central Shanxi. Google Satellite imagery, 2014.

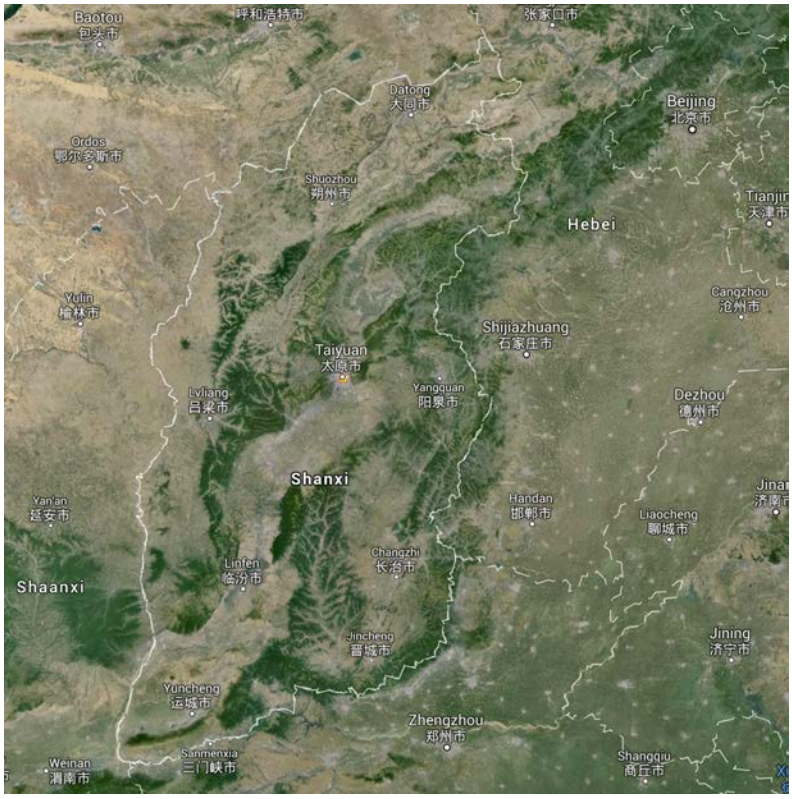


Figure 7: Taiyuan, located in central Shanxi. Beijing and Tianjin are to the northeast; Zhengzhou is to the south. Google Satellite imagery, 2014.

The official master plan is called the Taiyuan Master Plan & General Situation 2007-2020 (太原市城市总体规划 2007-2020, known nationally as the Taiyuan Cities Agglomeration; hereafter referred to as the Master Plan), was introduced in 2006 and began implementation in 2007. It calls for rapid development south and west in a strategy touted as "one area, one corridor, two axes" (see Figure 8). The one area refers to Taiyuan; one corridor refers to east-west traffic development; and the two axes refer to the Taiyuan-Jiaozuo Railway and the Datong-Yuncheng Expressway.

The strategy is following a model of transit-oriented development by encouraging residential and commercial installations along the highways and corridors between nearby cities such as Yuci and Jinyuan. It calls for developing the small town of Jinyuan into an environmental preserve, and turning vast areas in Yangqu and Qingxu into either environmental preserves or new industrial parks (options that are alarmingly dissimilar). Key elements of the strategy include allowing Taiyuan Urban Planning & Design Institute to planning guidance of the nearby town of Yuci, even though it will continue to be the government seat of the neighboring prefecture-level city Jinzhong. The resulting metropolitan merger is referred to as "太榆同城化," roughly translated as Twin Taiyuan-Yuci Cities or "fused Taiyuan Yuci City".[xix]

In the years since the plan's unveiling, there have already been significant investments in urban cultural amenities and environmental protection. The national government declared intentions to make Taiyuan an "Eco Garden City" by 2014.[xx] Shanxi has already built a new provincial soccer stadium, promoted the installation of a second high speed rail station, broken ground on the province's first metro system, created a cultural district of different functions (e.g. museum, library, science and technology expo center, opera house, and shopping mall), and increased the protection of historical sites and recreational parks.

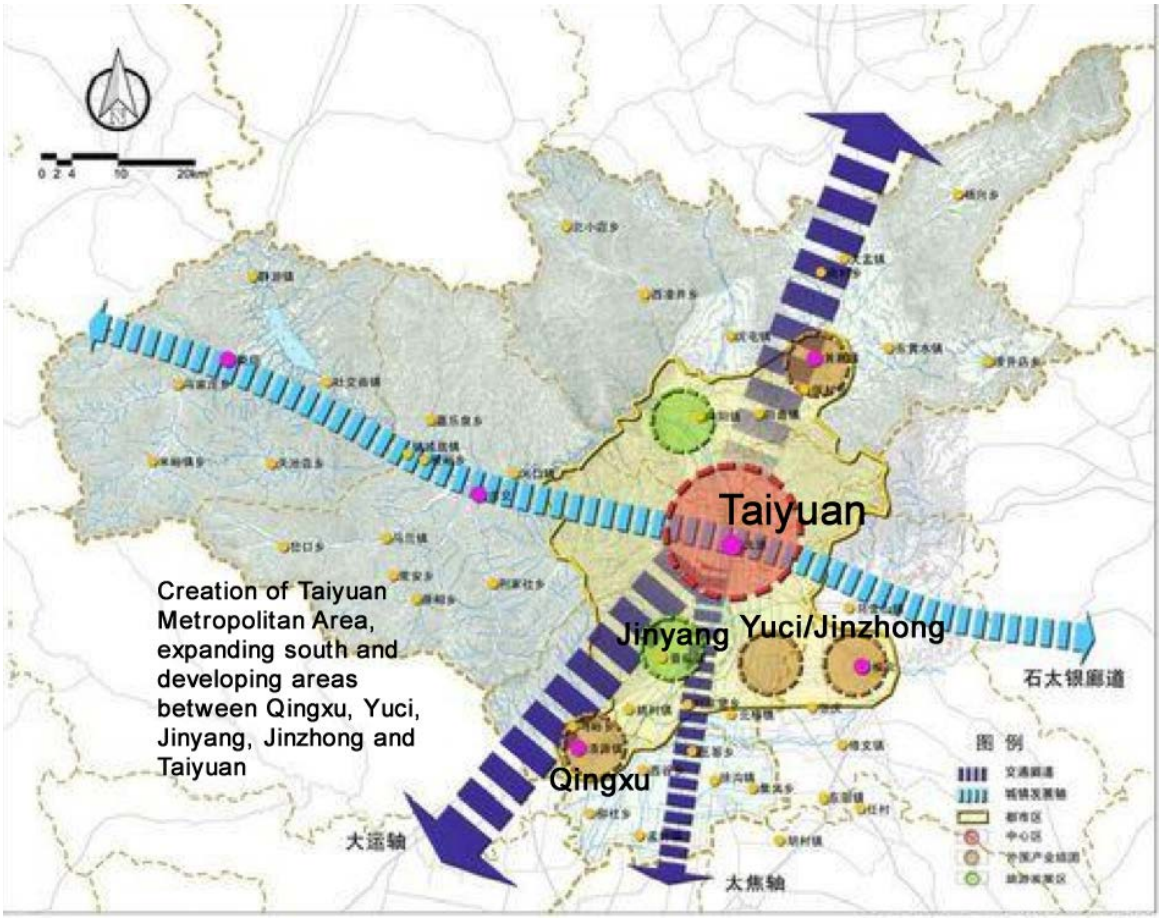


Figure 8: "One Area, One Corridor, Two Axes". From Taiyuan City Master Plan 2007-2020 (Translated by author)

The percentage of the GDP used for environmental spending has increased significantly as the Master Plan progressed (see Figures 10, 11, and 12 on page 13). Heavy

industry, formerly as close as 5km to city center, is in the process of moving to locations 15km or further away from the downtown. All of the major universities have been required to create new campuses in “University City”, an enormous educational campus that will house no less than 100,000 students, faculty and staff, 25 km from Taiyuan city center and just north of its urban nodal twin, Yuci.

When the plan has been fully implemented, Taiyuan’s municipality will total over 5 million people, making it more competitive with solidly second-tier cities like Xi’an, Shijiazhuang, Wuhan and Zhengzhou. But is increasing the administrative reach of Taiyuan and accelerating development ahead of population growth enough to turn a currently small and overwhelmingly industrial city into a sizable powerhouse of knowledge and culture? *Assuming the best-case scenario and a perfectly implemented master plan, will Taiyuan have actually achieved the creation of a sustainable metropolitan region?* Or will the city’s efforts prove to have invested valuable resources too fast and too far, leaving established and stable urban areas open to stagnation- or even decline?

CHAPTER 3

RESEARCH APPROACH

The Issue

To China, Taiyuan is a proverbial canary in a coalmine. Even though population forecasts predict China's total population will level off in 2050, China will still have approximately 1 billion urban residents in a country with limited natural resources. Already, the realities of heating in winter and generation of electricity for cities is wreaking havoc on environmental air quality. Without meticulous planning, Chinese governments will have to answer for the consequences to an increasingly demanding population, and run the risk of political instability. Taiyuan's coal-derived wealth, in the hands of a small percentage of state-owned enterprises, clashes with its visibly poorer population, which is only growing larger because of rural-to-urban migration. This makes Taiyuan is a prime study for other industrial Chinese cities trying to pursue modernization and growth while remaining socially harmonious.

High Ambitions: Are They Realistic?

Taiyuan's urban form has never been a stranger to planning controversy, especially when trying to gain footing on the national stage, shown most tellingly in the following anecdote[xxi]:

Taiyuan's most famous street, Yingze Dajie (seen in Figure 13, on page 15), was built in 1956. It was a massive undertaking at 70 meters wide (second only to the widest street in China, Chang'an Avenue in Beijing). However this was proposed at a time when most roads were only 7-8 meters wide, and all of Taiyuan only had 800 cars. For a city still recovering from the Japanese invasion and lacking political importance, it seemed wildly extravagant, and city officials were accused of being greedy and dangerously overambitious. But then-Mayor Yue Weifan envisioned the road, and the bridge it

needed to cross the Fen River, as shaping Taiyuan into an iconic city form- like Budapest with the Danube, and its own twin districts.

Figure 9: Yingze Dajie in 1955, facing west from Wuyi Square.[xxii]

Mayor Yue Weifan used a famous statement that is still used as justification for economic and urban development plans today: "50 年不落后、100 年不后悔", which translates as "If you plan for fifty years ahead, in a hundred years you'll have no regrets". This persuaded other city officials and the public to build the road. Yingze Dajie went on to shape Taiyuan's urban development towards grid-centered and motor-vehicle dependent development.

Now, five decades after Yingze Dajie and as the National Development & Reform Commission focuses on urban agglomerations, Taiyuan presents the province and its citizens with another ambitious plan, but just as Mayor Yue's critics asked, are all the elements of the Master Plan appropriately ambitious? Even as the great leap forward of constructing Yingze Dajie allowed Taiyuan to develop rapidly and formed a symbolic core and division between functions of the city, it also paved the path[xxiii] towards a kind of vehicle-dependent urban sprawl that planning officials find difficult to retrofit.

Figure 10: Yingze Dajie, after AECOM renovated the streetscape, 2014.[xxiv]

The danger in the lofty goals and radical changes that the Plan implements is that Taiyuan, like in 1956, is a small city compared to the rest of China. The latest population data (released with the 2013 Statistical Yearbook, gathered in 2012) marks the total population as 4.2 million people. Some forecasts for 2020 estimate approximately 5.1 million; other forecasts for Taiyuan place the urban population only at 5.7 million in 2039[xxv]. The planning strategy for Taiyuan requires a major shift of community facilities, residents and capital, if the new area is to be a sustainable and financially viable urban location, especially if the overall population growth is low relative to other Chinese agglomerations. In other words, the lower the population growth, the more the development context is a "fixed sum game", with investment to the south not being available to the north. Some major institutions like a provincial hospital and soccer stadium have already been built, yet they are severely underutilized (see Figures 15 and 16 on page 17). These structures represent billions of CNY, but lack reliable and convenient public transit service, compared to the more established downtown, leaving these new destinations isolated.

Although the intention is to make these new investments in infrastructure and destinations accessible via the city's first subway, construction of the first line has only just begun and is at least a decade away from completion. As of now, though some elements of the Master Plan have been successfully built, their success in becoming vibrant parts of Taiyuan's urban fabric remains a gamble. Such rapid and aggressive development can result in surplus and over-extended infrastructure, urban facilities with excess capacity, and/or unnecessary horizontal expansion resulting in longer travel times, increased traffic, and loss of surrounding farmland and environmental services land. At the intra-urban scale, overinvestment in some areas can lead to a dilution of services, density and quality of life in already developed areas, especially where economic and population growth is relatively slow. However, in several cities, ambitious development efforts spurred by high-side population forecasts have launched transformative changes (as was the case in Zhengzhou), arguably leading to better overall urban economic and livability performance.

In the quest to expand the urban area into Yuci, has the local government overinvested and threatened the long-term vitality of the city? Or, do they forsee the need for a new urban pattern more compatible with a sustainable eco-city, an urban platform that will support the transition from a resource-based economy into a service-based one? Will investments in medical complexes, sports stadiums and massive shopping centers divert development from the established city, putting established areas at risk of stagnation, or even decline? Will Taiyuan and Yuci's population be enough to fill these newly developed areas, the fulfillment of the "if you build it, they will come" philosophy- or will these structures languish without use for years, a ghostly reminder of grand ambition on the fringe of the city?

Research Questions

My primary research questions are: (i) Is so much investment in the new development area creating a backlash effect on the existing older areas through disinvestment and population decline, and (ii) Do the residents of the new area enjoy a higher quality of life measured in terms of key indicators such as commute time, access to green space, etc., relative to what they would have had in the established city?

Research question (i) is pursued with reference to demographic, economic, topographical, and land use parameters: (ii) is pursued through a framework of key indicators.

TABLE 1: KEY INDICATORS

Population	*Quality of Life*
Land area	# of Standard Middle Schools
Total Population	# of Primary Schools
Resident Population	# of Hospital Beds
Population Density	# of Hospital Personnel
Joined Shanxi	
Left Shanxi	*Environmental*
Economic Statistics	Forest/Green Area
Gross Regional Production	Newly Afforested Areas Planted in Past Year
Science + Technology Expenditures	Arable Land
Healthcare Expenditure	# of Irrigated Sites
Education spending	
Total Retail Sales of Consumer Goods	Annual Investment in Environmental Pollution Control
Net Income of Residents, Per Capita	Industrial Sulfur Dioxide Emissions
Living Expenditure of Residents, Per Capita	Green Space Per Capita

Methods

My method focuses on the comparative study of two areas in Taiyuan Municipality: the established core city (Yingze District) and the new, planned corridor to the south (through XiaoDian District and parts of Yuci; see Figure 11, on page 20).

To compare the futures of the two areas, I:

Establish indicators, aligned with the research questions, to systematically explore likely future outcomes in the two study areas, primarily relying on secondary data (statistical yearbooks, media content analysis, property developer information, and government plans). Based on this baseline data, I will develop a most likely future scenario for both areas, based on an urban planning scenarios methodology. I will systematically examine the consequences of this scenario, for both new area and old area, utilizing the identified indicators from Table 1.

A major outcome of my research will be an assessment of the efficacy of the corridor initiative. Is the overall concept appropriate? Should it be spatially modified, e.g., to create more nodality? Should the corridor initiative be up-scaled or down-scaled? Should the proposed mix of land uses, activities, and facilities be altered?

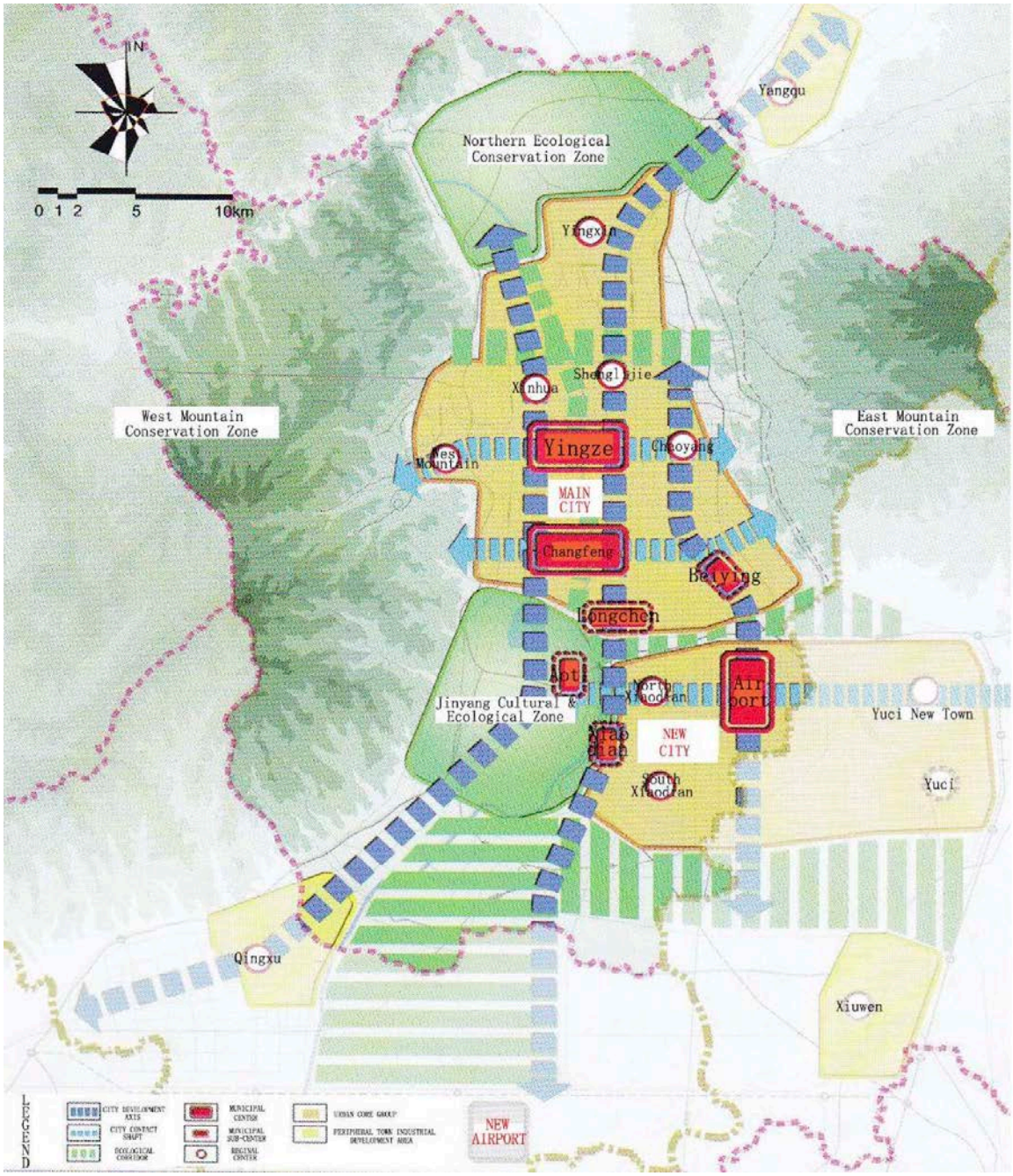


Figure 11: Map of Taiyuan's Master Plan and Expansion into Yuci.[xxvi]

CHAPTER 4

ASSESSMENT OF THE TAIYUAN CITIES AGGLOMERATION PLAN

Figure 12: Map of Shanxi Province. Google Maps, 2014.

Modern Taiyuan is geographically and economically the heart of Shanxi, provincial capital nested in a shallow valley between two mountain ranges halfway between Xi'an and Beijing (see Figure 13). Shanxi Province boasts one of China's largest known coal deposits (over 260 billion tons) and massive bauxite deposits; thus, Taiyuan is squeezed between the Taihang Mountains to the east and the Luliang Mountains to the west, in-between large mining operations only a 5-10 kilometer bus ride from city center (see Figures 13 and 14). As a result of the natural resources found in Shanxi, the city's economy relied on heavy industry, mining, coal processing, machinery and steel factories.

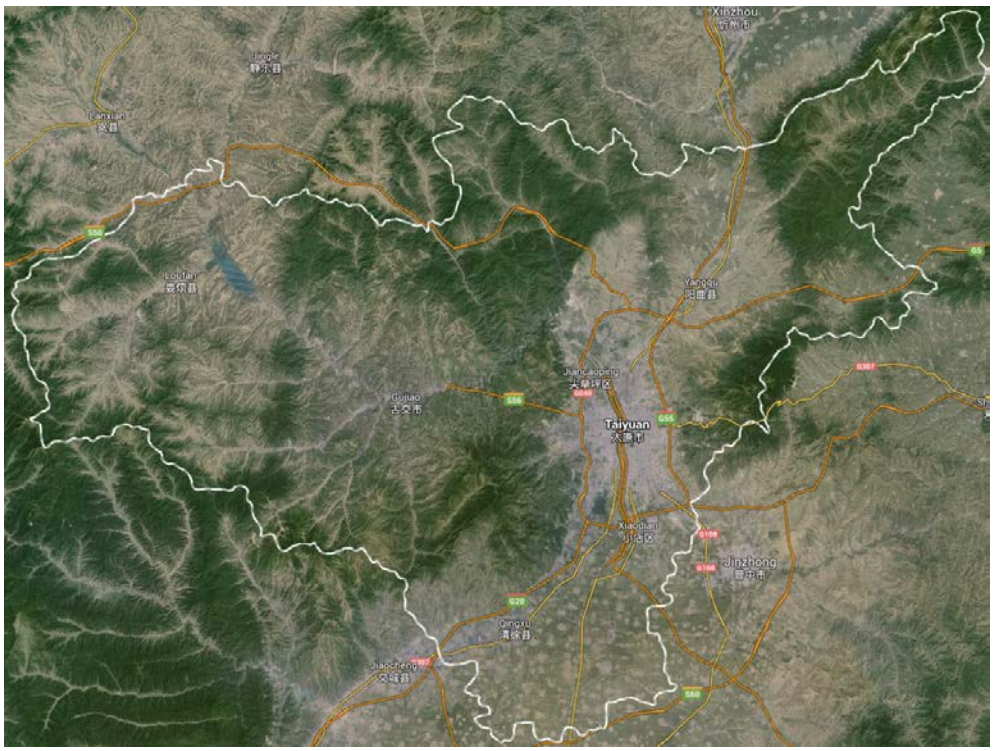


Figure 13: Map of Taiyuan. The whitish-grey shows urbanized areas (downtown Taiyuan) hemmed in by the Taihang and Luliang Mountains in green. Google Satellite imagery, 2014.

Figure 14: Map of Taiyuan, city borders. Directly south and east is Yuci, capital district of Jinzhong. Google Maps, 2014.

While Shanxi Province proved to contain one of China's richest coal and mineral deposits, it lacked cultural destinations, cosmopolitan amenities, and a population that (in general) cared enough to recognize such deficiencies. In 2006, Taiyuan released the 15-year Master Plan for urban agglomeration, amenity creation, and environmental improvement, that would dramatically alter Taiyuan's form and status by rapidly urbanizing to the south, blurring the city's boundaries with Yuci City.

The official Master Plan advocates rapid, heavy investment in the southern areas of Taiyuan on both sides of the Fen River, following the transportation corridor to Yuci and eventually expanding into Jinzhong and Qingxu County (see Figure 15, below). Northern areas like Yangqu County will still receive some infrastructure investment, but at a much less intensive scale.

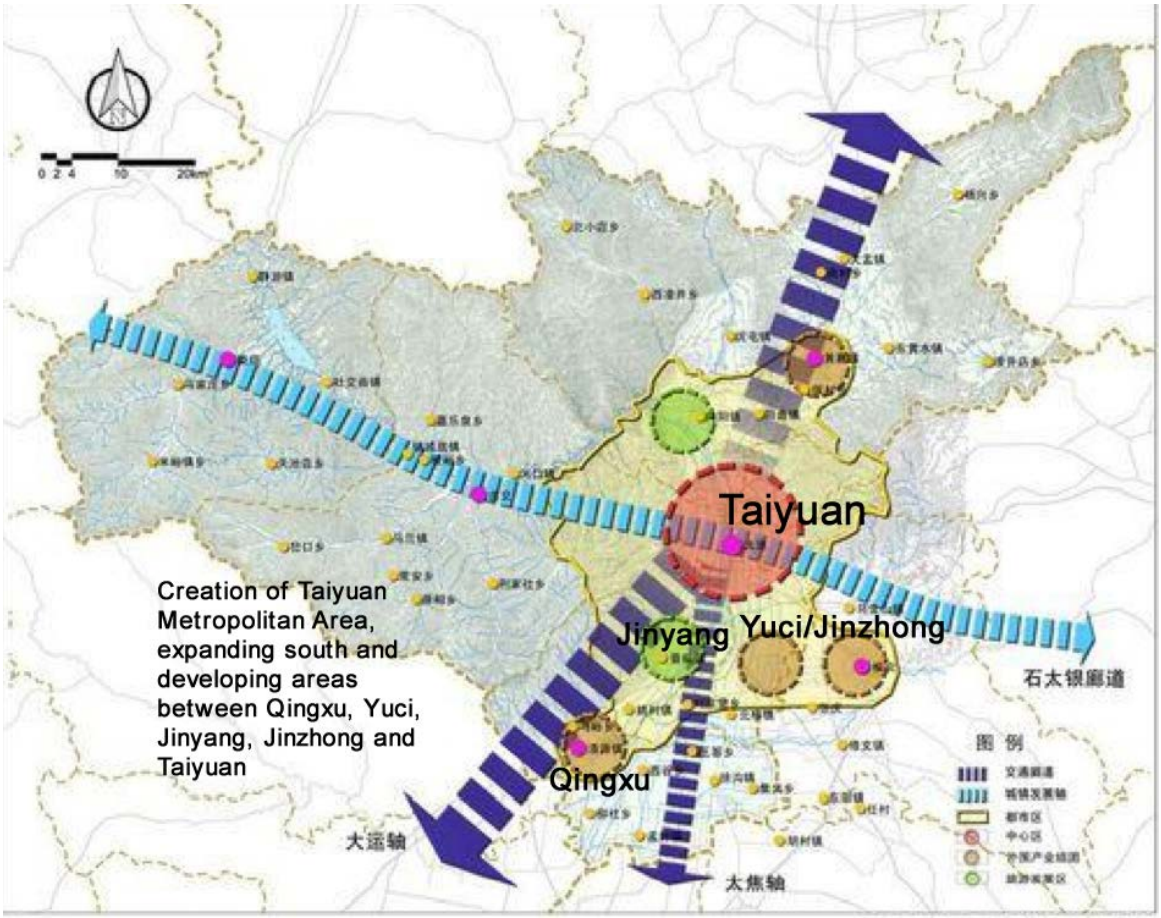


Figure 15: Translated from Taiyuan City Master Plan 2007-2020.

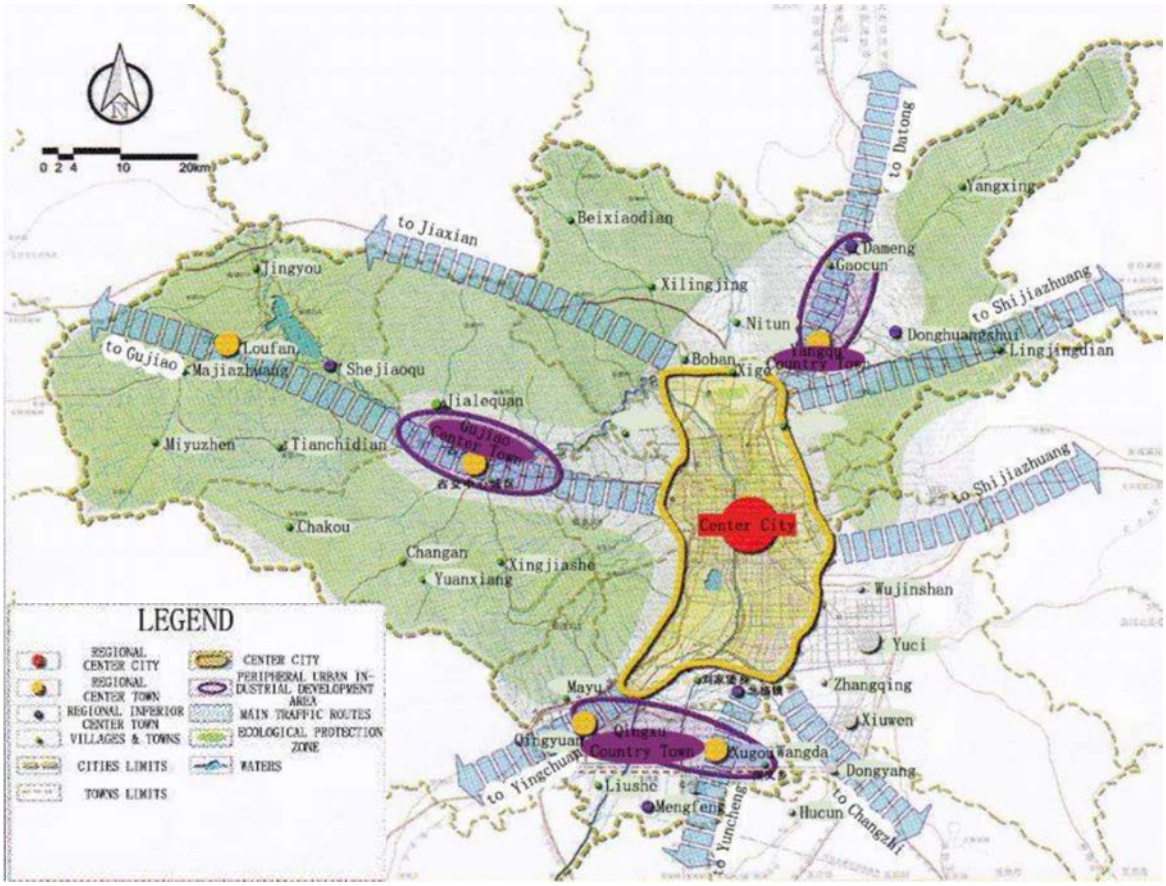


Figure 16: Spatial Planning of Taiyuan and surrounding areas.[xxvii]

As indicated by Figure 16 above, the Master Plan positions Taiyuan as the "core", surrounded by three rural districts to become satellite cities, and two ecological protection zones, all connected by multiple transportation links. The three rural areas are Yangqu County, Qingxu County, and Gujiao City, selected as the new sites for the industrial activities that are now prohibited in highly urbanized Taiyuan.

The ecological protection two zones are shown here as a northern ecological protection area (Yangqu Wastershed Protection Zone) and a western ecological protection area (Xishan Ecological Barrier), visible as the green swaths in Figure 18.[xxviii] However, these "ecological protection areas" are already extremely desertified, or otherwise prone to the same eroding-soil issues that are typical of the Loess Plateau.[xxix]While loess soil itself is fertile, the region receives little rainfall and both the

Xishan area and Yangqu area have been heavily terraced and mined (see Figure 19), and so mountainous that any kind of development is extremely difficult.

Figure 17: Rural village in Yangqu county. All over the Loess Plateau, 窑洞 (yaodong, cave houses) were built directly into the hillsides and the area around was terraced for farming, aiding in soil erosion.

Since Taiyuan emerged wealthy, albeit in a fog of ash and coal dust, its economic engine has been buoyed by steel and mechanical industries. Taiyuan's GDP in 2000 was 31.8 billion CNY, but in 2013 had grown to 241.287 billion CNY, a 659% increase over 13 years. However, the natural consequence of Shanxi's embrace of "dirty industry" has been Taiyuan's environment, which in 1997 the World Bank named as the most polluted city in the world[xxx]. This was not aberration. In 2001, when China ranked the 30 most polluted cities, 13 were from Shanxi. Taiyuan and its sister cities, Linfen and Datong, went from being famed for fruits, flowers and dates to infamous for metals in the water and particulates in the air.

The environmental impact on the health of the people of Taiyuan, in particular young children and the elderly, and international attention on air so thick with smoke it couldn't be inhaled, led city officials to take significant steps to pollution reduction. As the Master Plan began to be implemented, the coal mines were shut down- from 130 to

53 between 2006 and 2012[xxxi]. This also led to the institution of environmental parks and preserved zones. These efforts have paid off; in 2013, Taiyuan had the lowest incidences of asthma, rhinitis, eczema or food allergies in children in 10 Chinese cities that included Beijing, Shanghai, and Harbin.[xxxii]

Four-fold Approach

Taiyuan 2020 is envisioned as offering a high standard of living with a four-fold approach: firstly, providing high-class amenities like expansive retail locations filled with luxury goods and amenities like indoor go-kart racing, as well as making Taiyuan the provincial and regional leader in medical care; secondly, re-branding Taiyuan into a cultural destination through the renovation of historic areas such as Jinci Temple and Shipin Jie; thirdly upgrading the metropolis in an environmentally robust city, anchored by the creation of a massive ecological preserve around Jinci Temple and protecting the water sources in the north that feed the Fen River; and lastly, the creation of the province's largest educational campus, the multi-school "University City" that will be site to 11 schools and 146,000 students and staff.

This four-fold approach is important to helping alleviate Taiyuan's extremely high real estate prices. From 1950-2006, most of the historical, cultural, educational and retail destinations in the city had been in the oldest and densest districts, Yingze District and Xinghualing District, keeping real estate prices high (see Figure 18, next page). This drove up the demand for newer and affordable housing. Then in the early 2000s developers began responding to rumors of a master plan that would shift the city south, creating modern high-rise complexes much further south of the city, especially along Binhe Dong Lu on the eastern side of the Fen River. These complexes were scattered

beside the highway, all the way to Wusu Airport despite the fact that in 2007, the "built-up" area of downtown Taiyuan became significantly less dense south of Changfeng Jie.

Figure 18: Real estate prices in Taiyuan, March 2013 – February 2014. The average price per square meter is 8,621 CNY, or $428.29 per square foot.[xxxiii]

Figure 19: Snapshot from website that tracks housing prices in residential developments daily, March 2014.[xxxiv] "Pending" refers to developments that have not made price data available.

Now the average housing price is 8,621 CNY per square meter (approximately $1,410 USD per square meter), as can be seen from Figure 19- even along Changfeng Jie. As the city pushed south, housing complexes were accompanied by new shopping malls. In particular Tianmei Xintiandi, Beimei Xintiandi, and a Kempinski Hotel were built on Changfeng Jie, which changed from the outskirts of the built-up city into its own a high-end commercial destination, where prices reach as high as 22,000 CNY per square meter. This is the equivalent of $1,099.80 per square *foot*. To compare, the average price of a home in Phoenix, Arizona is $119 per square foot; the average price of housing in Shanghai is $1,820 per square foot. At first glance it is surprising to see such expensive housing offered in a city with little in the way of cultural and environmental amenities, so what is driving this demand? Is it pure speculation?

Connecting the City

A major connective feature of the current Master Plan is public transit and addressing transportation needs, through the construction of ring and arterial roads and the province's first subway system. China has a National Urban Rail Transit Association, which has standards that determine whether or not a city is eligible for a subway system. The three indicators are: a) an urban population exceeding three million, b) a GDP over 100 billion CNY, and c) a general city budget over 10 billion CNY.

The Taiyuan Metro Network has planned 7-10 lines, 5 urban ones and 2 long distance lines, with a total of 12 trains running daily. The planned network length is a total of 234.5km and 155 stations. Construction has begun on the first two subway lines, which form a "力" shape (see Figure 24, following page). Construction on Line 2 began in October 2013, going vertically from northern Taiyuan to far south, parallel to the Fen

River. Construction on Line 1 will begin in 2015, crossing from west to east over the Fen River along Yingze Dajie Bridge and then curving south towards the airport.

These two "skeleton lines" should be finished by 2017; the second phase of construction is planned for 2017 to 2023, building out lines 3, 4, and 5, covering major traffic corridors in central areas. The third stage is from 2024 to 2030, building out Lines 6, 7, and 8, expanding the network into the peripheral metropolitan area and opening up the possibility of mass public transit to tourist destinations. The fourth and final stage is set for 2030, building Lines 9 (which goes far northeast, into Yangqu) and 10 (which goes southwest, into Qingxu). [xxxv]

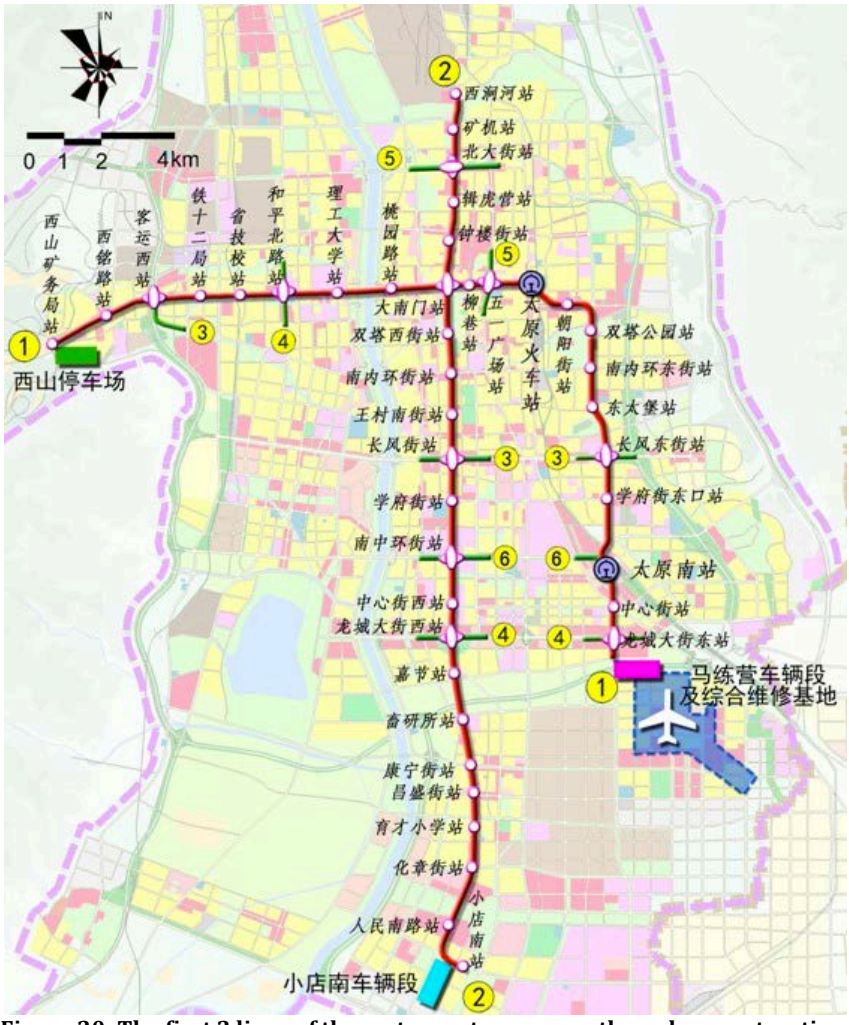


Figure 20: The first 2 lines of the metro system, currently under construction.

Line 2 is planned for 24.86 km, with 22 stations and 5 transfer points, and a max speed of 80km an hour. Early reports suggest that on completion, it would take less than 40 minutes to travel from northern Jiancaoping District to southern XiaoDian District. Going the same route (through the city) via car, especially with the mounting traffic congestion in Taiyuan, takes over an hour. It goes through major, old town areas (e.g., Great South Gate, Yingze Park, Taiyuan Zoo) as well as the newer developments (e.g. the Kempinski Hotel, Foxconn Industrial Park).

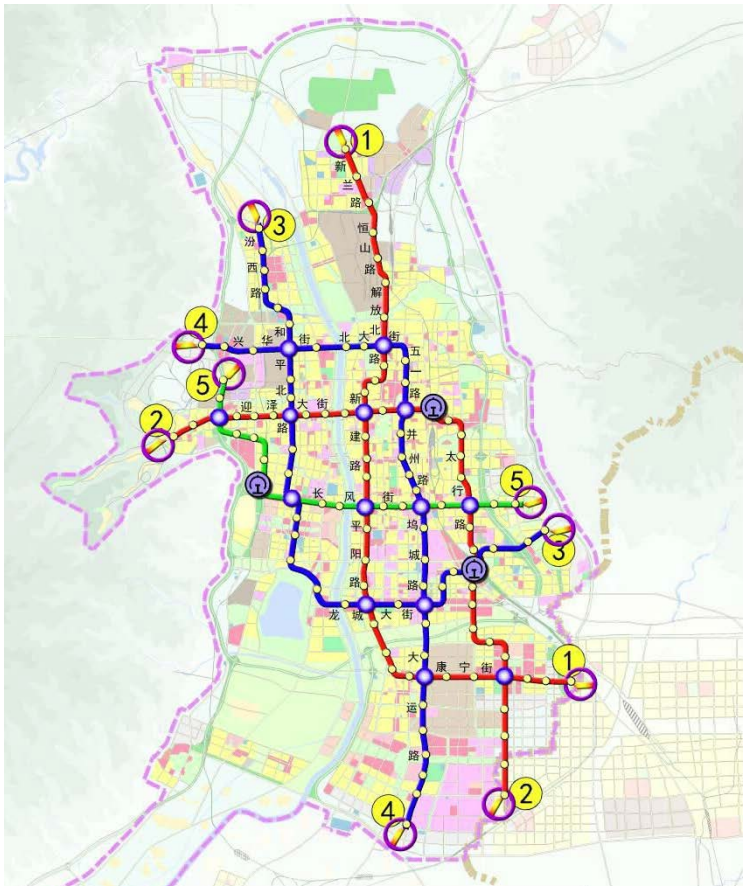


Figure 21: The 5 "urban" Metro lines.

Part of the design of the metro takes environmental preservation and sound disturbances into account with 9 control measures: land planning, aquifer/water protection, cultural relic protection, noise control, vibration control, electromagnetic mitigation, water pollution, ambient air pollution, and solid waste impact mitigation

measures.[xxxvi] although residents in rural areas are extremely concerned about the subway going through their villages or areas. Other residents, however, seem excited about the prospect of being "big city white-collar workers" by commuting via subway instead of driving.[xxxvii] With 12 trains running, capable of carrying 42,000 people the 120km circuit around Taiyuan in one hour, the system can accommodate 504,000 people in a 12-hour day (comparatively, Shanghai's metro system runs for 17 hours a day).

The subway system, when completed in 2030, will form the backbone of the Master Plan, because it will be connecting what are currently rural or satellite areas of Taiyuan Metropolitan Area (Yangqu, Qingxu) with Shanxi Hospital, the Changfeng Cultural Shopping District, University City, and the international airport. While the subway isn't breaking "new ground"- none of the areas planned for were so remote that they were unaccessible by car or minibus –it will allow for reliable and fast transit for previously rural areas.

In Figure 22 on page 32, the major transportation nodes are clearer. Yangqu to the north; Qingxu to the southwest; Yuci "New City", and Yuci to the southeast. In fact, Line 5 of the planned subway system will extend into Yuci so that it can reach Shanxi University City, which is built there (discussed on page 36). Another interesting point is the location of the airport. In this map it is much, much further south from Taiyuan City, reflecting a long-term possibility of moving the airport away from the Taiyuan-Yuci corridor in 2030 or later.

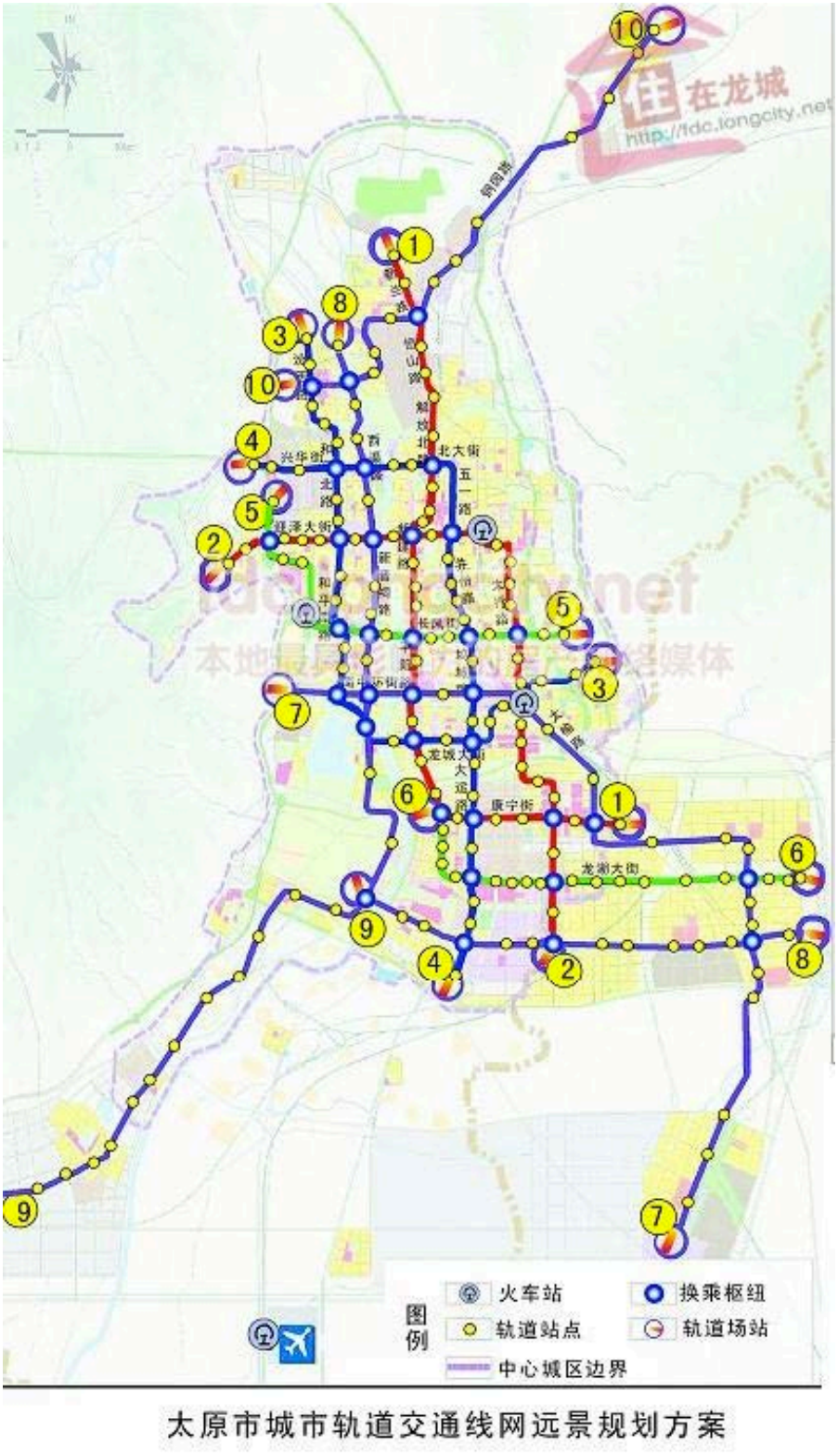


Figure 22: The Taiyuan Transportation Network map that shows all 10 lines of the planned subway. These extended lines reach Yangqu, Qingxu, and Yuci.

The second transportation aspect is that of automobiles; in 2010, the World Bank approved the Taiyuan Urban Transport Project and offered a loan of $150 million USD, which allowed for the construction of an arterial road (Taihang Road; see Figure 23, below).

Figure 23: World Bank-funded public transport component, increasing the major arterial roads from the established downtown to the newer areas in the south.[xxxviii]

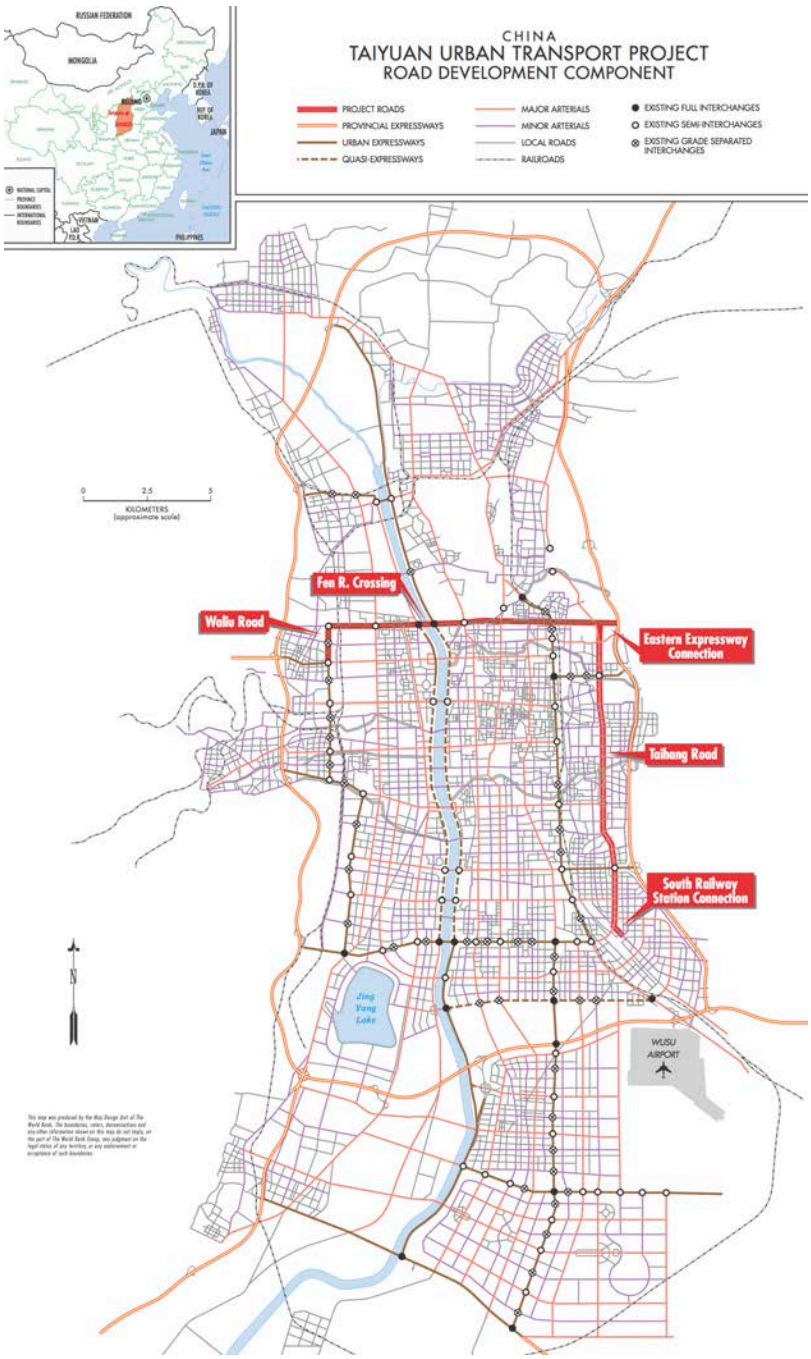


Figure 24: World Bank-funded road construction, finishing the "ring road" around Taiyuan.[xxxix]

The project also allowed for the extension of a ring road, Nanzhongzhuan Road (see Figure 24, above); development of a bus priority scheme in Xinjiang Lu, bus vehicle depots, and automated vehicle location and Bus Dispatching Systems; improved traffic

safety and management and signage (see Figure 25 below), and institutional development in transportation management.[xl]

Figure 25: Road sign for the Taiyuan Ring Roads, World Bank construction project. Site visit, 2014.

Twin Cities Growth

A key element of the plan revolves around the amalgamation of Yuci District into the umbrella of Taiyuan's metropolitan region (see Figure 26, following page), despite the fact that Yuci is not technically part of Taiyuan. Jinzhong is a prefecture-level city, but like Taiyuan, its urbanized area is a much smaller portion of its administrative area. Most of Jinzhong's urbanized areas are within Yuci, which is supposed to be the "twin city" to Taiyuan in its Master Plan.''

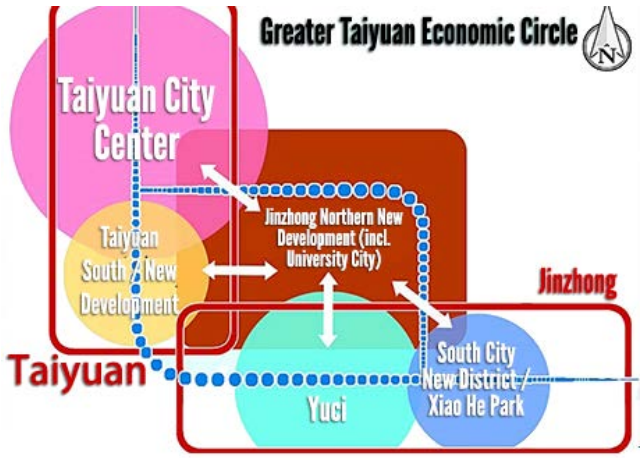


Figure 26: Development from Taiyuan's urban center south and west, into Yuci's periurban areas.

Yuci District has gone back and forth between the designation of city or county, depending on the dynasty that was in power at the time. Jinzhong City is a prefecture-level city, made up of several 12 districts and counties (the most famous of which is Pingyao, which most Westerners will recognize as the location where *Crouching Tiger, Hidden Dragon* was filmed; see Figure 27). Yuci District covers 1328 square kilometers, but its historical downtown and urban center is where the prefecture's government is located.

Figure 27: Jinzhong Prefecture-level City, and its counties and cities.

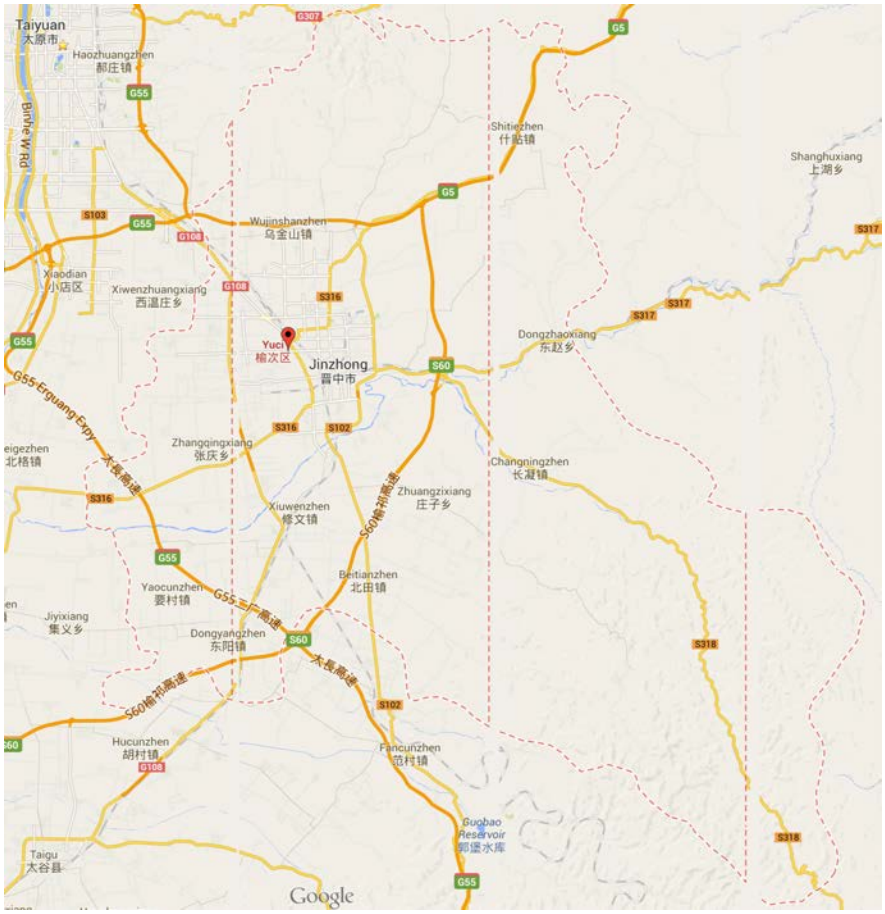


Figure 28: Map of Yuci District. The placemarker highlights the district government office. Interestingly, Jinzhong's most urbanized area (the downtown core) is located within Yuci District, but as a prefecture-level city, Jinzhong encompasses a much larger area.

Yuci borders Xiaodian District and is part of the "Taiyuan-Yuci Built Up Area", the first of several areas to be incorporated into the "Taiyuan City Agglomeration", a key element of the Master Plan,[xli] which calls for large-scale investment and construction along the Fen River and Binhe Lu, creating a vibrant corridor between Taiyuan and Yuci. That means developing new residential and commercial areas along this corridor, extending both east and west of the Fen River. The area southwest of Taiyuan encompasses the Jinyang Reservoir and Jinci Temple, a cultural and historical site.

Figure 28: Layout of Shanxi University City. Each college has its own campus with main entrance along shared streets. The site used to be farmland, and the "river" canal running through the area is artificial.

The major reason Yuci is being included in Taiyuan's current Master Plan is because of "Shanxi University City". The 40 square kilometer site is about 25 km from Taiyuan, close to the airport and at the junction of Jinzhong Prefecture and Taiyuan Municipality, housing campuses for all of the major universities: Taiyuan University of Technology, Shanxi University, Shanxi Medical University, Taiyuan Teachers' College, and Shanxi Finance University, as well as ten smaller colleges, for a total population of 100,000. The layout of the developing area is shown in Figure 28.

Figure 29: Taiyuan University of Technology's main entrance. Construction cranes can be seen in the background and many buildings are unfinished, but classes began in January 2014. Site Visit, 2014.

Figure 30: The campus areas are enormous and as of the Site Visit, mostly uninhabited.

An interesting fact is that the schools themselves had to invest the money in campus construction, even though it was part of the Municipal Government's master plan; Taiyuan University of Technology, with the largest new campus, has invested over 30 million CNY ($4.9 million USD) into its new area. When the subway system is expanded, Line 5 will extend to the campus areas. The whole of Shanxi University City is being constructed at a cost of approximately 10 *billion* CNY, the equivalent to $1.6 billion USD. Along with approximately 100,000 students, it is expected about 11,000 faculty members will also reside in University City, and an additional 13,300 people form the management and research staff.

Figure 31: The digging for the University City river canal. Site Visit, 2014.

Although some of the campus facilities opened in 2013, by March 2014 very few of the schools were completely constructed, and only a few thousand students were residing or taking classes there. In discussions with locals, students complained that the proposed bus lines run erratically, and the roads to the area are incomplete or prone to flash flooding, leading to a variety of traffic problems.

Figure 32: Roads from Taiyu Lu to University City, still unfinished as of Site Visit, 2014, despite some schools opening in 2013. To the right, a van gets stuck in a tunnel, even though the advertised sign at the entrance says 6 meters clearance. Site Visit 2014.

It is believed that once the campus is completely operational and students are in residence, with each student spending approximately 500 CNY per month, Shanxi University City could generate 900 million CNY ($147 million USD) in spending annually, an amount that would dominate much of the investment and commerce in Xiaodian District and Yuci.[xlii]

Completed Elements: Fusion, or Folly?

There are several major, completed elements of the current Master Plan. In the first Study Area, Yingze District, there are Shipin Jie (Food Street), the Historic District Renovation District, and the Yingze Dajie Street Renovation. Southeast of the built city and Yingze District is Study Area 2, Xiaodian District, where Changfeng Jie, the High Tech Development Zone, the Southern Railway Station, and Wusu International Airport

are located. Outside of the study areas, other elements of the plan have already been implemented: Changfeng Shopping and Culture District, and the Red Lantern Stadium. These two elements are notable because of the potential wasteful spending and poor planning that they represent.

Changfeng Shopping and Culture District (Figure 33) is located on the west side of the Fen River, at the junction of Wanbailin and Jinyuan District, and opened in April of 2011. This impressive complex spans over 3 square kilometers and has its own exit from the Binhe Lu expressway. This central cultural hub consists of a high-end retail shopping mall and parking garage on ground level (see Figure 34, on the following page), and cultural institutions and a plaza above it.

Figure 33: Changfeng Shopping and Culture District. Most of the institutions are encapsulated in the trapezoid left of the Fen River; the Coal Transaction Center and Expo Hall are the circular buildings north and west of the district. Satellite photo from 2012.

Figure 34: Lower Level of Changfeng Shopping + Cultural District. Site Visit, 2014.

Figure 35: Inside Changfeng Shopping Mall store. This store sold primarily expensive lamps and home furnishings. Site Visit, 2014.

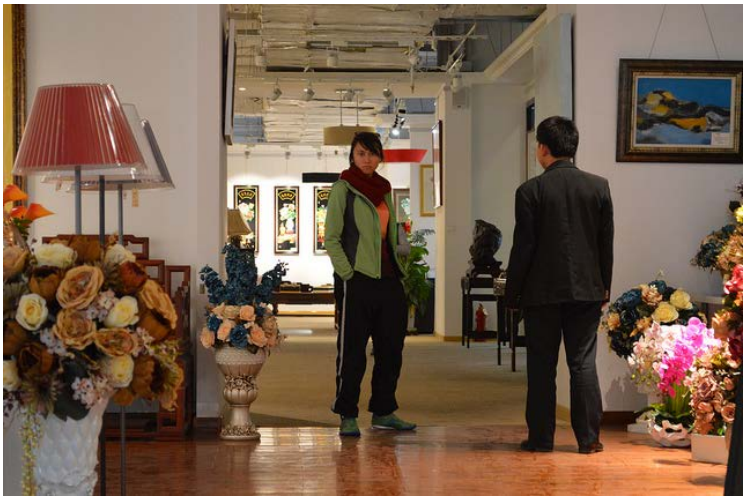


Figure 36: The author could not afford anything. Site visit, 2014.

The Grand Theater (see Figure 37, below) cost a total investment of 790 million CNY (approximately $129,221,169 million USD), offering a variety of performing arts to meet large-scale opera, ballet, drama, acrobatics, symphony, folk music, and chamber music performances.

Figure 37: The Grand Theater at the Changfeng Shopping and Culture Complex. Site visit, 2014.

The Taiyuan Museum of Art, designed by the Dean of Harvard's architecture school, is meant to reflect terraced Shanxi landscapes and an embrace of modern technology. At a cost of 370 million CNY (approximately $60,521,307 USD) to build, it is a sizable structure at 60,000 square meters, but in Figure 38 below, already showed wear and tear from acid rain.

Figure 38: Taiyuan Museum of Fine Arts. Meant to be bright white, the building is already discolored and on some sides, missing tiles. Site visit, 2014.

The new Taiyuan Museum by French architect Paul Landreu and meant to evoke images of Chinese lanterns, a 52,000 square meter structure that houses the city's collection of relics from the Jin and Tang dynasties, as well as facilities to conduct research and restoration of new discoveries. The city museum was even more expensive than the art museum, at a cost of 830 million CNY (approximately $135,767,341 million USD).

Figure 39: Taiyuan Museum. Site visit, 2014.

Although there was already a Science & Technology Museum since 1988, the museum opened a new, 28,000 square meter facility in Changfeng Shopping & Cultural District, with a total investment of 200 million CNY (approximately $32,715,022 USD). The new museum features permanent exhibitions, thematic science exhibition, scientific experiments, technology training, and planetarium presentations.

Figure 40: Shanxi Library Exterior, left. Shanxi Library Interior, right.

The Shanxi Library (Figure 40, above) is perhaps the most impressive institution in the complex; able to accommodate 3,000 patrons at once, the 50,000 square meter structure houses over 7 million books and several digital media rooms, including an audio room for the visually impaired, a 35 terabyte digital database, and an English-speaking staff. The library cost 350 million CNY (approximately $57,251,288 million USD) to construct.

Figure 41: China Taiyuan Coal Transaction Center. Site visit, 2014.

Lastly, the China Taiyuan Coal Transaction Center (Figure 41, above) was built on the northern end of the complex, serving as a financial center as well as an expo hall for all things coal, including demonstrating innovative mechanisms for coal distribution, and establishing and improving coal trading systems. This round, 100,000 square meter building and attached hotel cost 1 billion CNY (approximately $163,564,400 million USD).

Although approximately 10 km away from city center (almost as far away as the airport), several bus lines run to the district and at the time of the site visit, several hundred patrons were making use of the library's facilities; the other institutions were either not yet opened to the public, or the lower level mall was too expensive for most residents. At an estimated cost of 3,540,000,000 billion CNY, the Changfeng Shopping and Cultural District was an investment equivalent to $580,327,868 million USD. Was such an expensive educational and retail destination vital to the Master Plan- at least, at such an early stage? After all, at the time of the site visit, there appeared to be less than a thousand people on the premises of the entire district, with the majority in the Shanxi Library.

The second example of possibly poor planning was the construction of the Shanxi Sports Center, also known as the "Red Lantern Stadium" or "Phoenix Nest" because of its distinctive color and similar appearance to the Beijing Olympic's Bird Nest facility. It is located on the west bank of the Fen River, in Jinyuan District, almost directly across the river from Shanxi Hospital, approximately 16km from the city center. The Shanxi Sports Center covers more than 5 square kilometers, with a total investment of 1.6 billion CNY (approximately $261,713,760 million USD).

Shanxi Sports Center serves as a sports training base for at least a dozen Olympic sports, limiting its membership to professional athletes. It includes an Olympic swimming pool, a pingpong hall, a fitness center, and velodrome- a nod to the sport of BMX, which held its World Championship in Taiyuan in 2008, just two months before being added to the Olympics). However its most impressive, prominent, and public feature is the Red Lantern Stadium (Figure 37).

Built to accommodate 62,000 spectators, the Red Lantern Stadium was officially opened in September 2011, where it held a marathon, a car expo, and two exhibition

soccer matches. It should be noted that in 2011, and until the site visit in 2014, Taiyuan as a city was not home to a soccer club or team. Thus, in its 3 years of completion, the stadium had only hosted less than a handful of events.

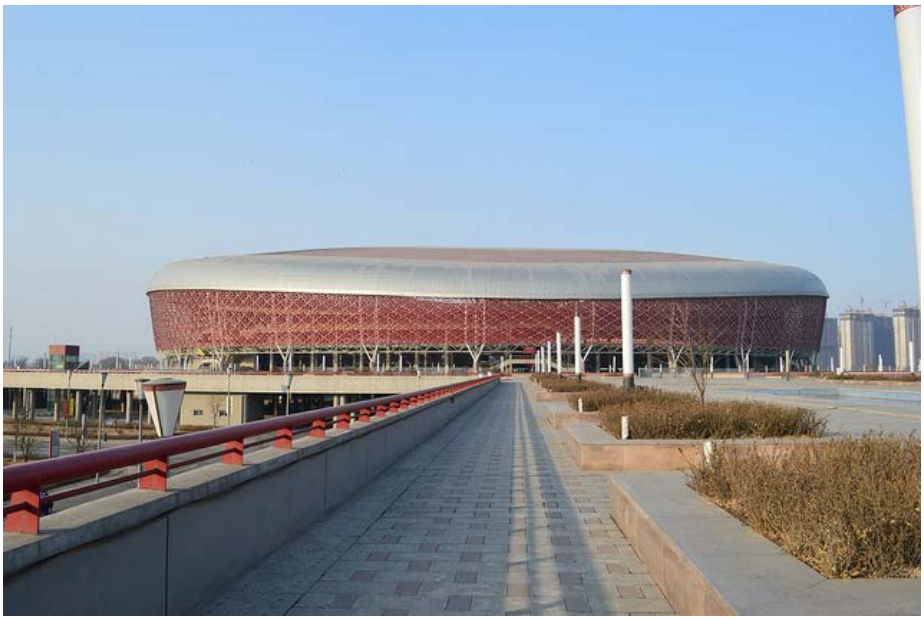


Figure 42: The Red Lantern Stadium in Shanxi Sports Center. Site visit, 2014.

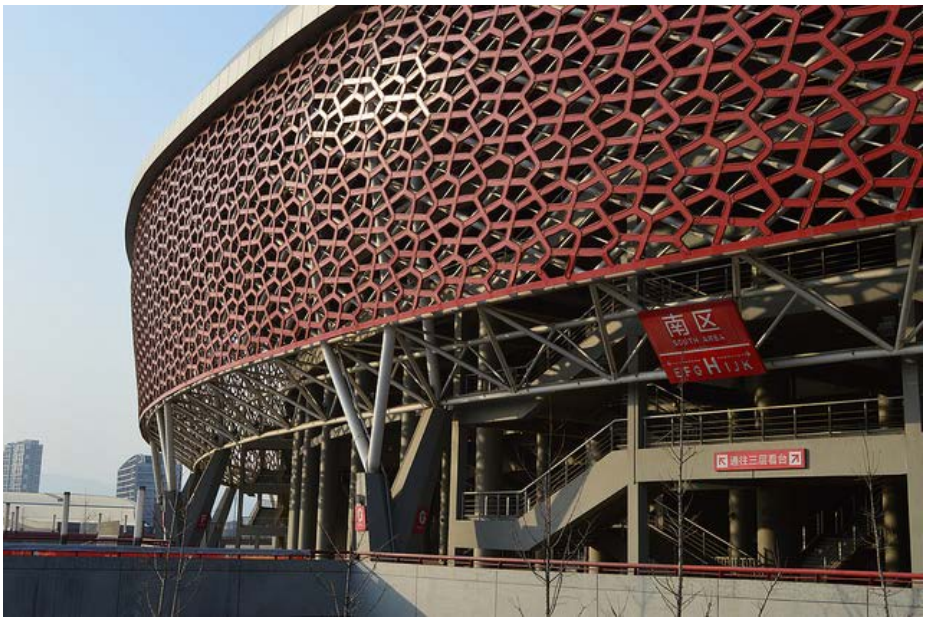


Figure 43: Red Lantern Stadium in Shanxi Sports Center. The gates that were originally designed to control the flow of spectators had been broken into, allowing the author access to the facility. Site visit, 2014.

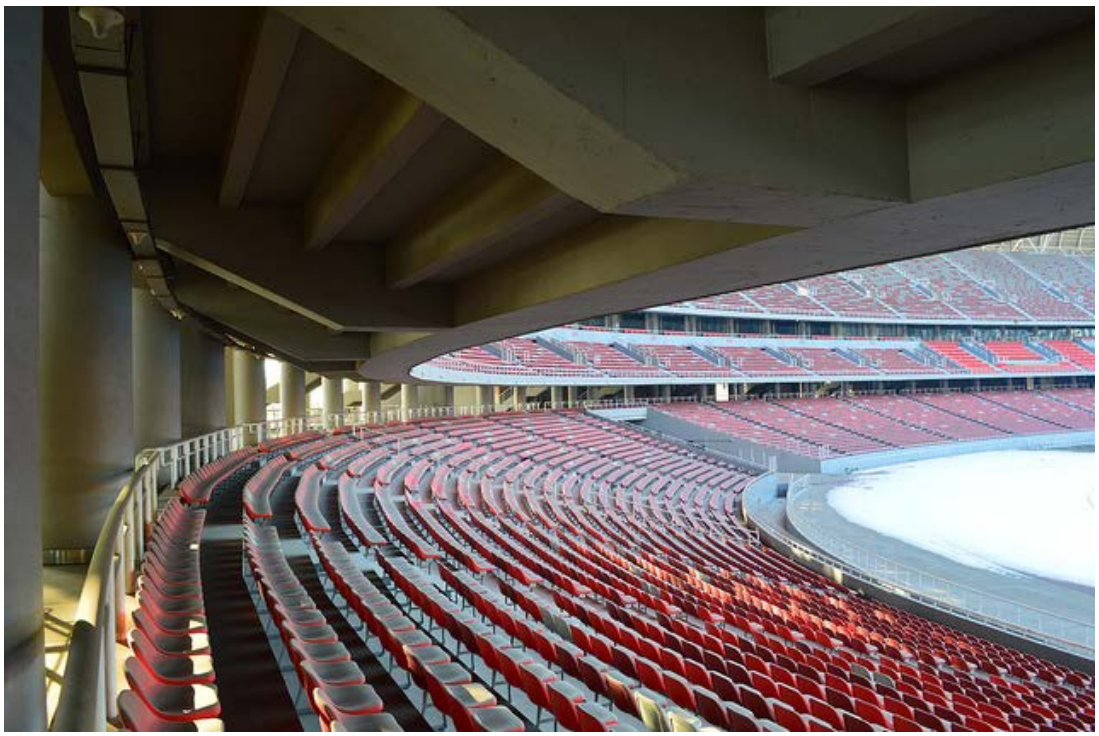


Figure 44: Inside the Red Lantern Stadium. The entire building was deserted except for a single janitor, cleaning on the other side of the arena. Site visit, 2014.

Figure 45: Red Lantern Stadium seats. The seats were covered in a thick layer of dust, either from lack of use, pollution, or both. Site visit, 2014.

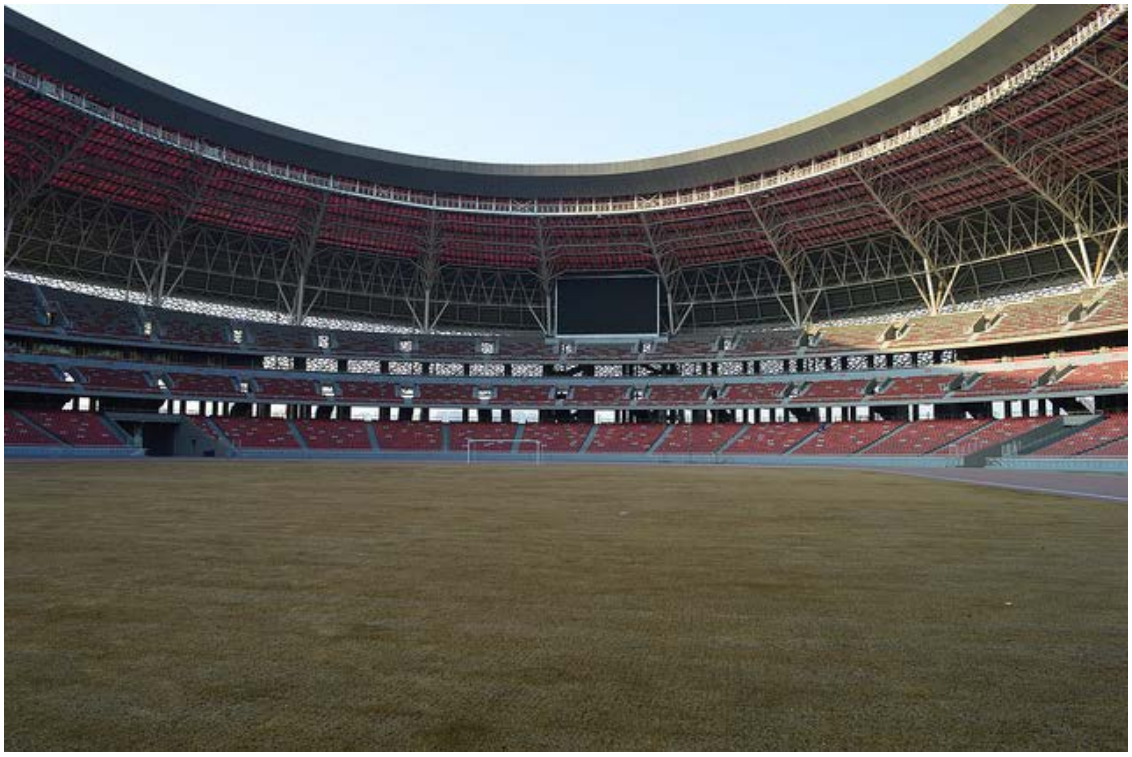


Figure 46: Red Lantern Stadium, from the pitch. The guard rail that would normally prevent fans from storming the field had been intentionally damaged, allowing access to the field- which was otherwise in very good condition. Site visit, 2014.

Taiyuan was briefly famous for having a foreign basketball player, Stephen Marbury, play for the city's home team, the Zhongyu Dragons. Less than a year into his contract, however, Marbury moved to a different team in China, and the Zhongyu Dragons have never won a championship. The reason that is significant is that Taiyuan has never been a sports-driven city (unlike American cities such as Green Bay or Philadelphia), and what notoriety it did have was not in soccer, but in basketball. What was the justification have been for building a 1.6 billion CNY stadium, far from the city, in a district with only 5% of the municipality's population? If part of the current Master Plan is to make Taiyuan a cultural destination and give it the prestige of its own soccer team, was it really necessary to make that investment so early into the stages of the plan?

The combined cost of the Changfeng Shopping and Cultural District and Red Lantern Stadium comes to over 5.1 billion CNY- over $834 million USD, invested in

areas that are far from the city center (making it difficult to access unless by private car) and offer entertainment or cultural pursuits that are out of reach for the majority of residents. If the city government were so willing to spend the funds necessary to complete these projects, would an established district like Yingze District find itself headed for disaster?

With the various projects being built around Taiyuan, what kind of impact are these elements from the Master Plan having on the city and its districts?

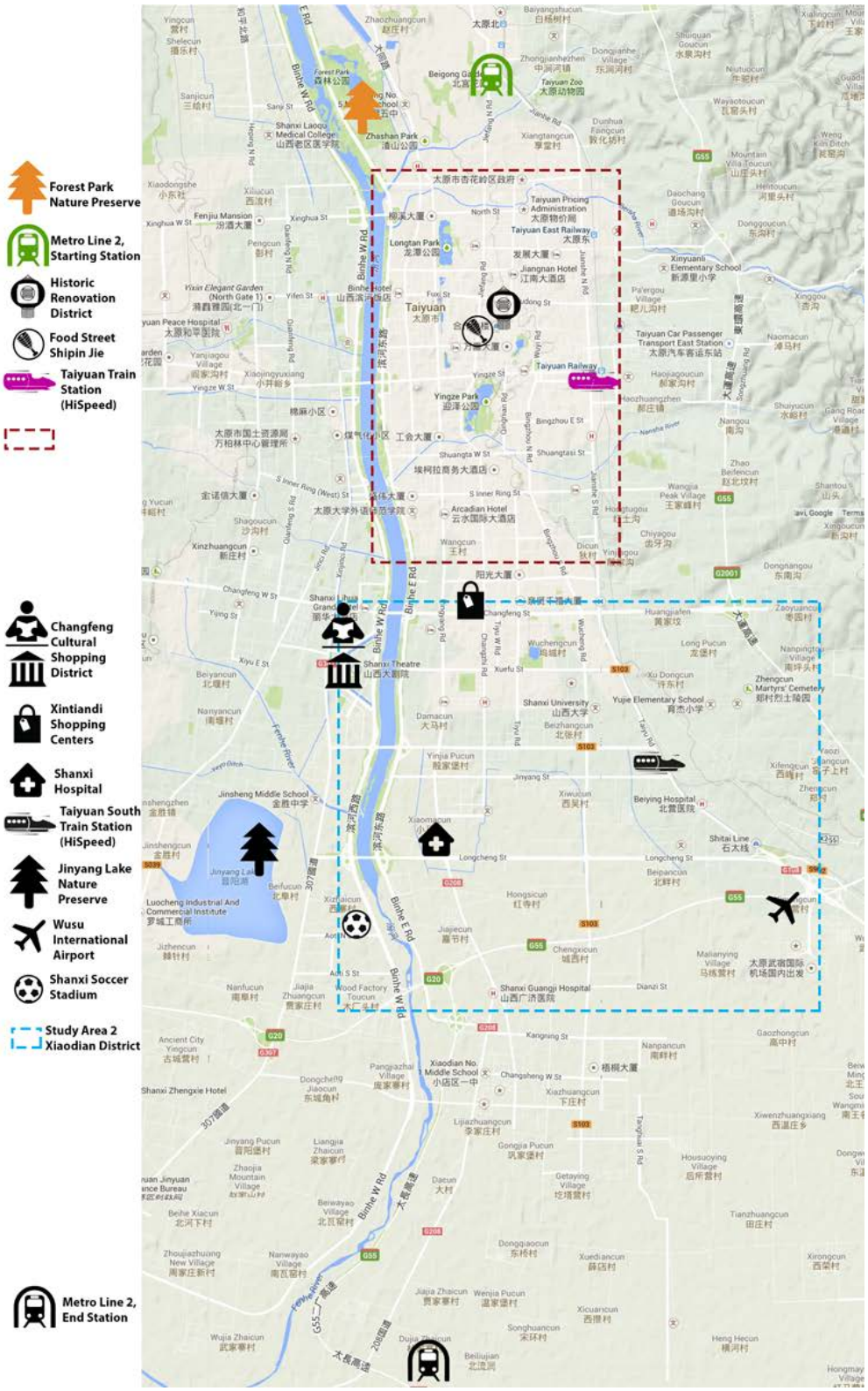


Figure 47: Elements Map with Study Areas

CHAPTER 5

TAIYUAN DISTRICTS

Taiyuan is comprised of 10 districts and counties, only 6 of which are considered "urbanized", with the most densely built districts, Yingze and Xinghualing, singled out in government documents as the "City Proper".

Figure 48: Taiyuan's 10 Administrative Districts. Its 6 urban districts are in the smaller ones clustered in the center, while the 4 rural districts surround it (Loufan, Yangqu, Guijiao, and Qingxu). Most of the heavy industry takes places in the outer districts.

Core		Population (2013)	Area (sq km)	Density (per sq km)
Xinghualing District	杏花岭区	650,279	170	3,825
Yingze District	迎泽区	598,819	117	5,118
Urbanized				
Xiaodian District	小店区	815,898	295	2,766
Jiancaoping District	尖草坪区	422,615	286	1,483
Wanbailin District	万柏林区	761,379	305	2,496
Jinyuan District	晋源区	224,465	287	779
Satellite cities				
Gujiao City	古交市	208,168	1540	131
Rural				
Qingxu County	清徐县	346,941	607	570
Yangqu County	阳曲县	120,774	2062	59
Loufan County	娄烦县	106,988	1290	84

Table 2: Data from Taiyuan Statistical Yearbook 2013. Numbers reflect total (*hukou*-holding and migrant) population in each district.

As the city grew, the eastern half (in Figure 49 on the following page, the eastern side of the Fen River, which bisects the city) retained commercial status and administrative prestige. On the east side is the dense downtown, including major shopping centers, corporation headquarters, and provincial offices, sometimes referred to in government documents as the “city core”.

Binhe Dong Lu (East Binhe Road) and Binhe Xi Lu (West Binhe Road), run north-south on either side of the Fen River and serve as major arterial highways both within the city and, in Binhe Dong Lu's case, also to the airport to the south.

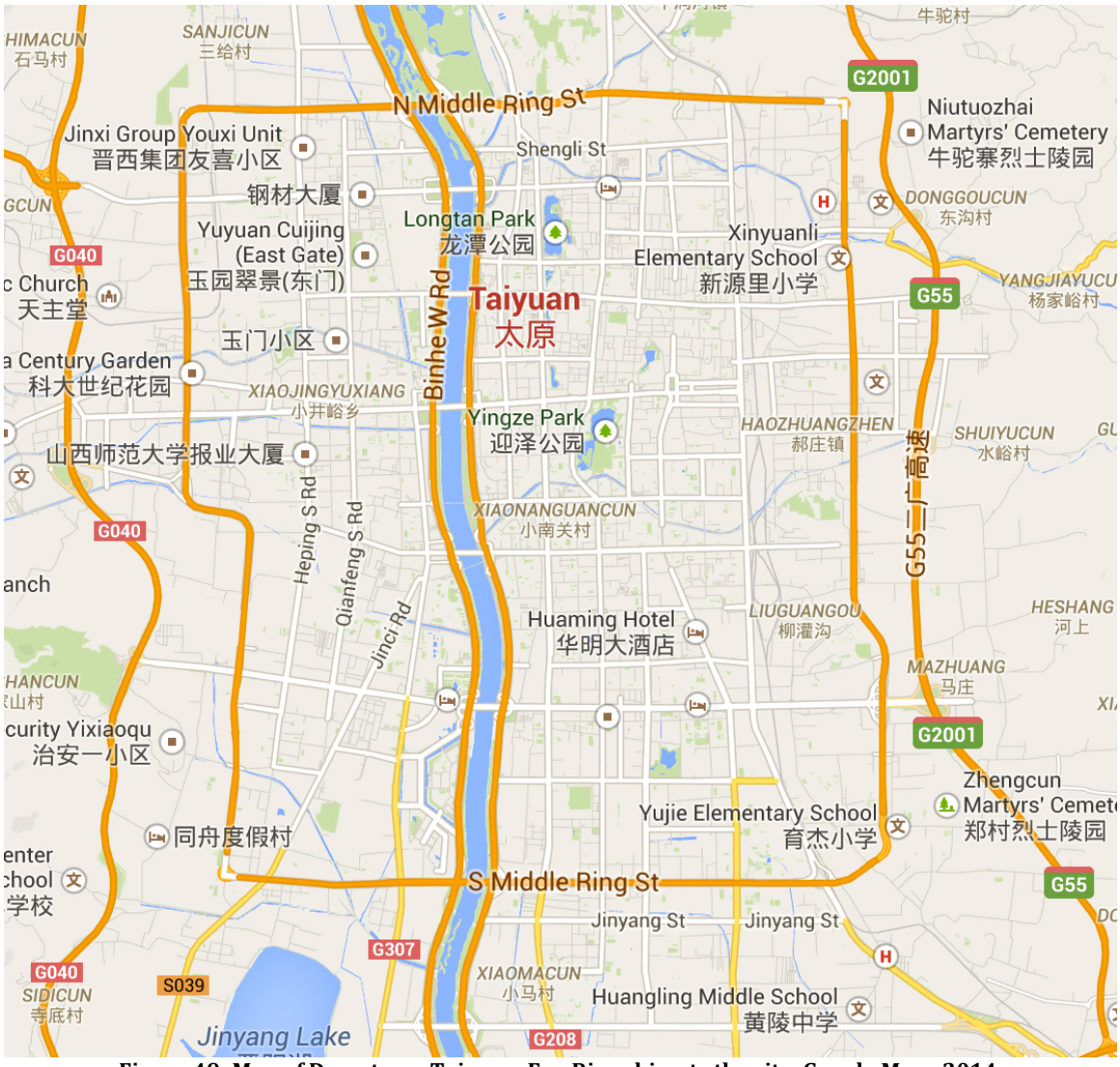


Figure 49: Map of Downtown Taiyuan. Fen River bisects the city. Google Maps 2014.

On the west side, there is a haphazard mix of suburban areas, Taiyuan University of Technology, and industrial zones. The largest coal mine is to the west, at the base of Xishan, and the largest steel plant is far north on the eastern side, away from historic and commercial areas. Yet since 2007, with the current Master Plan guiding

development, three major sectors have been moved much further south: industrial operations, cultural destinations, and high-end retail.

The first is in industrial operations; because of its polluting nature and tendency to curtail residential and retail appeal, refineries, factories, and pharmaceutical companies are being forced to relocate and operate on the perimeter of Taiyuan municipality. (The exception to this guideline has been TISCO, Taiyuan Industrial Steel Company, whose campus is so large and has been so long established in Xinghualing District that it cannot be moved without great expense.)

The second are new cultural destinations, like the massive opera, library, and museum complex, or the soccer stadium and Olympic training facilities that have opened up on West Binhe Road. Historically much of the cultural destinations had been located on the older, eastern side of the Fen River, so building these new destinations on the west side is a conscious attempt to bring new vitality to an underdeveloped part of Taiyuan.

The third is high-end retail; these new, glittering shopping malls are moving much further south, in part because the peri-urban edges are less dense and allow for larger construction projects, and in part because real estate speculation about these moves have led to a proliferation of high-end residential apartment complexes that all boast proximity to the latest and greatest in consumer fashion. Brands like Haagen Daaz, Starbucks, MANGO and Louis Vitton are regular staples in these malls, even though the average annual residential income in Taiyuan in 2013 was only 39,365 CNY ($6,396 USD).

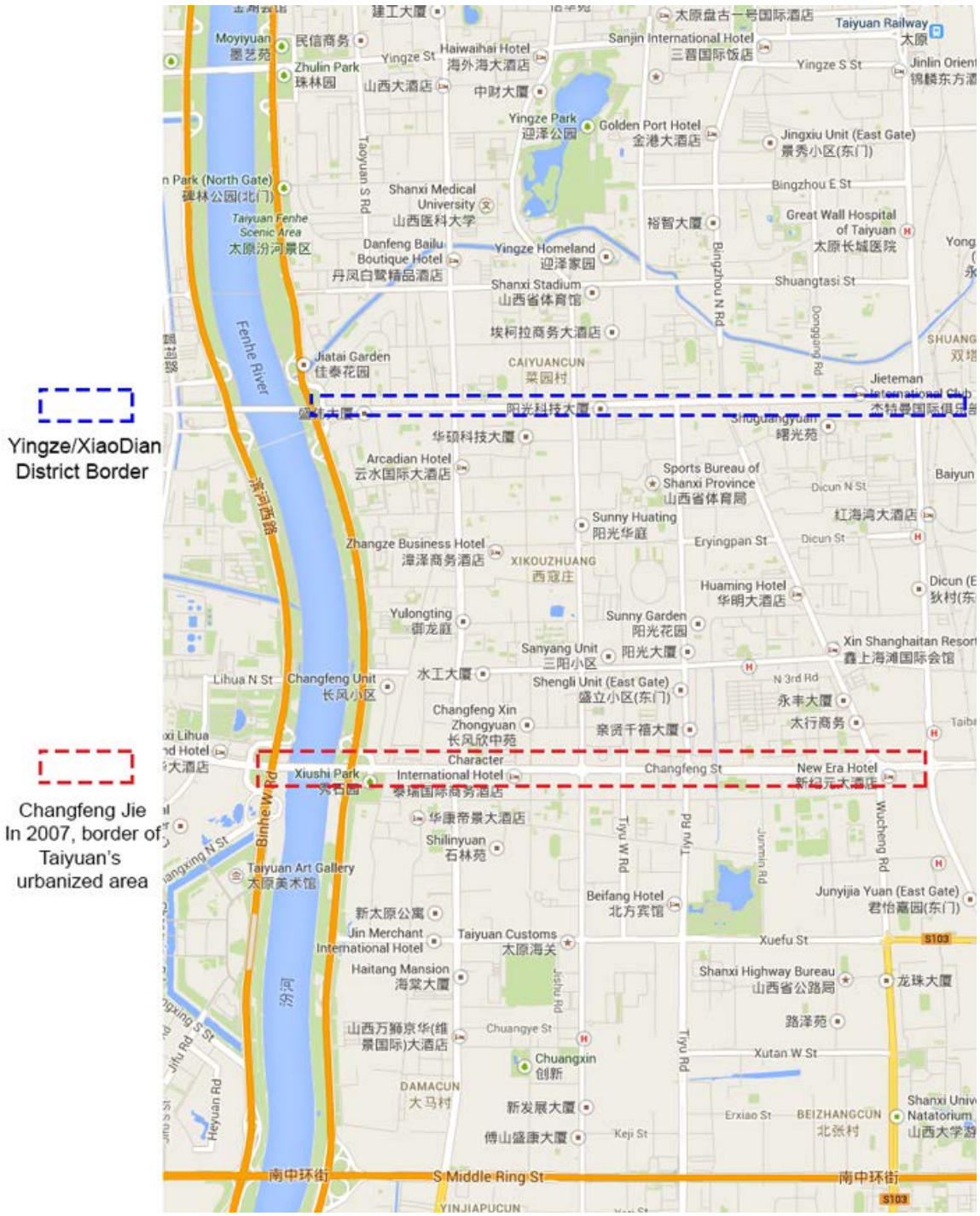


Figure 50: Changfeng Jie, in southern Taiyuan. Google Maps, 2014.

Until 2006, Changfeng Jie represented the edge of Taiyuan's most developed area (see Figure 50); south of it, the densely built, high rise towers and high-end retail began to give way to buildings under 10 stories around the Shanxi University area. The 15km stretch of Binhe Dong Lu from Changfeng to Wusu International Airport was sparsely developed and mostly zoned for industrial purposes, primarily inhabited by factory workers.

In 2013, the Taiyuan Bureau of Statistics released the latest available data, placing Taiyuan's total population (downtown, suburban and rural districts) at 4.25 million in 2012.[xliii] Furthermore, according to government officials, Taiyuan's annualized growth rate is 5.4%[xliv], an overall increase from the previous year by 0.52%, and a growth rate of 1.2%.[xlv xlvi]

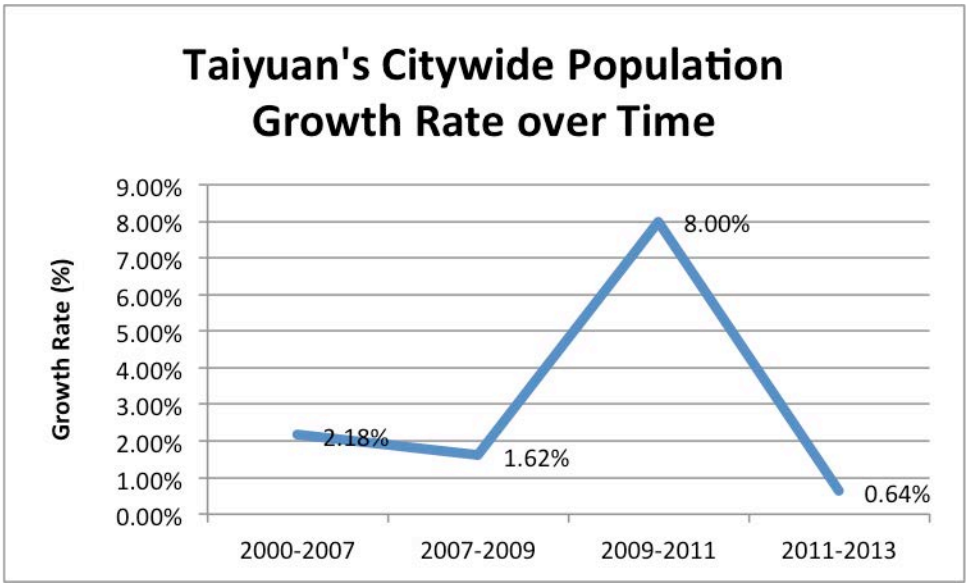


Figure 51: Taiyuan's growth rate. It peaked in 2009-2011, slowing considerably afterwards.[xlvii]

If the 1.2% growth rate held from 2012 to 2020, the municipality would grow to a population of 4,626,989 people.[xlviii] However, in Figure 51 there has been a sharp decline from the high of 8% increase in population (which can be explained by a push to urbanize and high numbers of rural-to-urban migration in that period) to 2013, which

sees the lowest levels of population growth since the turn of the century. Government officials have anticipated this slowdown in growth, since they estimate a population of 5 million people in 2020[xlix], but some studies place it at 4.8 million.[l]

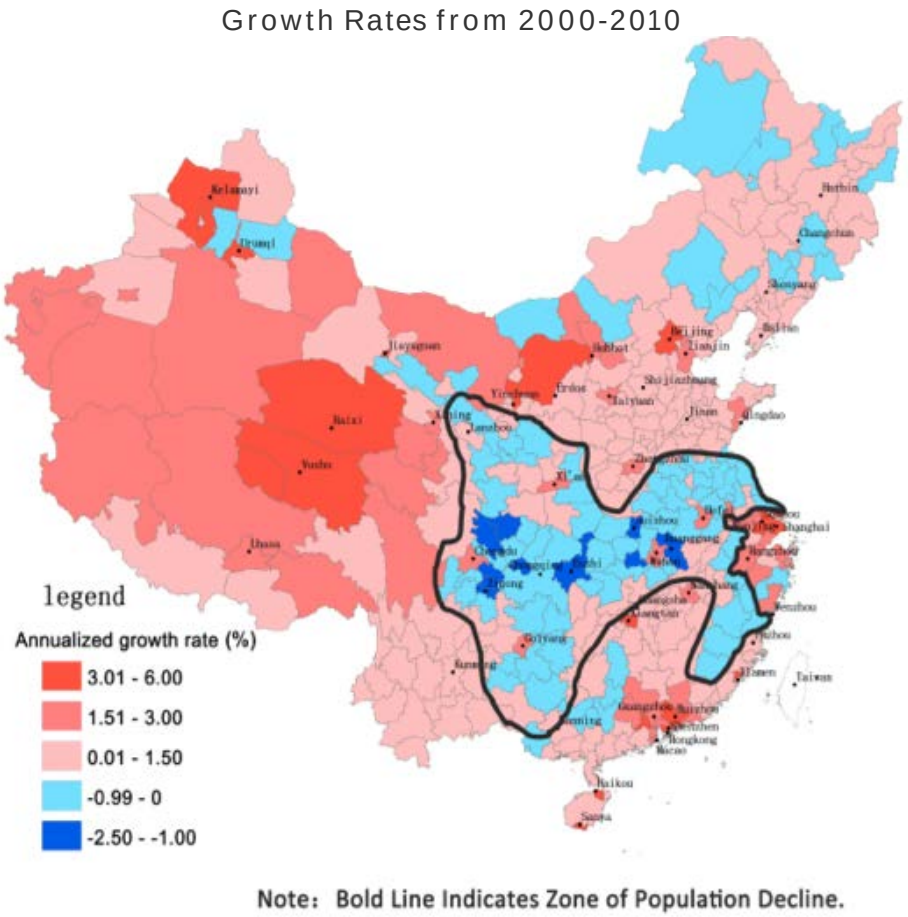


Figure 52: Central China experienced a loss of population at the turn of the century, although in Taiyuan, population growth was comparatively high.[li]

As seen in a Lincoln Institute study, from 2000-2010 Taiyuan was experiencing 1.51-3% annualized population growth rate, but after the 2010 growth "spurt" (see Figure 52), most of the population increase that city officials are expecting will be coming less from natural birth rates, and more from continued rural-to-urban migration, especially as the city's Master Plan implements new amenities to draw new residents from other parts of Shanxi province.

But if population growth is slowing down, and the city is focusing investment on major infrastructure changes- most to the south, out of the established downtown area – what kind of effect will this have on the established areas, particularly Yingze District?

I begin by looking at key indicators for two study areas.

Study Area 1 is Yingze District, which contains the established, "old" city center. Yingze is currently seat to most government offices (although plans are to move more government offices to the south), bank headquarters, and corporate headquarters.

Study Area 2 is XiaoDian District, an extremely large district south of Yingze and northwest of Yuci that contains most of the new growth and elements.

Study Area 1: Yingze District

Yingze District contains many, if not most, of what was considered classically "Taiyuan". On the following page, clockwise from left to right, some of these sites are the Yingze Dajie Bridge, the Shuangta Si Twin Pagodas, Taiyuan Railway Station, Yingze Park, Shipin Jie / Food Street, and Wuyi Square.

Figure 53: Map of Yingze District. The district headquarters are indicated by the yellow star. Although Yingze's most valuable assets are in the urbanized "heart" of downtown Taiyuan (to the west of the map), the district itself is largely to the east. Google Maps, 2014.

Figure 54: Left, a photo of Yingze Bridge; right, a photo of the Shuang Ta Twin Pagoda Towers (site visit, 2014).

Figure 55: Left, a photo of Yingze Park; right, a photo of Taiyuan Railway Station. Photos from Baidu Images.

Figure 56: Left, a photo of Shipin Jie aka Food Street; right, a photo of Wuyi Square. Site visit, 2014.

Yingze District is the smallest, densest district in Taiyuan. In 2014, the total population was 598,819 persons, making it the 4th largest of the 6 urban districts, with 5118 people per square km despite being only 117 square km in size.

It has also historically been home to most of Taiyuan's major government and bureau offices: Taiyuan People's City Government, the People's Government of Shanxi Province's offices, Shanxi Legal Office, Communist Party of Taiyuan Commission for Discipline Inspection Office, Shanxi Statistics Bureau, the Administrative Bureau of the People's Government of Shanxi Province, and the Shanxi Foreign and Overseas Affairs Office are all located in close proximity to each other.[lii] So with history, tradition, and government function, Yingze district has served as the seat of power and influence for the city and province.

Within this historic and storied district are some of the oldest neighborhoods, built with 6-stories of brick (because elevators were only required in buildings with more than 6 stories) and a form of block-controlled centralized heating that only worked once the city had decided it was cold enough to warrant turning on the heat. Because of the proximity to everything a downtown has to offer: bus lines, the train station, high-ranking high schools, shopping streets, key universities, and major government bureau headquarters, when choosing to reside in Taiyuan, Yingze District remains a desirable residential area.

While many amenities or facilities in Yingze have been renovated or expanded in the last decade, the creation of new destinations in Xiaodian District- new shopping centers, new hospitals, new apartment complexes, new schools -means that the District may find it challenging to maintain its strong appeal long-term. Four of these renovations or expansions are the Taiyuan Railway Station, Liu Xiang Shopping Street, Shipin Jie Food Street, and Yingze Dajie Street Renovation.

Study Area 2: Xiaodian District

Figure 57: Map of Xiaodian District. The district headquarters are indicated by the yellow star. A large district, Xiaodian contains most of the new elements of the Master Plan. Google Maps, 2014.

Directly south of Yingze District is Xiaodian District, which has the highest population of any district in the municipality (815,898 persons in 2013) and at 295 square km it is the second largest of the 6 city proper districts. Despite its high population, however, it is only the third-densest district at 2,766 persons per square km, owing in large part to the undeveloped nature of southern Xiaodian.

Xiaodian was established as a district in 1997. The primary industry of the district is focused on high-tech development campuses (of the national Economic and Technological Development Zones opened in 2002) and urban agriculture; Xiaodian produces 60% of Taiyuan's agricultural products.[liii] In 2004 Foxconn, a major consumer electronics production company from Taiwan that is responsible for most of the world's cell phones and computer parts, established one of its seven mainland China factories in the Taiyuan Economic and Technological Development Zone. Aside from being a major economic contributor to Xiaodian's GDP, Foxconn's presence was also strong factor in the "international" moniker of the airport; Taiyuan's renovated Wusu International Airport was only considered international because of weekly charter flights to Taiwan for Foxconn factory managers.

Xiaodian's GDP in 2000 was 994,280,000 CNY (approximately 162,285,079 USD), but thirteen years later had multiplied many times over, reaching 28,979,086,000 CNY (approximately 4,729,928,454 USD). Significant investment has been made in several areas: road infrastructure, the Southern Railway Station, Wusu International airport, the Red Lantern Stadium, and Shanxi Hospital.

Taiyuan Southern Railway Station

On July 1, 2014, the Taiyuan Southern Railway Station opened, becoming the largest integrated transportation hub in Shanxi Province and adjacent to Shanxi University, Shanxi Finance and Economics University, the Taiyuan High-tech Development Zone, and nearby University City. Located in the southeastern quarter of Taiyuan, in Xiaodian District, the station is 10.4 km (approximately 25 minutes) from Wuyi Square, which is adjacent to the main Railway Station.

Figure 58: Location of the Southern Railway Station. Located in Xiaodian District, it is south and east of Wuyi Square.

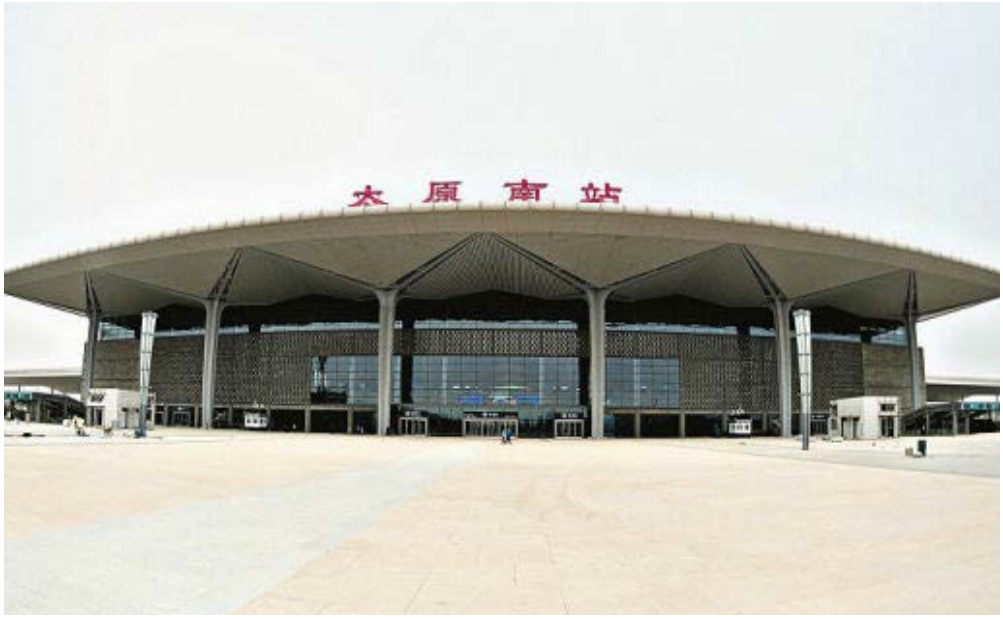


Figure 59: Exterior of Southern Railway Station, before offical opening in June 2014.

At 55,000 square meters, this station is expected to serve 40 million passengers or more each year and represents the first form of modernized transport in Taiyuan.[liv] The facilities were modeled after major international airport and railway statiosn, featuring international signage (see the interior in Figure 60), separate waiting rooms depending on class of ticket, waiting areas for disabled and elderly passengers, food and

retail, as well as connect to Metro Lines 1 and 14 (with Line 1 terminating at Wusu Airport). Unlike many Chinese railway stations, the Southern Railway Station offers stairs, escalators, and elevators for traversing between all levels.

Figure 60: Interior of the Southern Railway Station. It looks extremely similar to stations in Shanghai.

The building also features green building design, with low-emissions glass, controlled windows and specially treated rubber flooring for noise reduction. At a cost of over 30 billion CNY ($4.8 billion USD), it is the single most expensive element of the current Master Plan, with the possible exception of the subway system; but it is easily one of the most impressive.

Taiyuan Wusu International Airport

The original Taiyuan Wusu Airport was built in 1939, 13.2 km away from downtown Taiyuan in XiaoDian District, and remodeled in 1968 and 1992. By 2006 it was a single terminal, its exterior in dilapidated condition covered with grime and dust. The broken concrete pavement parking lots and the ambivalent taxi drivers that refused

to make the 13 km trip for less than 300 CNY (equivalent to $45 USD) made the entire experience of landing there rather grim.

Figure 61: Taiyuan Wusu Airport, 2006.

Figure 62: Location of Taiyuan Wusu International Airport.

The 2008 Olympics saw massive, even frantic infrastructure expansion by the national government. Taiyuan, already looking to complete key projects as part of the Master Plan, rushed renovation on the airport in 2007 to serve as a possible "overflow" airport for the Olympics (Taiyuan is only 50 minutes by plane to Beijing).

After a 1.57 billion CNY renovation[lv] and expansion of the Wusu Airport was completed (just in time for the Olympics), the single terminal had been transformed it

into a two terminals, 78,000 square meters combined. The gleaming glass and tile buildings are connected via glass walkways, and its steel-and-glass Departure Hall is eerily reminiscent of the Beijing International Airport. It even features a special "fast" lane for businessmen and travelers who are going to Beijing.

Taiyuan's airport is unusual compared to other regional airports in that it has long offered direct flights to Taipei. This is because of the presence of Foxconn's industrial park in XiaoDian District. Foxconn's management is almost entirely Taiwanese, and they offer these individuals the chance to fly back to Taiwan every 6 weeks. After the renovation, however, the international options of the airport grew to include direct flights to Hong Kong and Seoul. Built with a capacity for 6 million annual passengers, in 2012 it exceeded it, and in 2013 it exceeded that with 7.81 million passengers, making it China's 28th busiest airport[lvi] (a coincidental statistic is that according to the 2010 National Census, Taiyuan was also China's 28th largest city).

Taiyuan Wusu International Airport's current location is extremely convenient for access between Taiyuan and Yuci. Only 8km away is the Southern Railway Station, and the airport is parallel to University City. Unfortunately, this prime location also takes up a great deal of the roads and infrastructure, evidenced in Figure 56 on page 65, creating a bottleneck in traffic between the two urban hubs.

Figure 63: View of Taiyuan Wusu Airport after the renovation.

Figure 64: Taiyuan Wusu International Airport in 2013.

Since airport traffic is expected to increase as well, part of the current Master Plan may need to include eventually shifting the airport to a different location, further away from the Taiyuan-Yuci corridor, more directly south of downtown Taiyuan and closer to the Fen River. Eventually when the area becomes more built up, it may be inconvenient to have an airport in the middle of an urban area.

Shanxi Hospital

Some of the healthcare initiatives have included the establishment of the province's largest hospital and medical complex, Shanxi Hospital (see Figure 65). A full square kilometer in size, with a cost of over CNY 1.14 billion to construct (more than the entire district's GDP in 2000), the hospital opened its doors in October, 2011 and is currently a hub of activity.[lvii] Located 13 km from Taiyuan city center, 11 km from the airport and 20 km from Yuci along the G208 Highway (see Figure 66), the hospital complex opened with 2,000 beds, 100 doctors and 200 nurses.

Figure 65: Shanxi Hospital, on Longcheng Road. Site Visit, 2014.

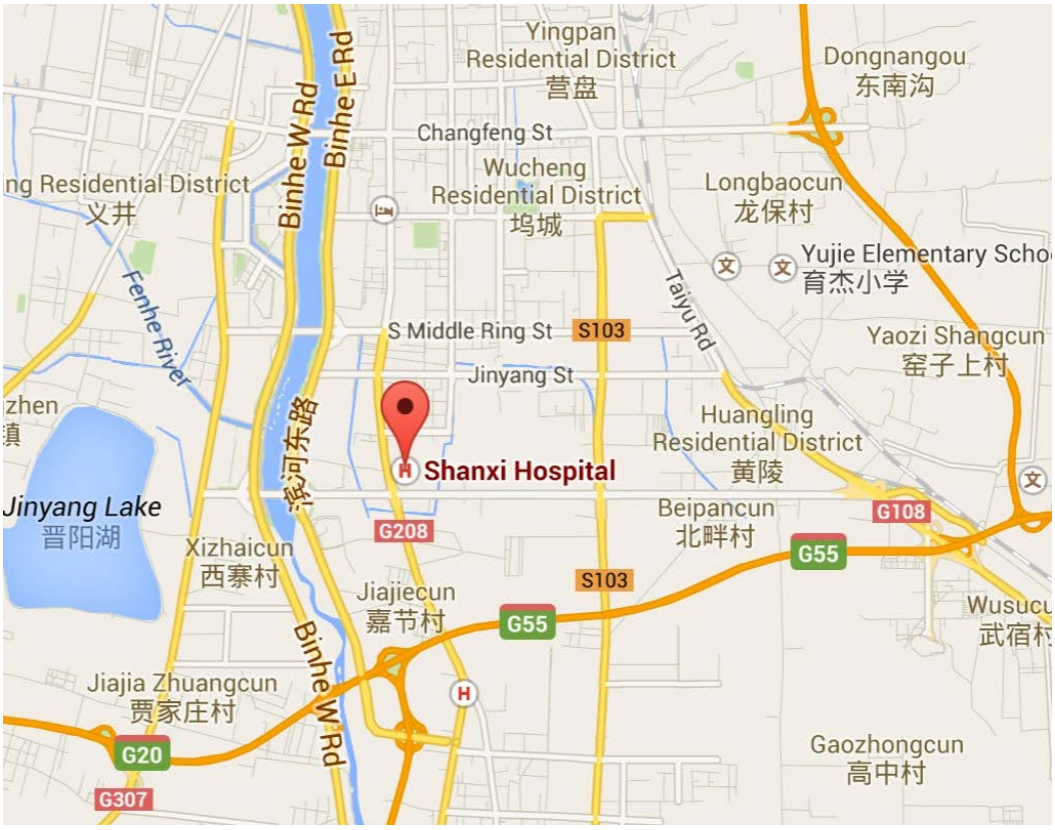


Figure 66: Shanxi Hospital Location. Google Maps, 2014.

When it was first built, there was little to no development in either direction on Binhe Dong Lu; the site selection seemed against the interest of public health because of how far away it was from city center, at a time when the built-up area of Taiyuan was 10km away.

However, part of the argument in favor of placing the hospital in a fairly unpopulated region was because of the Master Plan. The original site selection for the hospital was between Changfeng Jie and Xuefu Jie (see Figure 67). This placement meant the hospital was at the edge of dense development (Changfeng Jie) and near other large, corporate structures and retail, like the only Wal-Mart in Taiyuan, several financial institution headquarters, and five star hotels. It also would have been directly across the river from the planned Changfeng Shopping and Cultural District.

Figure 67: Originally proposed location of the hospital, somewhere between Changfeng Jie and Xuefu Jie.

But after proposing this plan and opening it up to public response, surveys and petitions revealed four major flaws.[lviii] Firstly, it would have involved the demolition of several major multi-family apartment complexes, meaning several tens of thousands of people would have had to resettle, and hundreds of thousands more would be affected by

the construction and changes to road traffic. The sheer size of the planned hospital (1.4 square km of property, and the building itself is 220,000 square meters) would have meant enormous construction costs, traffic delays, and resettlement in a more established part of Taiyuan. Secondly, government compensation for the loss of housing would most likely not be enough for these families to find new apartments because Taiyuan's housing market is so incredibly inflated. Thirdly, many residents objected to building a hospital there since, in Yingze District contained so many hospitals and clinics already. XiaoDian District, where the new hospital would have been located, is a very large district and so does not contain as many hospitals as Yingze, but between Changfeng Jie and Xuefu Jie there are several hospitals within a 3km radius, so the public viewed another massive hospital as a waste of resources.

And lastly, the public was concerned about the disposal of medical waste or the spread of diseases. Since the Shanxi Hospital was supposed to include advanced quarantine and testing facilities, it was considered better for public health if it was kept out of the urbanized areas.

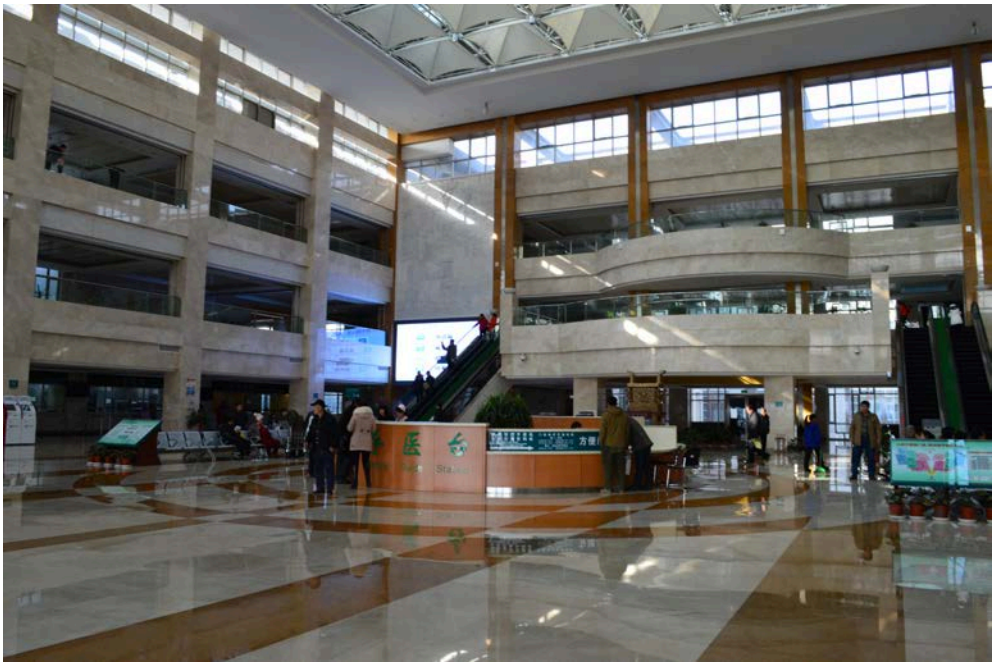


Figure 68: Shanxi Hospital, Information Desk and Lobby. Site Visit, 2014.

So the current location (see Figure 69, below) was chosen- well outside of Taiyuan's built up areas and deeper inside of XiaoDian District. On Longcheng Lu, it is accessible via the major highway Binhe Dong Lu, which goes towards the airport (10 minutes away by car), runs parallel to the Southern Railway Station, and eventually leads to Yuci.

Figure 69: Satellite view of Hospital Location.

This location has encouraged real estate development and increased speculation, spurring rapid construction of high-end, high-rise complexes and luxury apartments, seen in Figure 50. Some of the staff rent second apartments near the hospital at a cost of 2,000 CNY a month, an interesting price considering how similar it is to the rent of apartments in much more central locations of Taiyuan. In deference to its distant location to the city, new bus lines have been created, which take anywhere from 25-80 minutes to get from Wuyi Square to the hospital.

While that certainly makes commuting easier for doctors, nurses and supporting staff, it also means that the hospital is primarily accessible to a population that has

access to a car, or is not so ill that they can't sit on a bus for a long period of time. However, the hospital's out-of-the-way placement actually strengthens the connection that Taiyuan has with Yuci and the southeast areas of Jinzhong. A highly visible landmark, and already earning its reputation as the best treatment facility in the province, Shanxi Hospital seems to be serving well as an anchor for parts of the Master Plan that continue to emphasize pushing south.

Figure 70: Shanxi Hospital. Apartments can be seen being built along the skyline.

Although there are more elements to the Master Plan outside of these Study Areas, like the aforementioned Changfeng Shopping and Culture District, the Subway System, and the Soccer Stadium, due to limited resources and access to data, I believed an effective (although not comprehensive) evaluation of the effects the current Master Plan is having on Taiyuan. My two research questions encapsulate the major concerns of embarking on any major urban plan: Will it prove detrimental to the established core? Will the new developments actually have the benefits promised?

CHAPTER 6

ANALYSIS: STUDY AREA 1, YINGZE DISTRICT

If population growth is slowing down, and the city is focusing investment on major infrastructure changes- most to the south, out of the established downtown area – what kind of effect will this have on the established areas, particularly Yingze District, one of my two study areas? Will Yingze District slip into decline? The current Master Plan has been in effect since 2007, so the last seven years have seen major elements from the plan reach completion or at least begin construction. I will look at elements from the Master Plan in two study areas, with reference to demographic, economic, topographical, and land use parameters.

The first study area is Yingze District, the location of most government headquarters and many of urban Taiyuan's historic and culturally significant sites. The second study area is Xiaodian District, the district south of Yingze and northwest of Yuci, that contains many of the new transformative projects from the Master Plan.

I have identified three scenarios for Yingze District in 2030, approximately 10 years after the completion of the Master Plan and when Taiyuan Metro Network is complete.

High: The population would continue to increase, along with increasing real estate values, new services and amenities like new retail centers, exceptional middle or high schools, and parks. Major headquarters of companies or government agencies would be located there. Investment (both foreign and state) would be rising.

Medium: The population growth would slow down and stabilize, real estate values would not increase, and the number of new residential areas would be few. While new construction and amenity creation would slow, the existing amenities would be well-utilized.

Low: The established population would begin to decline, while the number of migrants from outside the city proper moving to the district would likely increase; although that might help overall population remain stable, it would be a sign that residential property values were falling.

I will compare population change, real estate investment, residential price per square meter, commercial price per square meter, GDP, secondary industry output, tertiary industry output, fixed investment, science & technology expenditures, and education expenditures to see if the primacy the government places on Xiaodian District is having a deleterious effect on Yingze District, and determine which is the most likely explanatory scenario.

Population

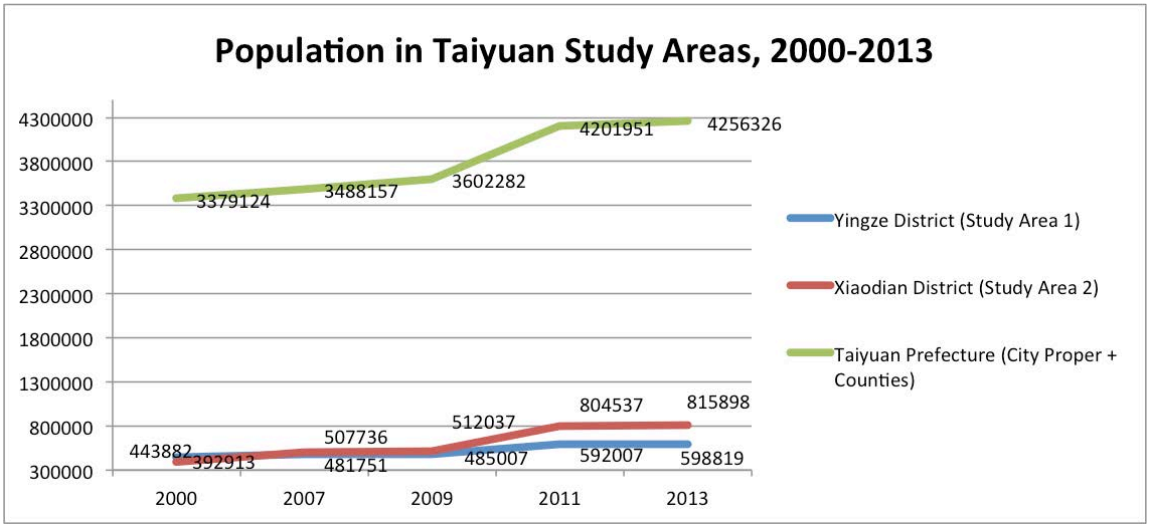


Figure 71: Data from Taiyuan Statistical Yearbooks. Population growth in Yingze District has not followed the same rapid increase as Taiyuan City as a whole.

Looking at the growth of Taiyuan between 2000 and 2013 in Figure 71, both the study areas experienced a slight decrease in population from 2007 to 2009, which is when the Master Plan began to be implemented- but also the time of a global economic downturn. In Taiyuan, such a resource-dependent city, the lack of global demand for

steel hit major companies (and major employers) extremely hard. Although build-up for the 2008 Beijing Olympics meant companies like TISCO were hiring more workers to meet the demand for steel products, there was a sharp decline after the Olympics.

Although this meant that many of the "floating", migrant population left the province looking for other work, the lack of manufacturing demand had the unintentional benefit of improving the air quality immensely. The number of blue sky days greatly increased, measured in Figure 72 as sunshine hours. In 2007, when industrial demand was high and both study areas had high population growth, the number of sunshine hours (red line) is fairly low compared to years 2008 and 2009, (green line and purple lines).

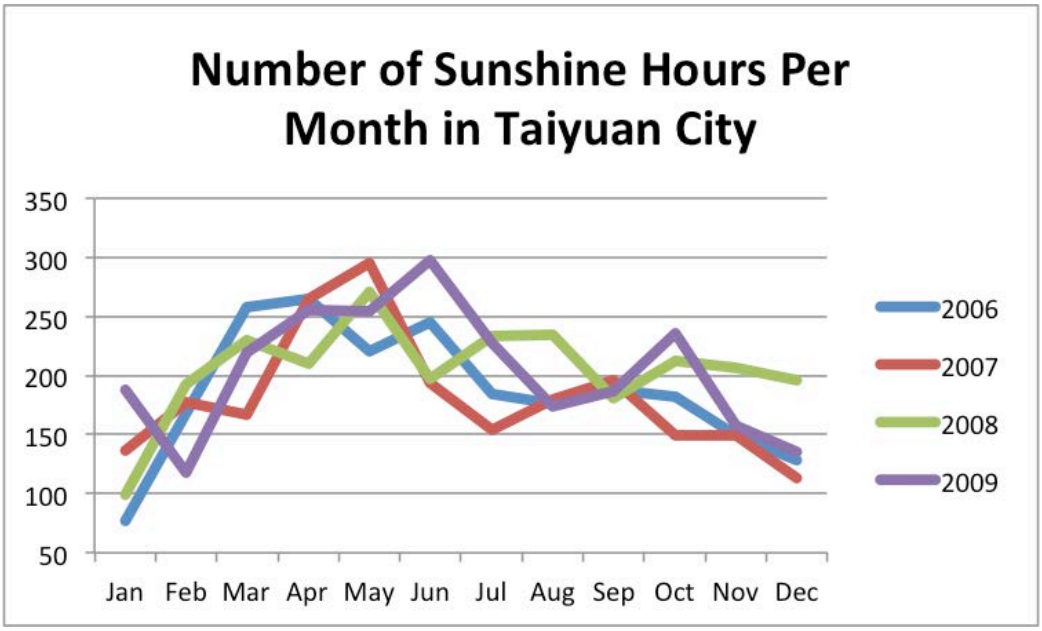


Figure 72: Number of Sunshine Hours per Month. China Meterological Administration Data.

But in 2009 to 2011, the population in Yingze and Xiaodian both begin to increase again- and Xiaodian increases dramatically. What accounts for these changes?

Part of it is global economic recovery. And part of it is the implementation of the Master Plan taking effect. With so much investment and infrastructure in Xiaodian, it spurs demand for residential housing, which leads to more land developers building high-end residential complexes in the area. For example: Foxconn established itself in the technological development zone, in a peri-urban part of Taiyuan as per the Master Plan, beginning construction in 2003, but only opening its doors in 2008. Because of the distance to the city and to encourage timeliness for factory workers, Foxconn had large, company-owned worker dormitories built near the manufacturing campus. The increase of provincial and migrant workers beginning employment at Foxconn would account for a spike in population in Study Area 2, Xiaodian District.

Another example was the construction of Shanxi Hospital. Construction began in 2009, and only completed in 2011. With 300 professional medical staff and much more in support staff, demand for nearby housing led to the rapid development of several 家园 (jiayuan, or housing complexes), which are visible in Figure 60 on page 67. Doctors, nurses, staff, and possibly wealthy residents with chronic ailments who view proximity to the advanced medical facilities as an amenity, drive housing demand in the immediate area.

More interesting than the absolute numbers of population in the Study Areas are the percentages they hold of the municipality's population. In 2000, both Yingze District and Xiaodian District only have a little more than 10% each of the municipality's population, with the former holding the greater share. Yet Xiaodian grows more rapidly than Yingze, surpassing it by 2007; where Yingze only increased population share by 0.7%, Xiaodian grew 3%.

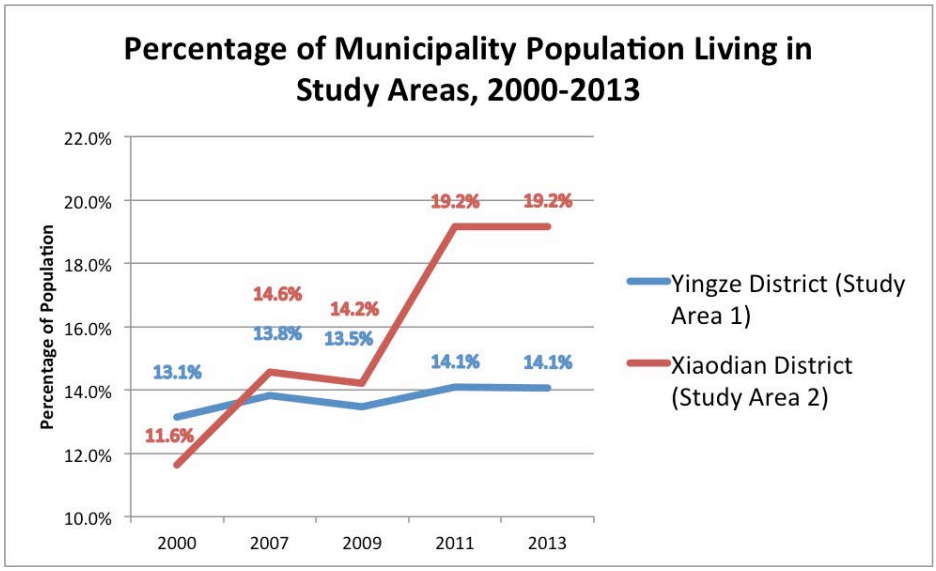


Figure 73: Percentage of Municipality Population Living in Study Areas. Statistical Yearbooks 2000-2013.

Both districts decreased their population share from 2007-2009, which is likely related to the global recession; this doesn't mean that people were actually leaving the district. It indicates that economic opportunity may have been stronger in the more industrial districts, causing them to grow more rapidly. After 2009, Xiaodian's share rapidly increases again- by 2011, Xiaodian District has more than 19% of the entire prefecture population living in its borders, 5% more than Yingze. Xiaodian maintains that higher share through 2013, but Yingze District does not decrease, maintaining 14.1% of the municipality population.

Although Xiaodian is clearly growing in absolute number of residents and share of prefecture population, Yingze District is not in a decline. Its population has steadily been increasing over the study period.

Average Real Estate Prices per Square Meter

Real estate speculation in Taiyuan has contributed to the city's notorious reputation for being expensive, especially surprising, considering the amount of pollution and the lack of amenities. The average price of an apartment is approximately 8,600 CNY per square meter, equivalent to $1405 USD (or $140 per square foot; comparatively apartments in Zhengzhou are 11,300 CNY per square meter, in Chengdu are 9,838 CNY per square meter, and in Tianjin are 15,117 CNY per square meter[lix]; see Figure 74). Much of this rise in price can be explained by demand driven by social constructs. The material side of marriage agreements puts enormous pressure on couples, especially men, to have a job and apartment (and preferably a vehicle) to prove they can provide for their family. To this end, owning an apartment is necessary, not just renting one.

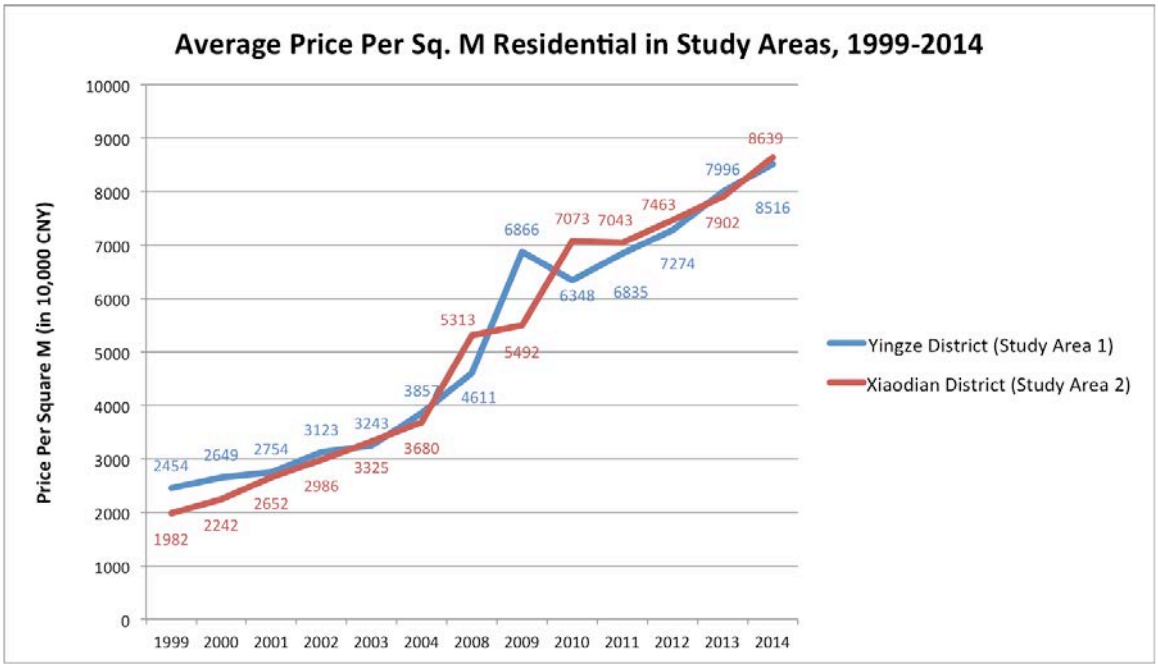


Figure 74: The trends for average residential prices in the study areas. Data is not available from 2004-2008.

But when examining the prices in Study Area 1, Yingze District- which has been historically desirable and fashionable - to Study Area 2, Xiaodian District, a trend emerges. Once the Master Plan was announced in 2007, prices in Xiaodian increased considerably, from 3680 CNY per square meter (approximately $603 USD) to 5313 CNY (approximately $870 USD), making it more expensive than housing in Yingze District. Then, from 2008-2010, the market was extremely volatile, again due to the global economic downturn. Apartments are often sold (by residents putting down massive deposits) before the buildings are constructed. The downturn impacted how much money developers had to complete buildings, greatly extending construction time; panicked investors would often demand their deposits be returned, a loss of income that would only further slow down the project, making Yingze a more stable investment by comparison.

Figure 75: Left, the Howard Johnson International Apartments in Yingze District; right, the Changsheng Double Happiness Apartments in Xiaodian District. The average price of a high-end apartment in Yingze is 17,861.25 CNY per square meter ($2,928 USD), and in Xiaodian it's 21,930 CNY ($3,595 USD).

After 2009, however, Xiaodian's residential prices have steadily increased. This is because of the global economy recovering, as well as the investments the city has made in amenities and infrastructure (e.g. the hospital, the Southern Railway Station) boosting the value of these properties. Conversely, Yingze's housing prices have fluctuated from 2007-2013. This volatility comes from swings in the available housing stock. It is difficult to build new facilities in the urban core of Taiyuan, and older apartment buildings are less than 7 stories high to avoid the necessity of an elevator. Although the city is working at tearing down these older apartments and putting up more modern and larger ones in their place, the transition will take time. While Yingze District is transitioning, Xiaodian District will continue to be building large apartment complexes, often on easier to develop green field sites.

The conclusion that is drawn from Figure 74 is that the trends in prices (Yingze District's and Xiaodian District's) are incredibly similar. Residential real estate is not being negatively affected in Yingze because of investment and development in Xiaodian.

Commercial Real Estate

An important indicator to compare district level development is the amount of office space recently constructed, available, and its price. Although Yingze Dajie (located in Yingze District) was once the prized street in Taiyuan to locate leading stores, offices, or government agency headquarters, Changfeng Jie in Xiaodian District has emerged as the "fashionable" new place for modern and expensive offices, attracted by Xiaodian District's new high status, facilitated by mixed-use zoning.

The buildings along Yingze Dajie are enormous, often characterized by extensive perimeters and gates that required approval from armed security guards to enter (see Figure 56, below). These buildings have distinctive, even iconic architecture, and are

usually surrounded by dedicated parking or internal roads. The fact that these buildings are purposefully disconnected from any of their neighbors is supposed to speak to their importance; they are single-function government or company headquarters. (Such strict division of spaces was the dominant mode of planning in the 1980s.) Most of the buildings were also not equipped to be lit up at night, so vast parts of the street would be dark after sundown.

Figure 76: Photo of the Shanxi People's Congress Hall, on Yingze Dajie. Notice how isolated each building is. Imposing and distinctive, they share no functions or space with other structures along the road.

However, all along Changfeng Jie, from the Fen River to the west to Tiyu Lu in the east, the street has become more dense (and in some ways, even more grand) than Yingze Dajie. The luxury retail destination podiums of major buildings serve as the ground floors of high-rise apartments and office towers. The proximity of these tall buildings is such that they form a highly visible and modern skyline. While buildings in Taiyuan used to rely on street-level signs for evening light, along Changfeng Jie it feels like it is always open- the buildings themselves are brightly lit or feature flashing, rotating messages across their exteriors.

Figure 77: Tianmei Xintiandi, a new shopping and office square on the north side of Changfengjie. Directly across the street is its second half, Beimei Xintiandi. On the left, Shanxi Coal International Energy Group's headquarters.

Figure 78: Left, opposite side of Tianmei Xintiandi, this time with a view of the Hotel. Buildings along Changfeng Jie are lit up at night, a recent development in new buildings in Taiyuan; traditionally the downtown would go mostly dark after 9pm. Right, the same buildings, early in the afternoon on a bad pollution day. Site Visit, 2014.

Figure 79: Rendering of the proposed Taiyuan China Sea Plaza building in Study Area 1, Yingze District, on the southeastern corner of Wuyi Square.

Accordingly, from a commercial standpoint, Xiaodian is composed of new and attractive areas that are drawing more attention than Yingze District. Yingze District seems to be trying to counter this inter-district competition having announced the "tallest building in Taiyuan", called the Taiyuan China Sea Plaza, which will begin construction this winter and be completed sometime in 2016. It will be 310 meters high and at the corner of Yingze Dajie and Wuyi Square, resulting in the historic Bingzhou Hotel being demolished. The proposed building, from Figure 79 on the previous page, would look at home in Dubai's business district.

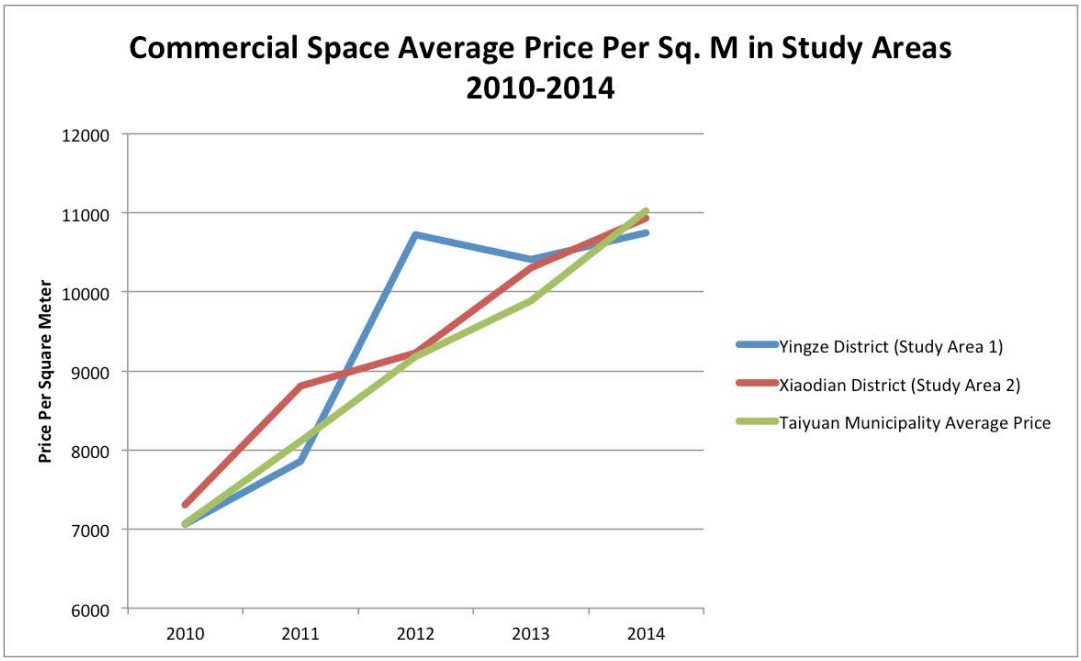


Figure 80: Commercial space, prices per square meter. Data was not consistently available before 2010.[lx]

Based on data covering the last five years in Figure 80 (earlier data was not available) it is apparent that commercial real estate prices have steadily increased- not just in Yingze or Xiaodian, but throughout the Municipality as a whole (see Figure 60, following page). However, property values in Yingze appear to be more volatile than Xiaodian, jumping to 10,719 CNY per square meter in 2012 ($1,757 USD); comparatively, Xiaodian was only 9,232 CNY per square meter ($1,513 USD). The following year the

Yingze's commercial property prices fell again, while Xiaodian's prices continued to increase, reaching 10,931 CNY per square meter in 2014 ($1,791 USD).

It is interesting that the prices in Yingze jumped so rapidly in 2012, because that is a year when it was apparent that population was rising rapidly in Xiaodian district; yet, a higher population in Xiaodian did not result in higher commercial property prices.

One fact that may explain Yingze's commercial attractiveness in 2012 were major renovation projects that were completed at that time, such as the Taiyuan Train Station, Liu Xiang Shopping Street Renovation, and Yingze Dajie Beautification. These projects gave much needed modernizing facelifts to heavily populated areas, and companies and businesses may have wanted to take advantage of the updated storefronts and locations, by leasing these renovated properties.

GDP

The pillar industries of Taiyuan include metallurgy, coal mining and dressing, petrochemicals, electronics, heat and electrical power supply, equipment manufacturing, special purpose equipment manufacturing, chemicals, tobacco and transportation equipment manufacturing. But critical to the city and even its culture is coal: Shanxi produced almost 25% of China's coal output in 2012, second only to Inner Mongolia. As China's economy has grown, Taiyuan has benefited by providing a resource that kept the country's manufacturing and energy industries humming.

But the 2007-2020 Master Plan rightfully puts little promise in the continuance of coal's economic dominance. The city spent the first decade of the 21st century developing policies to encourage more sustainable industries. In 2012, sales of consumer goods rose 16.1% to 112.95 billion CNY, ranking first in the province; within the same year, the city approved 14 foreign invested enterprises. Population increases from 2000-

2007 came from new businesses and existing industries expanding offering more jobs, and this was reflected in the sharp increase of GDP from 2000-2007, seen in Figure 81.

Figure 82 compares GDP in the study areas (and to the city proper), as indicated, while Xiaodian increases its GDP, its growth is not as dramatic as Yingze's. Xiaodian's very large increase in population (almost doubling the number of people there) did not translate into a doubled GDP. Instead, Yingze increased its GDP 4060.45% from 2000-2013, a significant increase that can be explained by the huge share Yingze District has in the service sector. 86% of Yingze's GDP comes from the service sector.[lxi] This reflects a key difference between the two districts: Yingze, having expelled most manufacturing companies to other districts, is focusing more on the service and financial industries, whereas Xiaodian is the location of choice for large manufacturing operations.[lxii]

Comparatively, the city proper experiences a significant drop in GDP (-6.53%) between 2009-2011 because of one district, Jiancaoping. Jiancaoping is the district with the most intense agricultural production, and the decrease in GDP could be explained by several environmental events or regulatory changes, such as the melamine milk scandal in 2008. This event, which only reached the public in late 2008, caused a major restructuring of dairy and related processing companies during 2009.

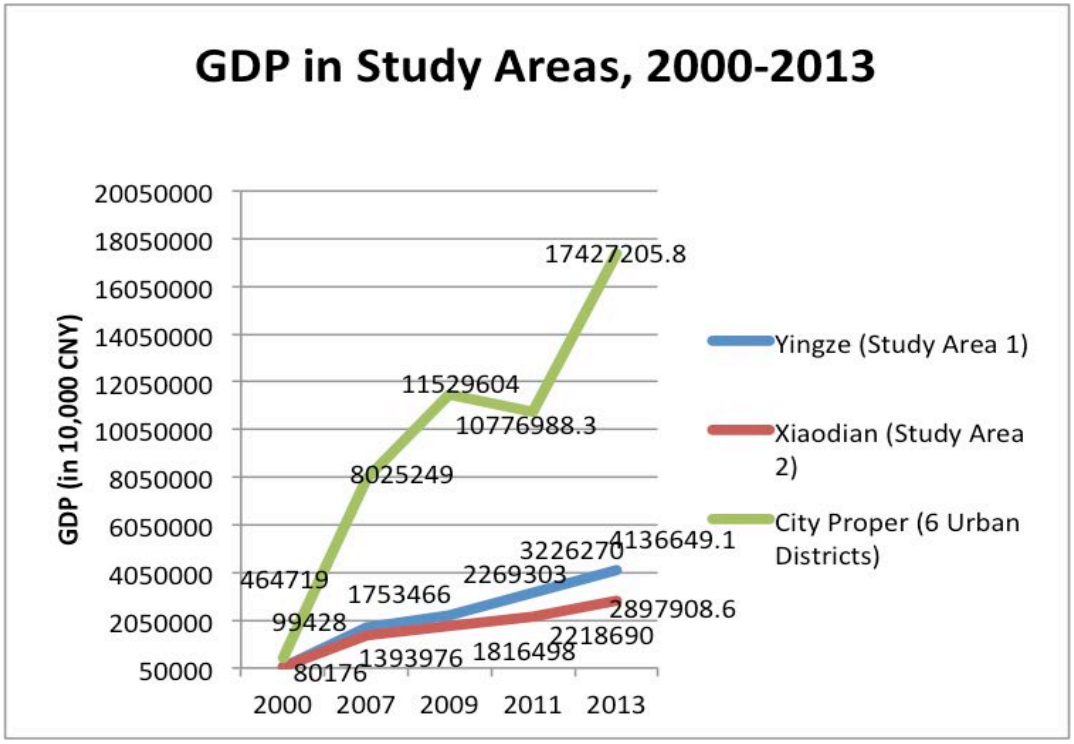


Figure 81: GDP in Study Areas. Statistical Yearbook Data, 2000-2013.

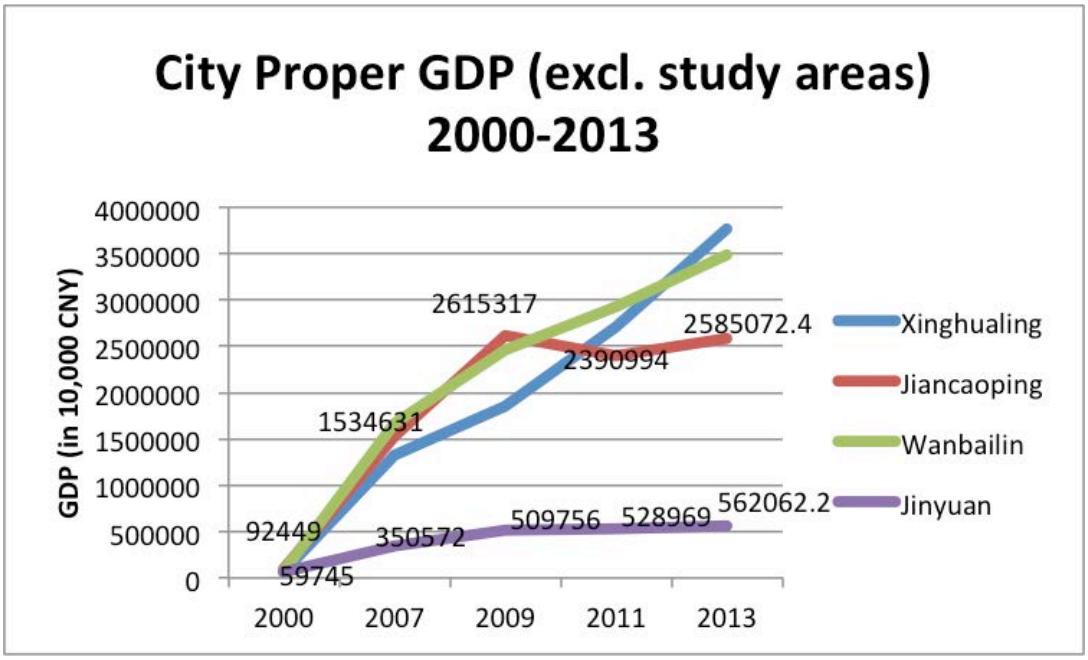


Figure 82: By isolating out Yingze and Xiaodian from the city proper, it's easier to identify which districts actually decreased in GDP. Statistical Yearbook Data 2000-2013.

Secondary Industry

Figure 83 clearly shows that secondary industry in Taiyuan takes place in districts besides the study areas. There is an economically and policy driven progression of manufacturing moving away from urban centers, with their high residential populations, partly because of environmental concerns. This dispersion of manufacturing is reflected in, and supported by, the Master Plan's policy to move factories out of the city center. Comparing just the study areas, in Yingze District, state-owned enterprises accounted for much of the increase. In 2010 Yingze District alone represented 65.2% of urban construction projects, including completion of 1,048,759 square meters of housing.[lxiii] But Yingze still had less secondary industry output value than Xiaodian. In 2013, Xiaodian had 23.8% higher output value than Yingze. From 2000 to 2013, Xiaodian went from 5.57% of Taiyuan's manufacturing economy to 22.9%, a direct result of two national electronics manufacturing and economic development zones (including the Foxconn campus) being opened within the district.

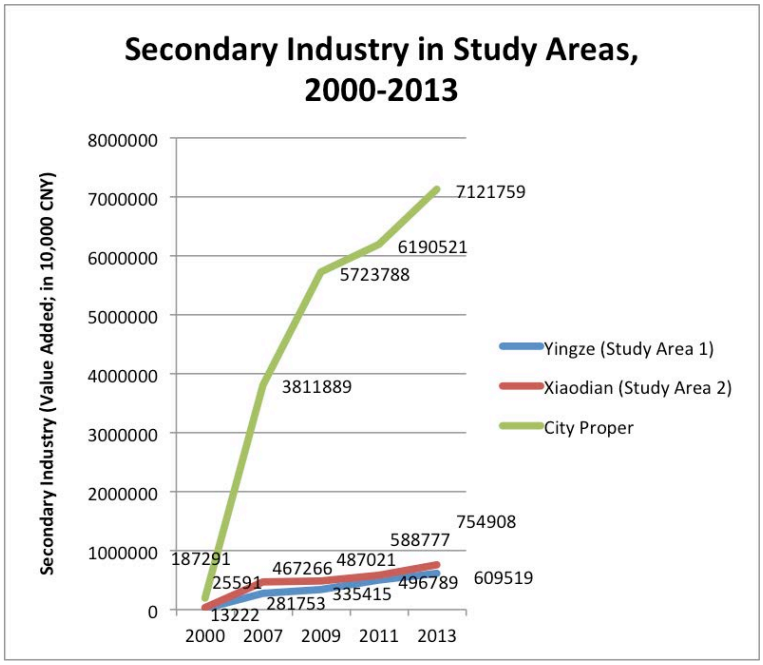


Figure 83: Secondary Industry in Study Areas. Statistical Yearbooks 2000-2013. Most of the city's growth in secondary industry is coming from other districts besides Yingze and Xiaodian.

Further evidence that manufacturing and processing is moving to other districts is seen when output value of secondary industry in the city proper is broken down by district, in Figures 84 and 85.

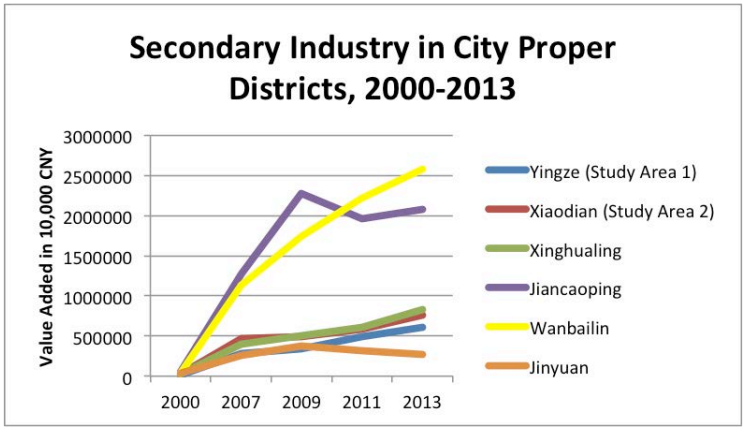


Figure 84: Secondary Industry in City Proper. When examining each district's contribution to overall secondary industry, two districts stand out: Jiancaoping and Wanbailin.

In 2000, there is closer distribution between the six districts. Yingze contains 7%, and Xiaodian contains 14%; Wanbailin contains 19% and Jiancaoping contains 29%. By 2013, Wanbailin has a staggering 36% of the city proper's secondary industrial output value, and Jiancaoping is not far behind at 29%; Xiaodian has fallen to 12% and Yingze has risen to 9%.

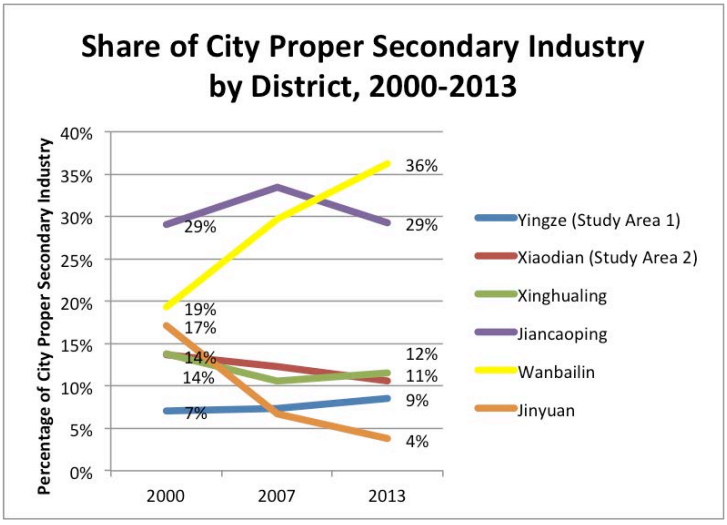


Figure 85: Share of City Proper Secondary Industry by District. Although in 2000 the districts have a fairly even distribution of manufacturing, by 2007 the shift changes dramatically. By 2013, Wanbailing and Jiancaoping are trending towards permanent dominance in secondary industry.

It must be noted, however, that while city policy and the Master Plan dictate moving heavy industry out of districts like Yingze, Yingtze actually *increased* its output share, by the same percentage that Xiaodian District's share decreased. This could mean that technological innovation has increased the production capacity of existing facilities, so while no new facilities are being built, the remaining companies in the District are extremely productive. And Xiaodian's decrease could be explained by a diversification of their economy, reflected in tertiary value increases. But if the city government is truly committed to moving manufacturing processes out of the most dense and urbanized areas, Yingze's share of secondary industry should to be shrinking, not growing; even the manufacturing facilities that have been allowed to stay for the time being, like TISCO, need to have a long-term plan in place to move to peri-urban or rural areas.

Tertiary Industry

Tertiary industries cover a wide range of activities, including hospitality, entertainment, government, financial services, information technology, and retail. Because of Yingze's long history and position as the traditional site of the Municipal government, financial, and retail sectors, it is no surprise that it is the leading district in terms of tertiary industry value, at 35,230,940,000 CNY in 2013 (see Figures 66 and 67). City and provincial government headquarters, bank and telecommunications headquarters, and the city's first major shopping streets are all located in Yingze. Yingze's tertiary industry value grew approximately 39.16% each year between 2000-2013[lxiv]. Xiaodian has also increased its tertiary industry value, but at a slower rate than Yingze (36.64%), with significantly less total value. Considering Yingze's historical advantage, particularly related to government departments and leading SOE and private sector actors, this is not entirely surprising.

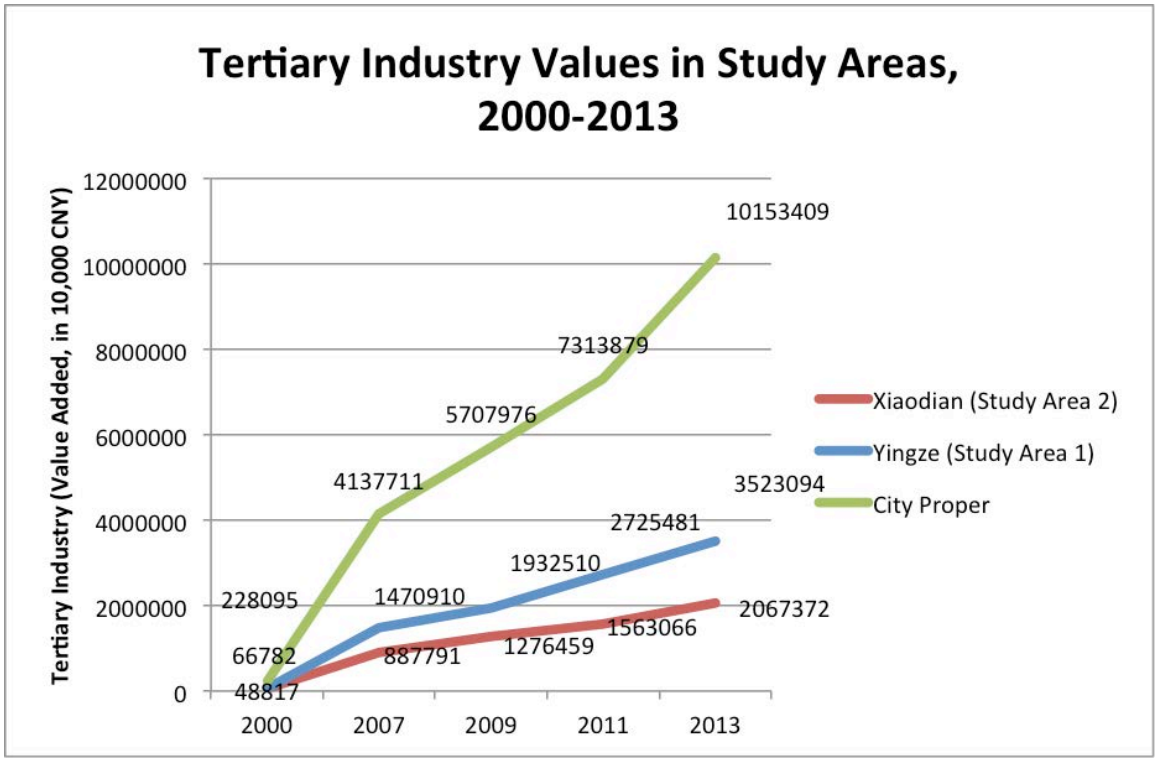


Figure 86: The values of tertiary industry in study areas compared to the city proper. Statistical Yearbooks 2000-2013.

What is especially interesting though, is the volatility in Yingze's share of the City Proper's added value of tertiary industry , especially compared with other districts in the City Proper (see Figure 86). Yingze seems to experience 3-5% fluctuation every few years, although generally trending toward an increase, where as Jiancaoping is also fluctuating every few years, generally decreasing. Xiaodian has remained remarkably stable from 2000-2013, hovering around a 21% share. It is Xinghualing District (directly north of Yingze) has emerged as a consistently growing leader in tertiary industry expansion, and a greater contributor than Xiaodian to service sector expansion, probably due to its close proximity to Yingze; it grew from 15% to 28.9% share of tertiary industry from 2000-2013. Just as Yingze holds the largest share of the service sector (86% of GDP), Xinghualing contributes 78%.[lxv]

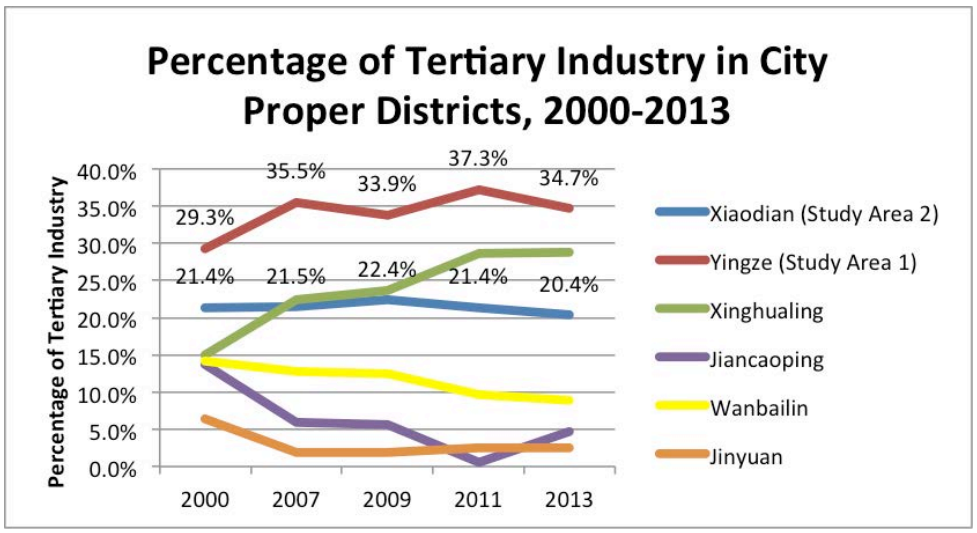


Figure 87: Share of tertiary industry between districts. Statistical Yearbooks 2000-2013.

Geographically, of the six districts that make up the city proper, the three districts where tertiary industry is increasing (or in Xiaodian's case, remaining stable) are the districts east of the Fen River, and the districts that are decreasing are on the west side. This corresponds with the Master Plan of encouraging growth on the southeastern direction of Taiyuan, towards and beyond Yuci.

Fixed Investment

Fixed asset investment in projects like roads and bridges slowed down nationwide in April 2009[lxvi]; although by 2012 the government was accelerating new project approvals in the areas of power, water and railways investment; however investment levels never quite fully recovered in Taiyuan.

Looking at Figure 68, Yingze's fixed asset investment is fairly stable from year to year, due to the highly developed nature of the District. Massive investments were made in the 50s (such as the Yingze Dajie Bridge) and because the level of building density is already so high, there are very few opportunities and reasons to invest in more public facilities in Yingze district.

Xiaodian, despite all its growth, has an erratic fixed investment pattern compared to Yingze district; in 2007, Xiaodian's investment was only 59.1% of Yingze's, yet jumped up 295.8% in 2009 to levels that were almost quadruple Yingze's investment. Then, along with the national government slowdown on fixed asset investment, Xiaodian plummeted to a new low in 2011.

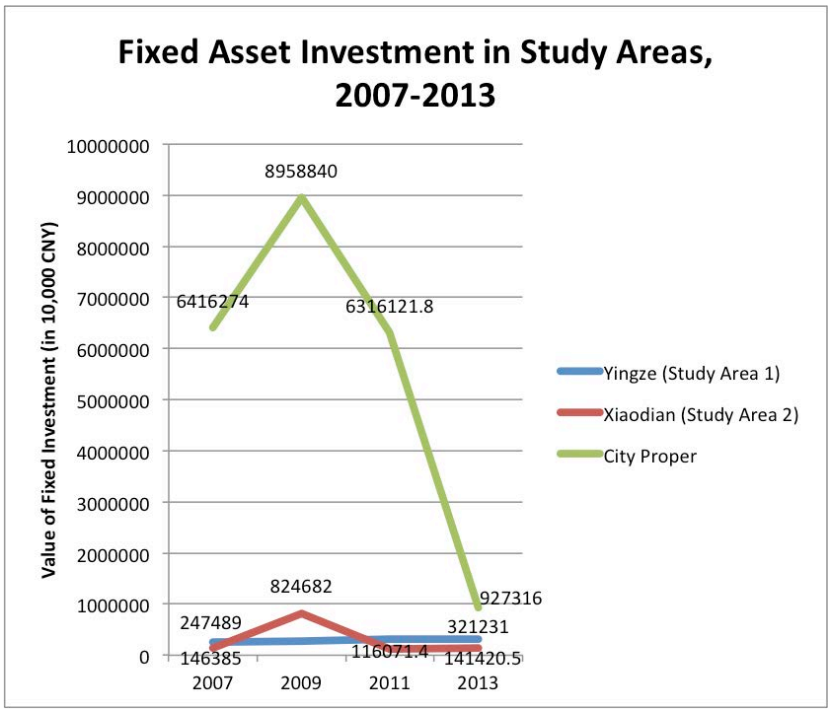


Figure 88: Fixed Asset Investment in Study Areas. Statistical Yearbooks 2007-2013.

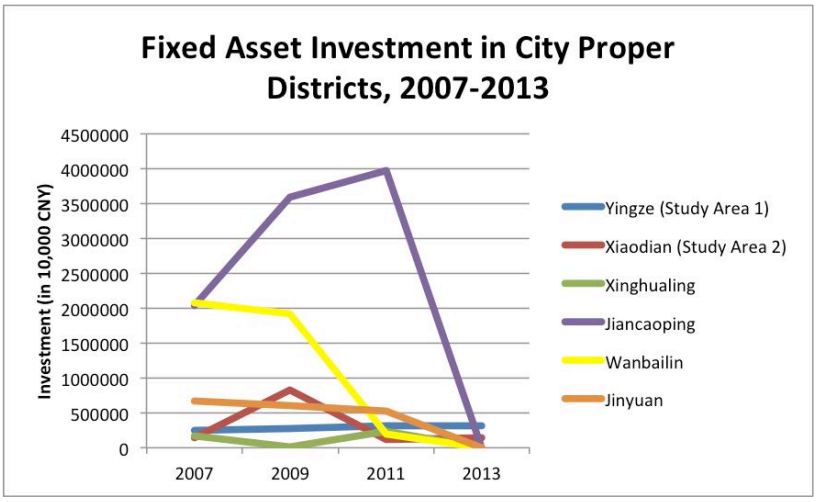


Figure 89: Fixed Asset Investment by District. Statistical Yearbooks 2007-2013.

Neither of these districts were the city proper's real focus when it came to fixed asset investment; most investment was going to Jinyuan, Wanbailin, or Jiancaoping Districts (see Figure 89). The Changfeng Cultural Shopping Complex and Soccer Stadium are located in Wanbailin, and Jiancaoping is a district that houses not just large agricultural projects but also industries like TISCO and Taizhong Heavy Machinery Manufacturing. Jiancaoping is the only district in which fixed asset investment continues to increase dramatically after 2009 (Xinghualing is consistently last, but did improve slightly from 2009-2011), but the reprieve only lasts until 2011, when every district except Yingze decreases investment.

So interestingly, in terms of fixed asset investment, Yingze seems resilient. Its density makes it difficult to embark on any large public construction projects. The subway system will have several stations in Yingze District, but it's unclear if the costs for the subway system come from each district governments or from the municipal and national governments. Since most districts except Yingze are scaling back on fixed asset investment, it would seem that the funds for the metro do not come from district governments.

Science & Technology Expenditures

As the Municipality tries to transition its economy into service, education, and research-based industries, the logical assumption would be that the government is spending more money to support science and technological innovations. Looking at Figure 84, Yingze District led the rest of the city proper from 2007-2011, with a vast increase from 2007-2009 in science and technology expenditures. Strangely, Xiaodian district was not even second to Yingze in expenditures, which is notable because of the

city's emphasis in making Xiaodian District a leader in science and technological investment and production.

But from 2009-2011, science and technology expenditures fell city-wide. This was in reaction to the global economic recession; the district governments cut their budgets, and expenditures in 2011 were almost the same as in 2007. Since 2011 though, paralleling the economic recovery, the districts have been slowly increasing their expenditures. Importantly, 2011 was the first year where Xiaodian emerged as a leader in science and technology expenditures. The value is still not as high as in 2009, but because of city officials' public commitment to these fields, it is likely expenditures will continue to increase. Xiaodian's new position could also be due to the city's policy of moving manufacturing businesses out of Yingze District; both Xiaodian and Xinghualing districts, which respectively border Yingze to the south and north, are the 2013 leading districts in science and technology investment (see Figure 90).

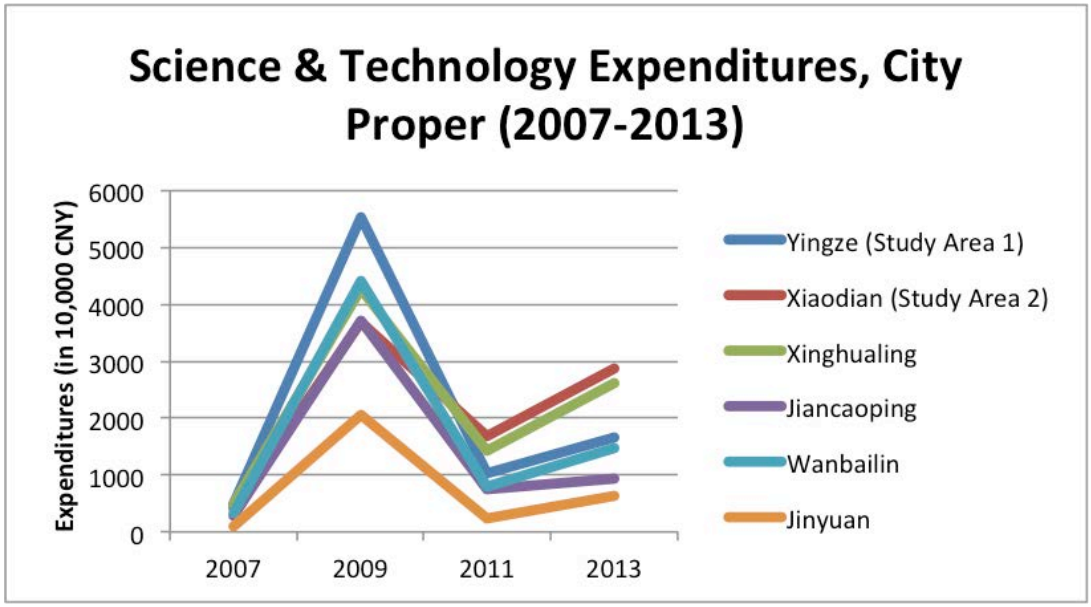


Figure 90: Expenditures by district. Statistical Yearbooks 2007-2013. Yingze is the leading district, followed by Wanbailin. The data was not available for 2000.

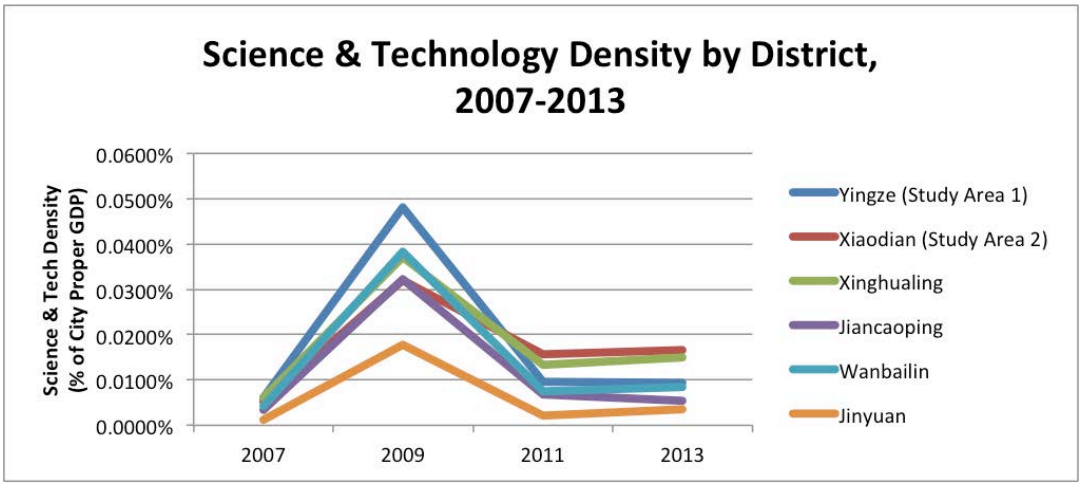


Figure 91: Science and Technology Expenditures by District as Percentage of GDP. Statistical Yearbook 2007-2013. The data was not available for 2000.

Education Expenditures

Education expenditures reflect how many students are within a district, and whether or not the district anticipates the number of students to grow. Based on Figure 72, Xiaodian's expenditures are similar in magnitude to Yingze until 2009, slowly increasing until 2011 when it begins to jump rapidly. This pattern parallels the population data examined earlier. Now that Xiaodian has become the most populous district, it makes sense to have higher education expenditures, especially as a still-developing district, reflected in a younger population than the city proper as a whole, more schools will be needed in the District.

Surprisingly, the fast growing population, and increased education expenditures are not reflected in a simple increase in schools. Looking at Figure 88, there is a trend in *both* districts toward declining numbers of primary schools, and an increase in middle schools. (Data for high schools was not available, but since Chinese students test after middle school to get into ranked high schools, location of high schools matters less than primary or middle schools). It appears that the general age of the children in Xiaodian district is increasing, leading to the necessity of more middle schools. It will be interesting to see if, as the Master Plan continues to be implemented, Xiaodian's growing

eminence as the “better, more improved” Taiyuan will cause more families to locate and raise their children there.

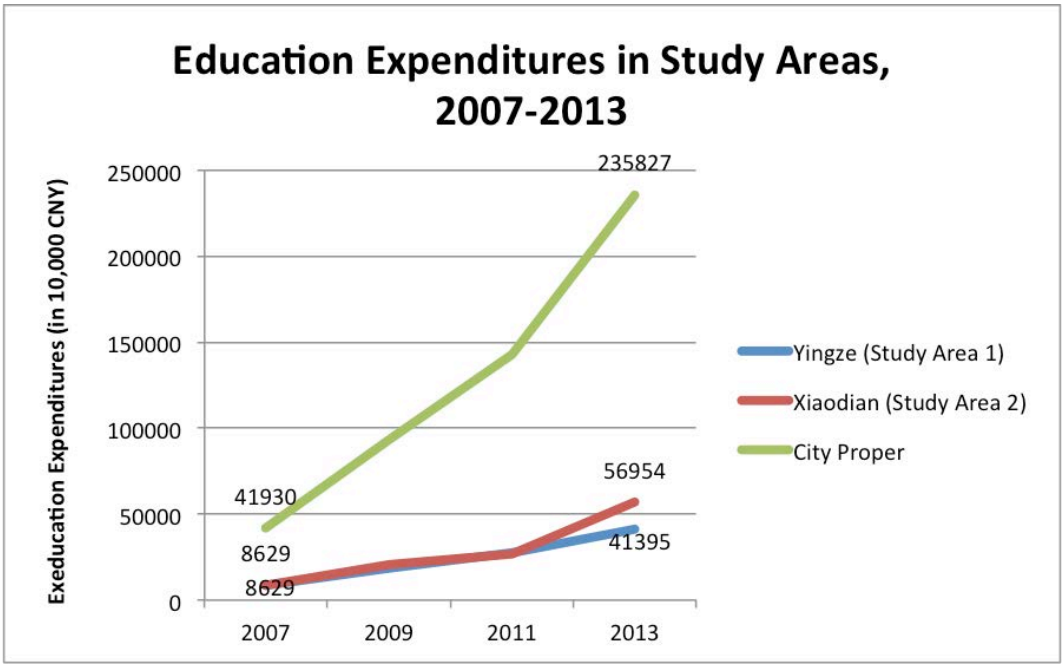


Figure 92: Education Expenditures in Study Areas. Statistical Yearbook 2007-2013.

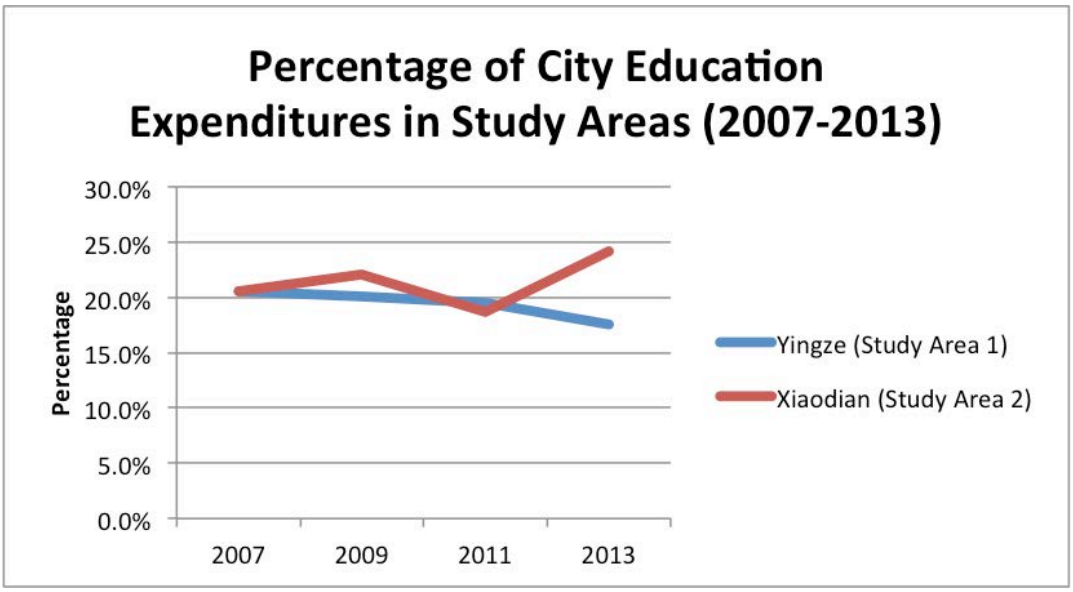


Figure 93: Percentage of City Education Expenditures in Study Areas. Statistical Yearbook 2007-2013. The data was not available for 2000.

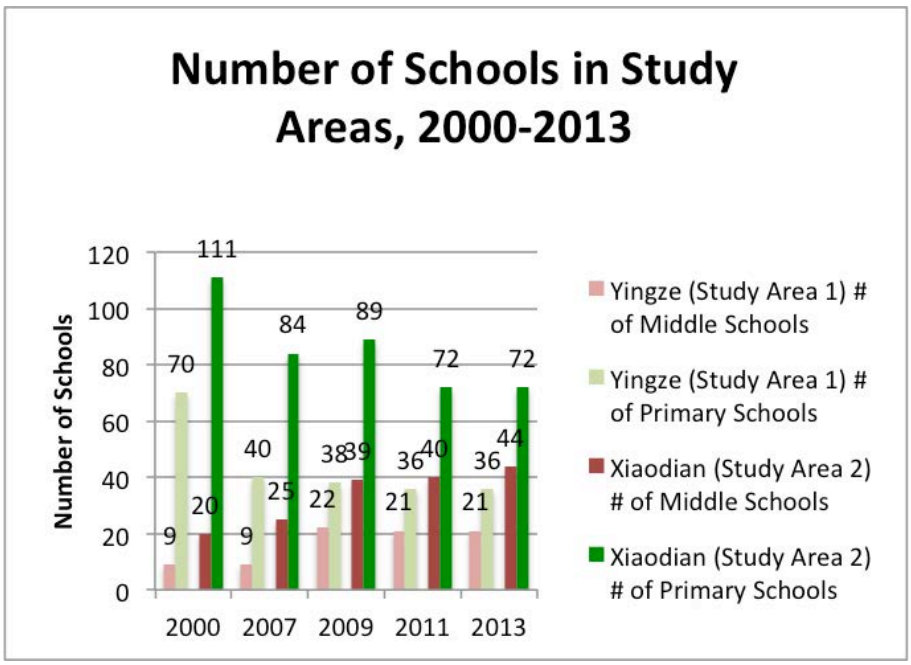


Figure 94: Number of schools in Study Areas. The number of primary schools is decreasing, but the number of middle schools is increasing. Statistical Yearbooks 2000-2013.

Study Area 1: Conclusions

It was originally hypothesized that such rapid, strong investment in infrastructure in Xiaodian District, consistent with the southward development strategy would have a deleterious effect on Yingze District, and in some ways the effect of this shift in investment is noticable: volatile real estate prices, a decline in education expenditures and number of schools, a decline in science & technology expenditures, and a decline in share of city population. But by many other measurements- GDP, fixed asset investment, and tertiary industry -Yingze is not suffering from Xiaodian's growth. In terms of GDP and share of tertiary industry (value added), Yingze is in fact the clear leader of the two districts.

In 2012, according to the local governments, the natural population growth rate (the rate of natural increase, crude birth rate – crude death rates) in Yingze was 1.56%[lxvii] and in Xiaodian, it was 6%.[lxviii] If that held true from 2013-2020, starting with a

population of 598,819 people, by 2020 Yingze would be home to 667,351 residents; in Xiaodian, starting with a population of 815,898 people, by 2020 1,226,808 people would live in Xiaodian.

However, these numbers would represent the "high" scenarios. While it's possible Yingze could add 70,000 citizens in the next 7 years (at 10,000 people each year), the District only added 6,812 people between 2011-2013, and it is already the densest in Taiyuan. Xiaodian is experiencing explosive growth now, and although it will continue to add to its population, to maintain 6% growth over 7 years is highly unlikely.

A "medium" scenario would be steady and stable growth. The exponential growth rate in Yingze from 2011-2013 was 0.574%[lxix], and assuming that continued, in 2020 Yingze District would house 623,285 residents- 44,000 less than in the high scenario, growing by approximately 4400 residents a year. The exponential growth rate in Xiaodian from 2011-2013 was 0.703%[lxx], and if that continued until 2020, there would be 856,895 people in Xiaodian: 369,913 people fewer than the high scenario estimate. Such a stable rate of increase is more likely for Yingze District as the area is already the densest in Taiyuan, and unable to add major manufacturing facilities and associated worker dormitories, but it is unlikely that Xiaodian, with its rapid growth, would only add 40,000 people in the next 7 years. A "medium" scenario for Xiaodian would be a 3% exponential growth rate in Xiaodian District, leading to 1,003,451 residents: just over 180,000 additional people by 2020. Considering that University City (just outside of Xiaodian District, in Yuci) is supposed to accommodate 100,000 students, faculty, and staff, it is extremely likely that Xiaodian will continue to be a desirable and attractive location to settle in, either for work, health or educational reasons.

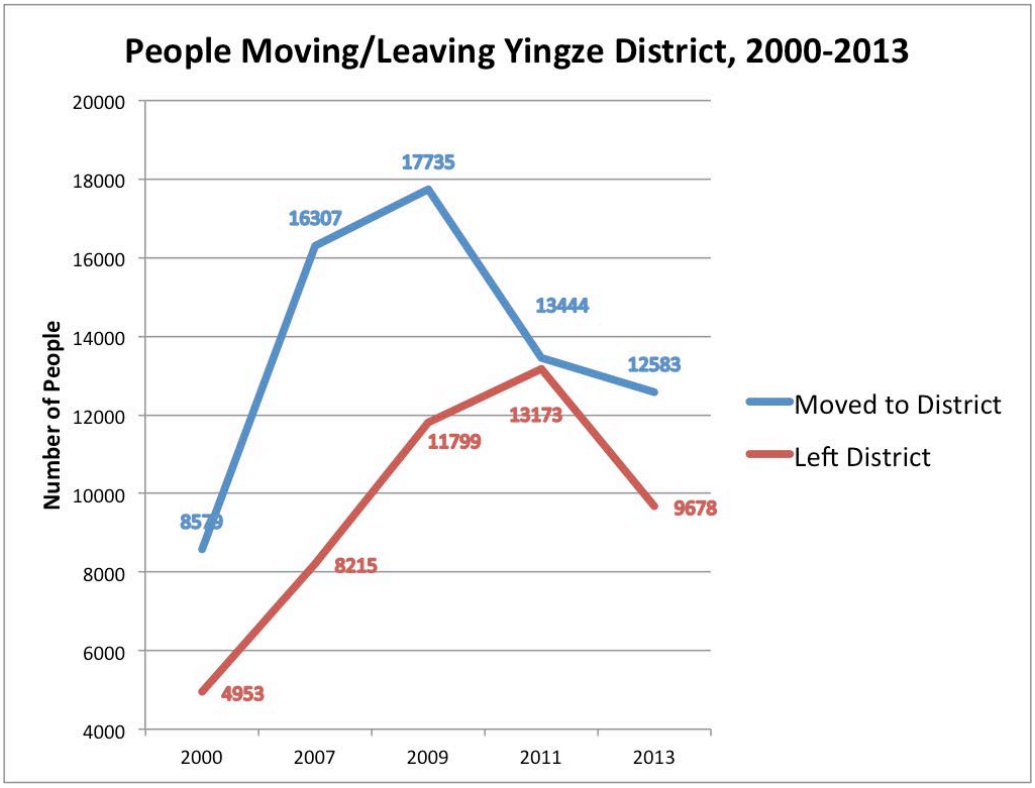


Figure 95: People Moving/Leaving Yingze District 2000-2013. There seems to be a common trend that something that makes the district desirable has a delayed effect on encouraging migration out of the district. However, incoming migration remains higher than emigration.

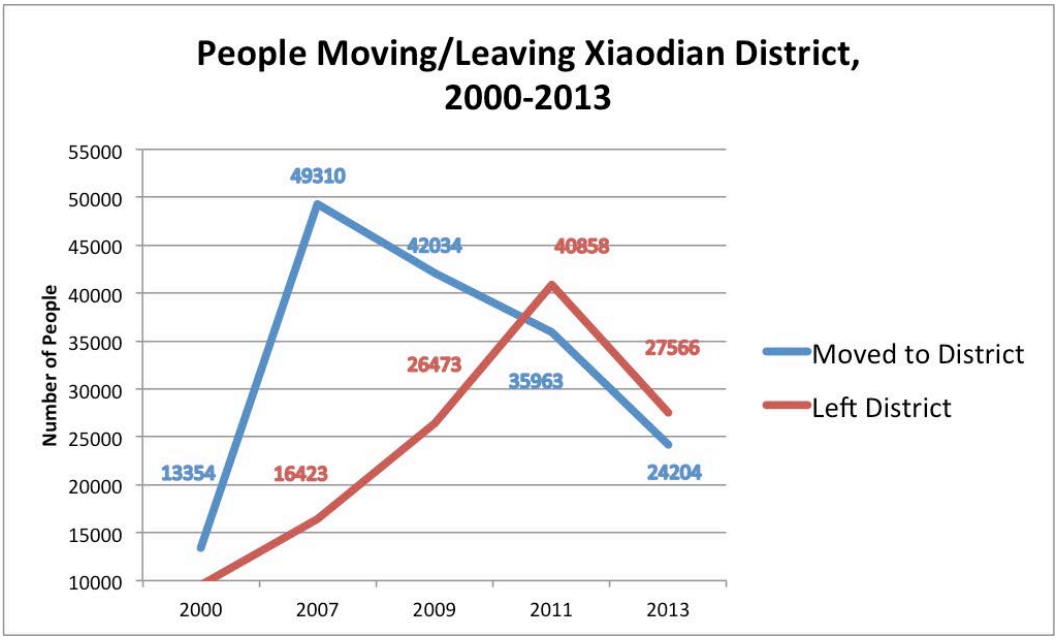


Figure 96: People Moving/Leaving Xiaodian District 2000-2013. Between 2000-2009 people are flocking to the district, but between 2009-2011 emigration out of the district exceeds incoming migration.

Barring sudden disaster, it is unlikely that either Yingze or Xiaodian district will begin to decrease residential population (a “low” scenario). With well-executed renovations of historical and culturally important areas, Yingze has been maintaining a public image that keeps it relevant despite the glitter and glamor of new developments in Xiaodian. Although I had originally believed that the expensive, multibillion CNY investment in southern districts would have a strong negative impact on Yingze District, the area continues to perform well when measured against the City Proper.

And as though to confirm for its citizens of its own primacy, the construction of the Taiyuan China Sea Plaza at Wuyi Square is a not-so-subtle reminder that even while commercial and industrial interests shift south, Yingze District will remain as the heart and core of Taiyuan.

CHAPTER 7

ANALYSIS: STUDY AREA 2, XIAODIAN DISTRICT

My second research question focuses on Study Area 2, the rapidly developing Xiaodian District, to determine: If residents there were enjoying a higher quality of life than they might have in the established city (represented by Study Area 2, Yingze District). "Quality of life" is measured in terms of key indicators in three categories: socioeconomic, environmental, and commercial development.

The socioeconomic indicators are: Income per capita, Number of hospital beds per capita, Residents per health personnel, Number of middle schools. The environmental indicators are: Green space per capita, Annual investment in pollution control, and Sulfur emissions. And lastly, my Commercial Development indicator is retail sales.

Income Per Capita

Examining income in the Study Areas (Figure 91), it was surprising to see that annual income per capita was higher in Xiaodian than in Yingze in 2007, with 14,035 CNY per person compared to 11,681 CNY per person. The incomes remain higher in Xiaodian until 2011, when absolute number actually falls[lxxi]; in 2013, the gap between the two districts begins to narrow.

What explains higher incomes in Xiaodian relative to Yingze? It is possible that with manufacturing and logistical industries continuing to locate in Xiaodian (due to industrial dispersal) that residents have access to higher paid opportunities than in Yingze, which is becoming increasingly reliant on low-end service employment. Wages at the Foxconn plant in Xiaodian are higher than at any other Foxconn plant in China[lxxii],

whereas service jobs in sectors like fast food and retail (considered desirable, steady jobs) only pay approximately 8 CNY an hour.

But after 2011, something changes; wages actually decrease in Xiaodian, although wages in the city proper continues to increase. This could be due to elements of the Master Plan being completed in the District, thus construction jobs go elsewhere (Wanbailin or Jinyuan), pulling the average income per capita of the city proper upwards while the decreased demand for work in Xiaodian leads to slightly lower wages. Another explanation would be the 2012 riots at Foxconn (Figures 98 and 99). In September of 2012, factory workers destroyed the north gate of the facility and were engaged in aggressive protests with police. Foxconn production was disrupted for several days, which may have had repercussions for wages at Foxconn and other companies that had space in the Science and Technological Innovation Park.

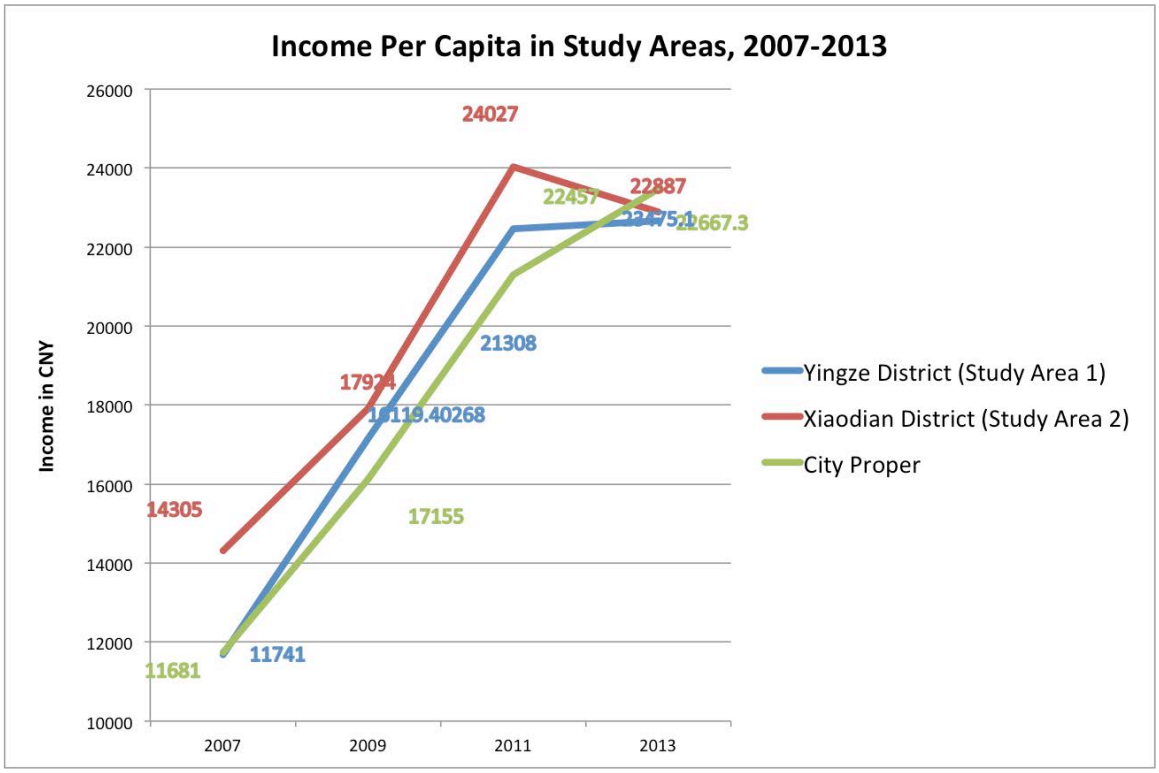


Figure 97: Income Per Capita from Yingze and Xiaodian. Statistical Yearbooks 2007-2013.

Figure 98: The Foxconn Plant in Taiyuan, 2012.

Figure 99: Foxconn Plant in Taiyuan, after September 2012 riots.

Number of Hospital Beds

Another indicator of quality of life is the capacity for medical treatment. Although Xiaodian can boast the largest and most advanced hospital in the Province, hospital beds increased from 3,100 beds to 5,257 beds from 2011 to 2013 in Xiaodian District, Yingze maintains a massive lead with 8,499 beds (see Figure 101 on the following page).

It's not surprising that Yingze would have more hospital beds. As of 2013 Yingze has 52 hospitals, where Xiaodian only had 47. Yingze, well established as the core of Taiyuan, not only has public hospitals but several well-known private hospitals such as Bo'ai Hospital (see Figure 100, below). Bo'ai Hospital rooms bear more similarity to four star hotel rooms. Since Yingze was the most desirable, and dense, place to live in Taiyuan for decades, it's logical that most of the hospitals (both public and private) would be located within that district.

However, with the implementation of the current Master Plan, Xiaodian has become a more desirable and populated district, resulting in more hospitals and clinics being established within the area. According to Figure 102, the number of hospital beds per 1000 residents in Xiaodian is increasing, even though its population is increasing dramatically. In 2007, there were 5.03 beds per 1000 residents; in 2013, there were 6.44 beds per 1000 residents. In Yingze, the number has fluctuated, from 11.63 beds in 2007 to 15.30 beds in 2009, down to 12.25 beds in 2011, and up again to 14.19 beds in 2013. These fluctuations are the combination of new hospitals and rising population.

Figure 100: Interior of a Bo'ai Hospital Room.

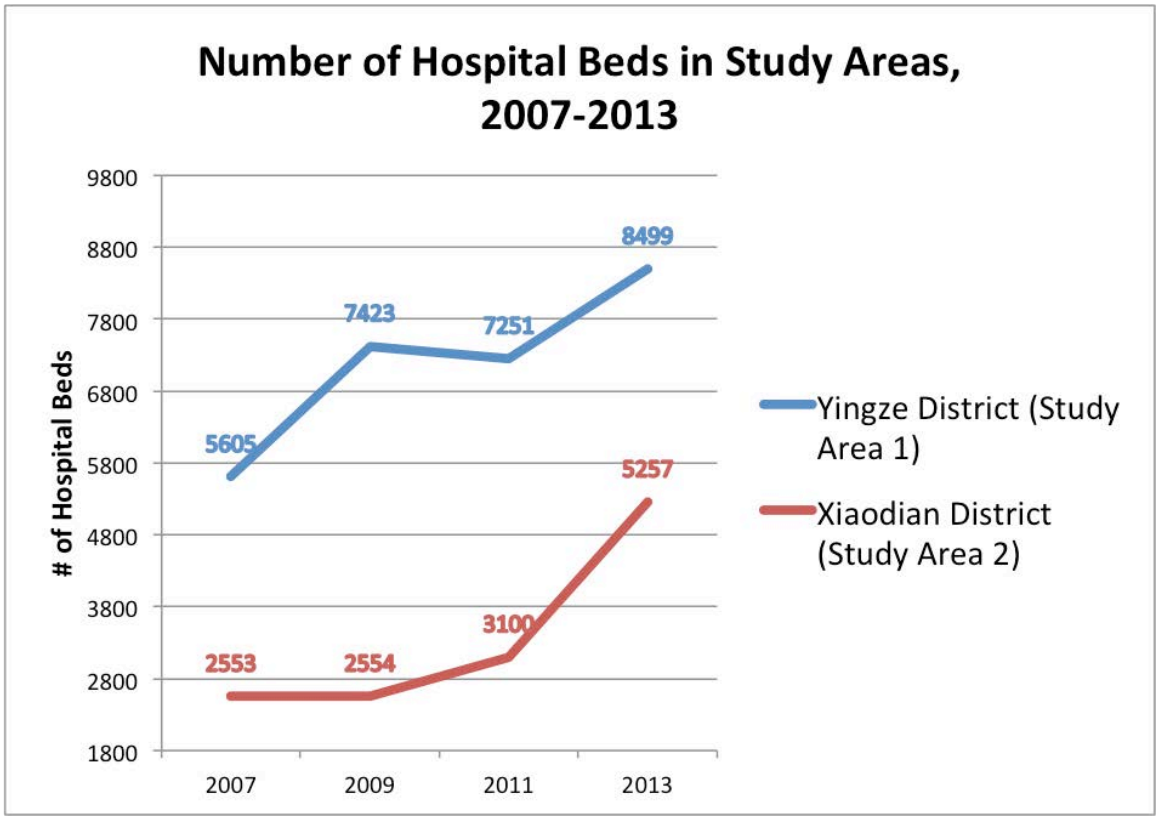


Figure 101: Number of hospital beds. Statistical Yearbooks 2007-2013.

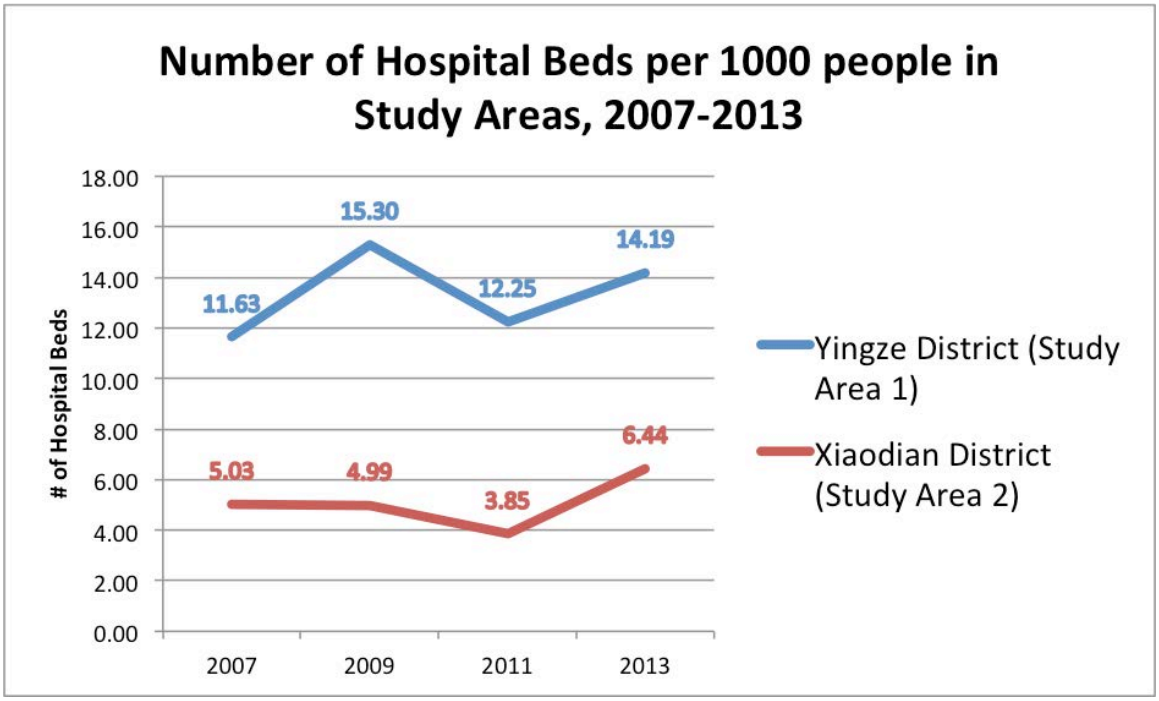


Figure 102: Residents per hospital bed. Statistical Yearbooks 2007-2013.

Number of Health Personnel per 1000 Residents

A very similar pattern to the trend in hospital beds is apparent in the number of healthcare personnel. In Xiaodian, in 2007 there were 199.9 residents per healthcare worker, but by 2013 it falls to 149.2 residents. Yingze changes from 80.4 residents per healthcare worker in 2007 to 63.6 residents in 2013 (see Figure 103). The decrease in Xiaodian is more pronounced, with a 25% decrease compared to Yingze's 21.5% decrease. As more hospitals are built in Xiaodian, this indicator should continue to improve. It is likely that Yingze will also continue to fall, but at a less pronounced rate.

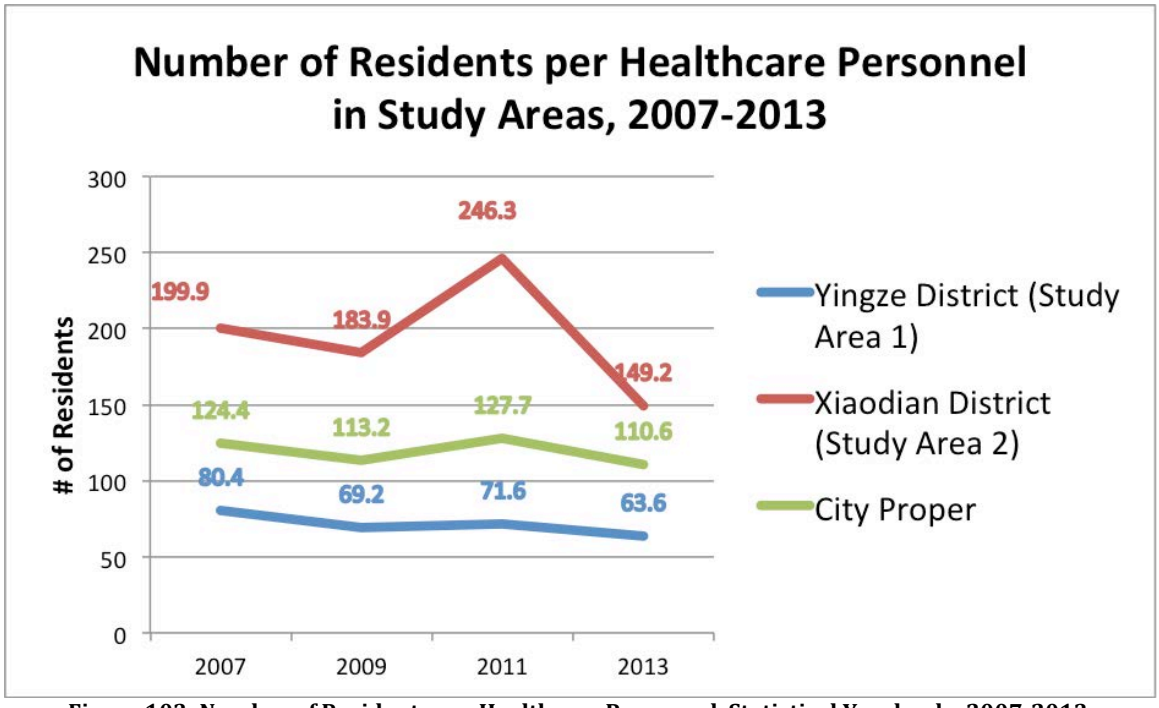


Figure 103: Number of Residents per Healthcare Personnel. Statistical Yearbooks 2007-2013.

Number of Middle Schools

Part of what makes a district attractive to residents is the quality of education. Chinese students are subject to placement tests after elementary school, which determine which middle school they might attend. Most of Taiyuan's most prestigious middle schools are located in Yingze District, which is the norm in China, where the best schools, and other public facilities are generally located in the core city. However, new, modern facilities have been built for the Shanxi Experimental Secondary School, which is in Xiaodian District (see Figure 104).

One of the most surprising things to note is that according to Figure 105, in 2007 Xiaodian had almost triple the number of middle schools than Yingze, despite Yingze having better schools (25 schools in Xiaodian, compared to 9 schools in Yingze). Xiaodian increases from 25 schools in 2007 to 44 schools in 2013; in particular, in 2011 there are 40 schools, which then increases by 4 over the next two years. In Yingze, in 2011 there are 21 schools, and this does not increase at all over the next two years.

Although the birth rate has slowed tremendously in China due to the effects of the one-child policy, recent changes to that policy allow for certain couples to have second children. As Xiaodian continues to develop and grow, it's quite possible more new families will locate in Xiaodian district and it will see a "baby boom", reflected in new primary and secondary schools.

Figure 104: Shanxi Experimental Secondary School. About 6km from city center, this school is the only one directly managed by the provincial department of education.[lxxiii]

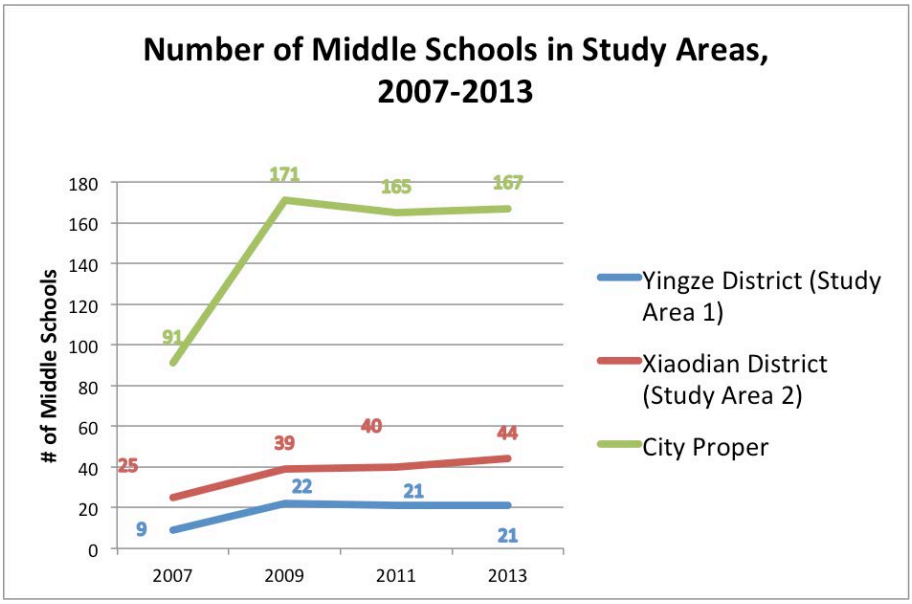


Figure 105: Number of Middle Schools in Study Areas. Statistical Yearbooks 2007-2013.

Green space per capita

Taiyuan's Master Plan quotes the United Nations standard of 60 square meters per capita of green space that should be available in cities for a healthy quality of life. 60 square meters is a significant amount when China's national standard for an "eco city"[lxxiv] is only 12 square meters. However, Taiyuan is still struggling to reach that standard.

For Taiyuan, in 2008 the City Proper had only 8.38 square meters of green space per capita, which improved to 9.09 square meters in 2009 and to 9.39 square meters in 2010. Based on Figure 86, Xiaodian District has had increasing green space to offer residents since 2007, by 2013 even surpassing the Municipal goal by approximately 9.75%. This seems counter intuitive at first, because Yingze District contains a large public park called Yingze Park (Taiyuan's equivalent to Central Park in Manhattan) and Xiaodian has no such signature park.

Figure 106: Tai Chi being practiced outside of a Temple structure in Yingze Park.

Yingze Park is a gorgeous, well-maintained park that offers amusement rides, a large, multi-sectioned lake, museums, and weekly events that draw thousands of visitors a day. It totals 632,800 square meters of green space (the lake is included in that number) and represents a significant portion of the green space that Yingze District can offer its residences. In areas like Manhattan or Bangkok, large centralized parks are considered good planning practice for the large spaces they offer in otherwise dense areas. However, even such a popular and well-kept attraction does not make an overwhelming impact on the Green Space Per Capita indicator for Yingze District, since Yingze Park is surrounded by buildings and roads, constraining the parks expansion while the District itself registers higher and higher population densities each year. The District is essentially built out, making new park creation virtually impossible.

Despite not having a city-wide green space attraction, Xiaodian District experienced a sharp increase in green space, increasinging from 7.51 square meters in 2011 to 13.17 square meters in 2013, while Yingze District only marginally increased from

5.82 to 5.96 square meters over that same period (see Figure 107). Its rate of increase is actually slowing; from 2007 to 2009, Yingze added .39 square meters of green space per capita, increasing per capita green space from 5.12 square meters to 5.51 square meters. But from 2007 to 2013, the District was only able to add .84 square meters, a 14% increase. Comparatively, Xiaodian increased its per capita green space from 6.32 to 7.26 square meters just between 2007 and 2009; over the six year period, it experienced a 52% increase in green space per capita. What can explain Xiaodian's consistent, and then explosive, lead over Yingze District in terms of per capita green space?

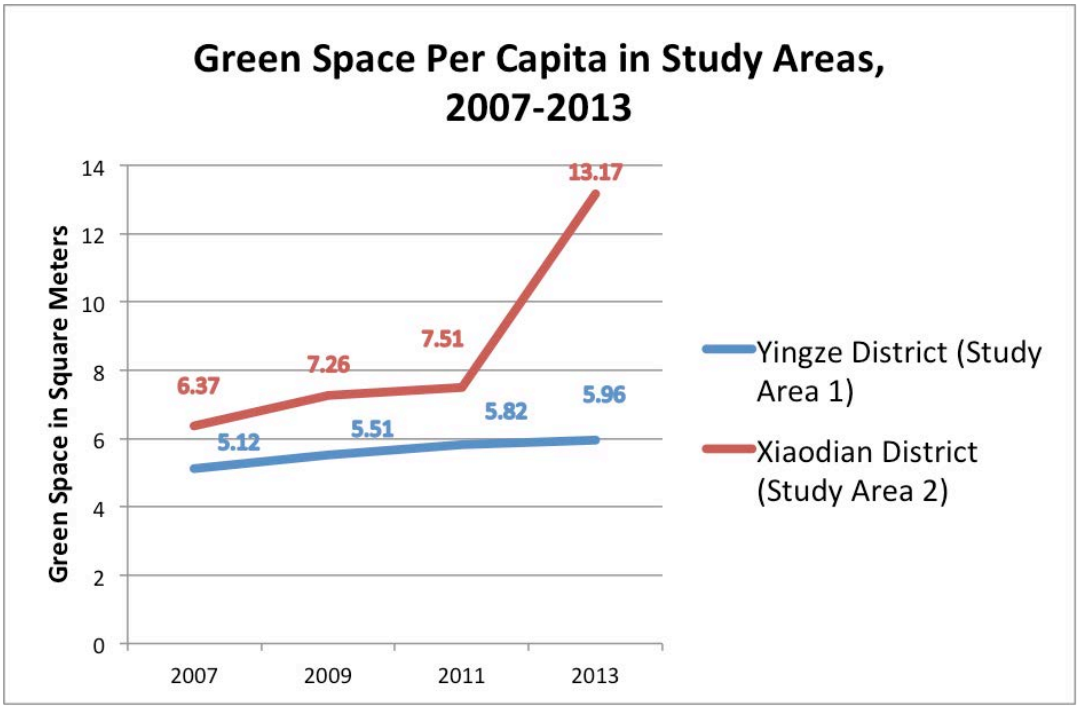


Figure 107: Statistical Yearbooks 2007-2013.

Xiaodian District contains the majority share of the eastern Fen He Park. The banks of the Fen He (river) were converted into public parks in 2000, the first completed portion covering 6 km of the river length. Continuous expansion projects culminated in the official opening of the Southern River Project in 2011, which added over 14km of

length to the park, for a total of 20.5 kms of park corridor (this figure includes both sides of the river, so approximately 10 km on each side).[lxxv] The completion of the Southern River Project, which is entirely within Xiaodian District, accounts for Xiaodian's sharp increase in per capita green space in 2011. And while Xiaodian is continuing to build up its parks, it is hoping to build a Central Park-like attraction in the form of the Dongshan Ecological Preserve, which will include mountain bike trails, a wedding square, a renovated temple, and lakes.[lxxvi] If the District wants to continue to position itself as the newer, healthier, and more beautiful Taiyuan, it will need Dongshan Ecological Preserve to rival Yingze Park's stature and entertainment value.

Annual Investment in Pollution Control

This indicator is complex to interpret, in part because higher expenditures for the purpose of pollution control indicate that pollution is a problem in an area. Study Area 1, Yingze District, is the most densely populated district in the city, and Study Area 2, Xiaodian District, has the highest overall population of any district, so both have strong incentives to limit pollution. Xiaodian District has the second highest air quality pollution index (it is the second-most polluted district in the Municipality), and Yingze District has the lowest.[lxxvii]

However, investment in pollution control in Xiaodian District swings wildly. According to Figure 103, in 2007, the district only spent 136,000 CNY on pollution control, but by 2011 was spending more than 24 times that amount: 3,301,000 CNY. That number fell again to only 810,000 CNY in 2013 (approximately 124,000 USD). Comparatively, in Yingze District, in 2007 the annual pollution control investment was 3,820,000 CNY, falling slightly to 3,438,000 CNY in 2011 but then taking an incredible increase, over 9 times that amount to 32,000,000 CNY in 2013 (approximately 4.9

million USD). How can a single district spend almost 5 million USD in pollution control, and another district only 2.5% of the same amount? The answer may be reflective of a "lump" problem, or when a higher expenditure is the result of a one-time purchase/investment of equipment (a water-treatment facility, new exhaust filters in a factory, etc).

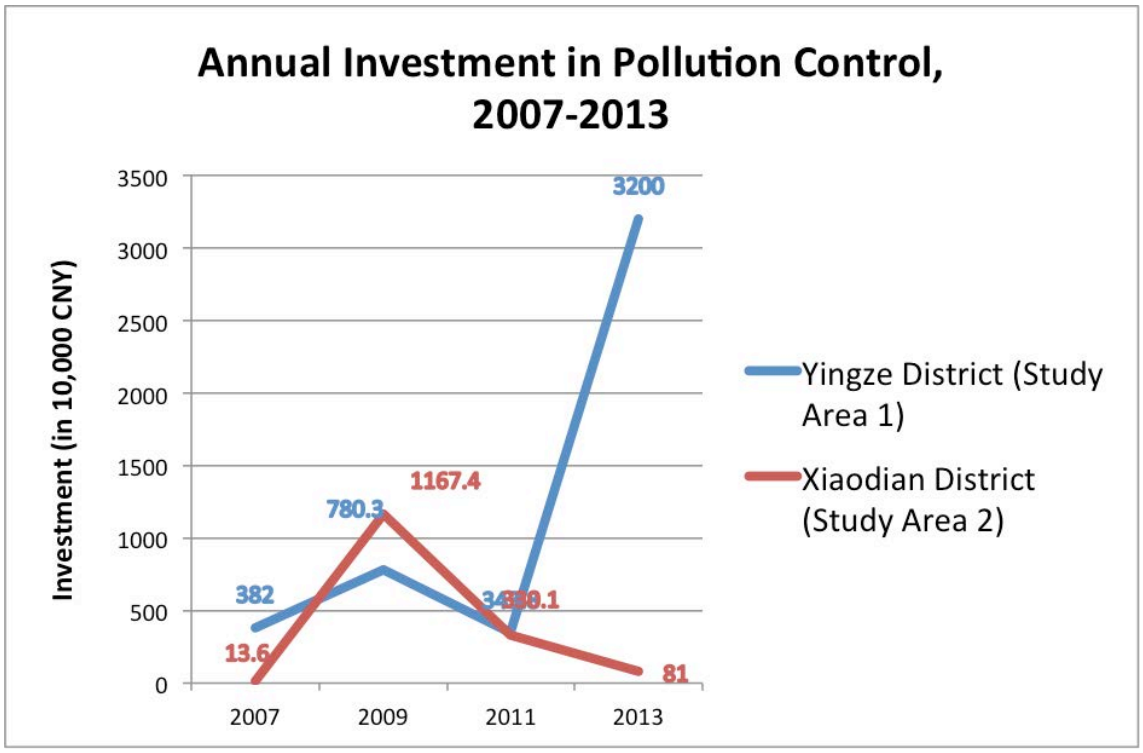


Figure 108: Unpredictable pollution control spending. Statistical Yearbook Data, 2007-2013.

Yingze district government released a comprehensive plan in 2007 to address pollution, focusing on coal-burning activities in winter, policing industrial burners and boilers, and regulating construction sites to control dust.[lxxviii] Another plan was released again in 2011, this time detailing retrofitting options for certain coal-burning facilities, and penalties for illegal coal-burning operations. An interesting difference between these two plans is that in 2007, the plan includes a single list of monitors for each action item; in 2011, the plan has not only more action items, but most action items included six groups for inspection, effectively a sixfold increase in the monitoring function.[lxxix] It is

possible that along with increased monitoring and inspection, the increase in annual pollution control investment also comes from the installation of new technologies and strategies to improve ambient air quality.

Comparatively, it is more difficult to find public announcements or plans from Xiaodian District Government on the matter of pollution control, at least as far back as 2007. The biggest concern in the District is also ambient air quality (Taiyuan City's largest concern since 1999), but most of the publicized pollution control projects involve construction site cleanup and removal of debris or rural sanitation projects.[lxxx] Because of Xiaodian's large area, there are still many more rural sites within the District than in Yingze. Thanks to the low density, and the heavy investment in only a small fraction of the district, Xiaodian may actually be procrastinating in pollution control because the majority of its residents live in newer complexes, in areas that are less heavily polluted. It also may be due to Xiaodian's southern location; water quality problems are much more intense in the Yingze District because of the high numbers of residents living in close proximity to canals or the Fen River, which can be contaminated by industrial pollution, or just careless citizens. Xiaodian's larger population centers are not so close to the Fen River, and because of the newer construction and lower density, lacks the sort of obviously visible problems that Yingze District encounters with water quality.

If regulations are enforced to strict standards, Xiaodian District may be able to avoid having to make serious investment and retrofits the way Yingze District has had to.

Sulfur emissions

In 1999, in response to the World Bank's assessment that Taiyuan was the world's most polluted city, the Asian Development Bank funded a coal gasification plant in 1999 as part of a $102 million USD, three-project effort to curb pollution in

Taiyuan,[lxxxi] and two years later also funded China's first domestic sulfur emissions trading program.[lxxxii] Reducing sulfur dioxide, a major byproduct of burning coal, has long been a major goal of the Municipality, and project outcomes in Taiyuan are used to make the case for adopting national policies for other heavily coal-dependent cities throughout China.

Of the two study areas, Study Area 2 (Xiaodian District) has experienced the most rapid economic development in recent years, in part because until the implementation of the current Master Plan, urban and infrastructure buildup was limited. As a result, elements of Xiaodian's downtown core, lack centralized heating, which is available in Yingze, Wanbailin, and Xinghualing Districts, but has not yet been extended far into Xiaodian District. Widespread centralized heating is energy efficient because it controls usage for millions of residents, but also because there are energy efficiencies based on scale. However, it also means that until the city turns on the system (usually November 1st or November 15th), even if temperatures have already fallen by early October) building interiors are uncomfortably cold, prompting residents to use space heaters or even coal-burning stoves, both of which are energy and environmentally inefficient. Xiaodian District implemented a central heating system powered by steam boilers in 2010, reducing the need for coal-burning heaters in the area, reducing emissions by 572 tons.[lxxxiii]

When assessing sulfur emissions from the Municipal Statistical Yearbooks 2007-2013, (see Figure 103, following page), the effects of Xiaodian's expanded centralized heating program appear to contribute to the decreasing emissions trend. Xiaodian emited 1,048 tons of sulfur dioxide in 2007, then reduced emissions by 42% to 602.2 tons in 2011. What is astonishing is the 86.5% reduction in emissions from 2011 to 2013: a mere 81 tons of sulfur dioxide were emitted in 2013. This decrease may be attributed to

"clean coal" processes that reduce the amount of sulphuric content in coal. In Yingze District, however, there has been no steady trend. In 2007, the District was only producing 278 tons of sulfur dioxide; but in 2011, that increased 3.7 times, to 1,029.59 tons. By 2013, a mere two years later, the levels drop again to 353 tons.

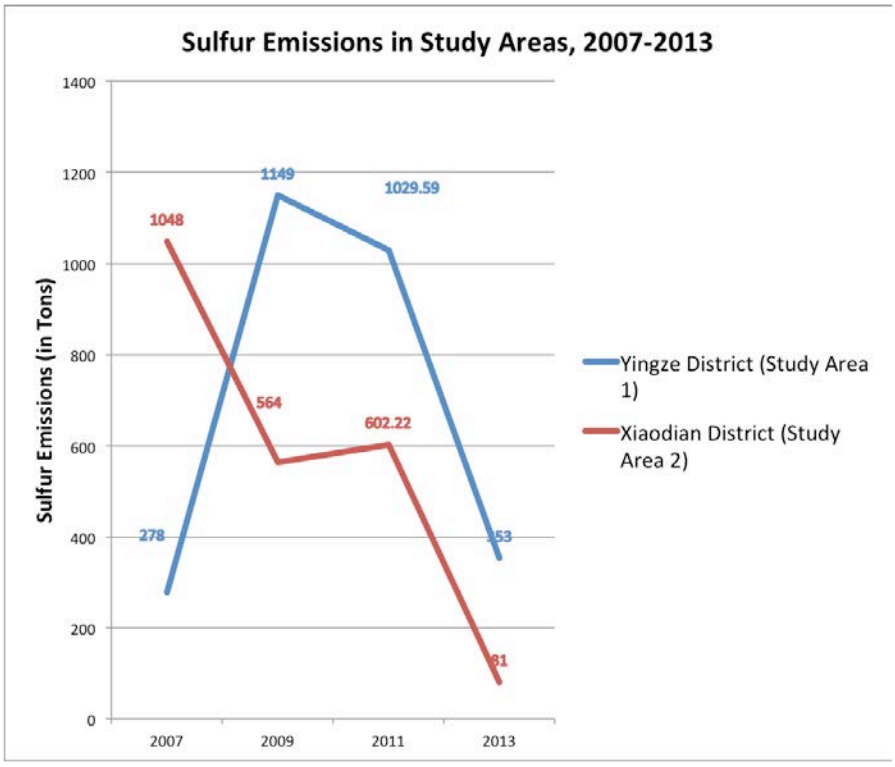


Figure 109: Statistical Yearbook Data, 2007-2013.

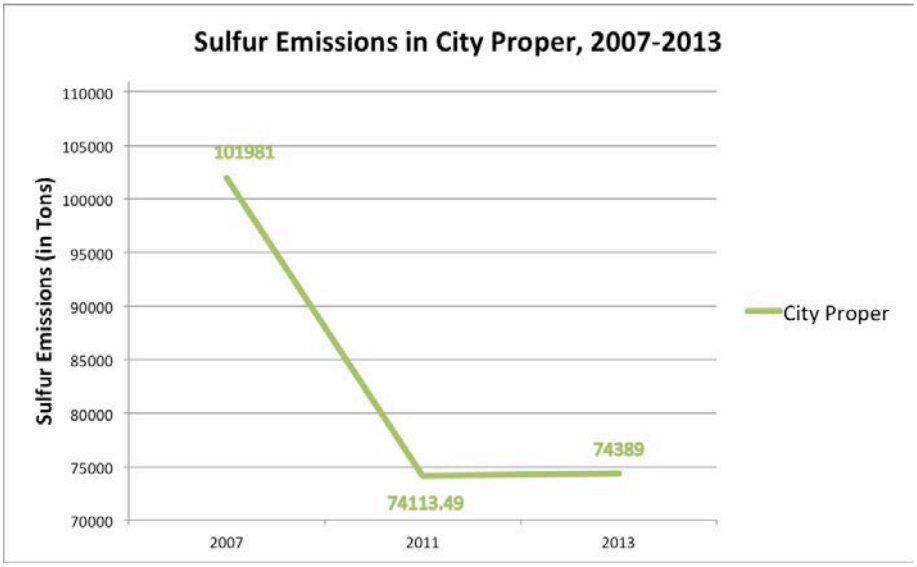


Figure 110: Statistical Yearbook Data, 2007-2013.

Part of the decreases may also be attributed to the dispersal of industries outside of the City Proper: in 2012, eight major companies were moved out of the downtown area in order to keep polluting processes away from the public.[lxxxiv] The goal was that moving these companies, and installing newer power-production technologies in their new locations, would reduce sulfur dioxide emissions by 4,000 tons annually. [lxxxv]

However, according to Figure 110, between 2011 and 2013, emissions in the City Proper actually increased by more than 200 tons, so if there was any earlier reduction from these investments they were negated by other factors, e.g., industries starting up and / or residential heating.

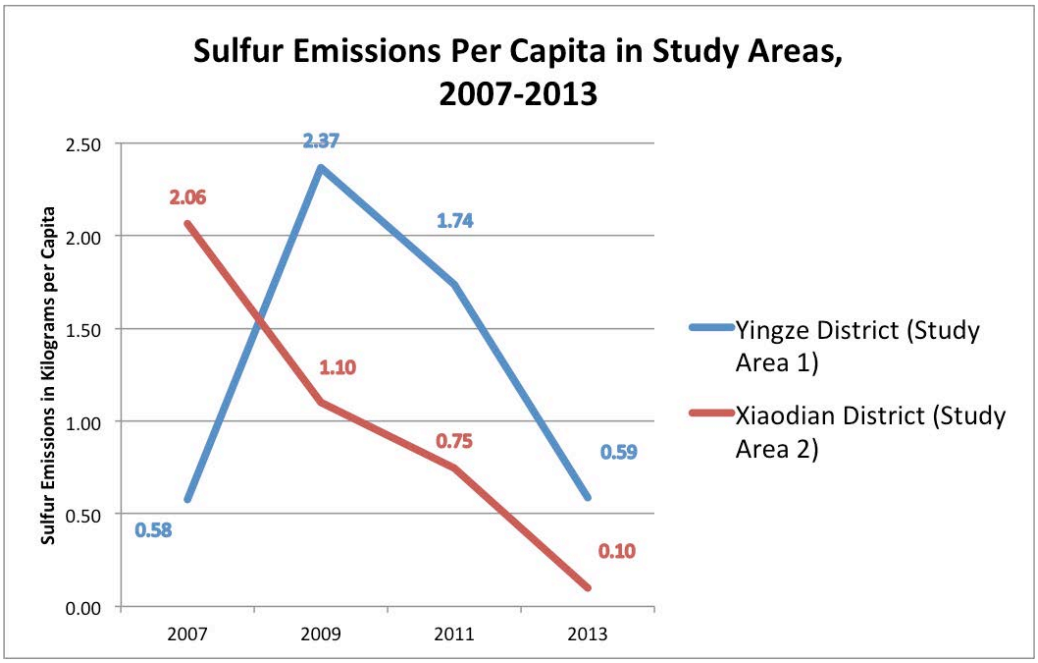


Figure 111: Sulfur Emissions per Capita in Study Areas, 2007-2013. Data taken from Statistical Yearbooks. This data shows that even as the population in Xiaodian has increased, the emissions per capita is decreasing.

Comparing the two figures- sulfur emissions in the Study Areas, and sulfur emissions in the City Proper –reveals that only 1/10th of a percentage point of sulfur emissions are coming from Xiaodian District, and only 0.5% is being produced in Yingze District. This means the majority of sulfur emissions, even if they are declining, are being produced in the four other districts of the City Proper. It becomes even more interesting

when looking at sulfur emissions in the Study Areas per capita (Figure 111); there were some emissions increases, in Xiaodian there is a steady decrease in emissions per capita, meaning that even as the population grows, they're producing less and less sulfur dioxide.

However, just comparing Study Area 2 (Xiaodian District) and Study Area 1, Xiaodian is progressively reducing its emissions: an important feature since the District has the highest share of the Municipality population. Xiaodian is clearly doing a much better job than Yingze District in reducing sulfur emissions. The caveat here is that air pollution is not a static thing. It can travel from district to district quite easily, so the impact of reducing emissions as shown here just means that industrial or public works processes within the district have made strides in improving their facilities and producing less sulfur dioxide. Of course that's a good thing, but it doesn't *really* help the air quality for residents if in Jinyuan or Qingxu, other factories are polluting the air. That pollution could come in on a breeze and hurt residents in any part of the Municipality. Still, as an indicator of progress, it's a confident measure that Xiaodian District is trying to improve its environmental quality.

Retail Sales

An important factor explaining how Study Area 2 (Xiaodian District) is distinguishing itself from other districts in the City Proper is its role as a shopping, hospitality, and entertainment destination. Changfeng Jie, with its two diagonally-facing malls, 北美新天地 (Beimei Xintiandi) and 天美新天地 (Tianmei Xintiandi), the Kempinski Hotel, that include multiple Starbucks, import grocers, and luxury stores. Importantly, the luxury shopping cluster has shifted from Yingze to Xiaodian District. With so much focus on the new, the modern, and the expensive, Xiaodian District should

have higher total retail sales (and also catering, personal services, and lifestyle expenditures) than Study Area 1.

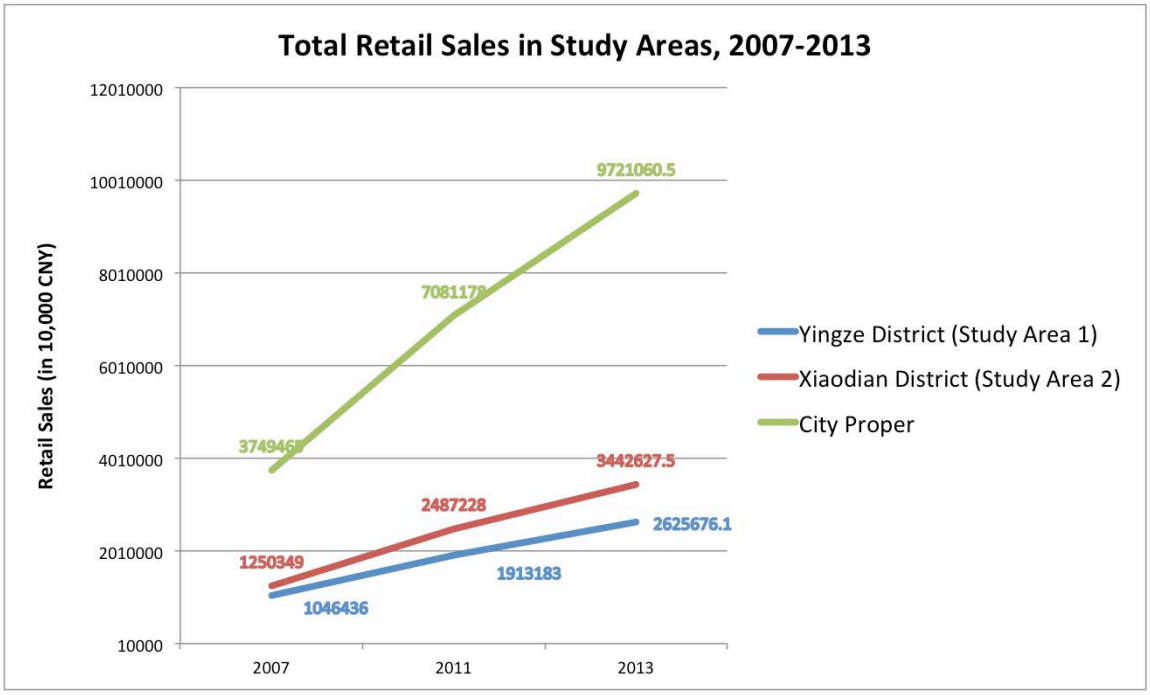


Figure 112: Total Retail Sales in Study Areas. Statistical Yearbook Data, 2007-2013.

The data in Figure 112 confirms this hypothesis. In 2007, both districts were comparable in retail sales: Xiaodian District had approximately 12.5 billion CNY (equivalent to almost 2 billion USD) in retails sales, while Yingze District had 10.5 billion CNY (over 1.6 billion USD). Xiaodian District's total retail sales were only 19% higher than Yingze District's, and represented 33% of the City Proper's total retail sales. But after 2007, Xiaodian continues to increase its market lead over Yingze, By 2011, Xiaodian District's retail sales increased 98%, to 24.8 billion CNY, and maintained a 35% share of the City Proper's total retail sales. Yingze also increased, by 83%, yet Xiaodian increased the gap from 19% to 30% higher than Yingze's total retail sales. In 2013, Xiaodian remained 31% higher than Yingze and represented 35% of the City Proper's total retail sales.

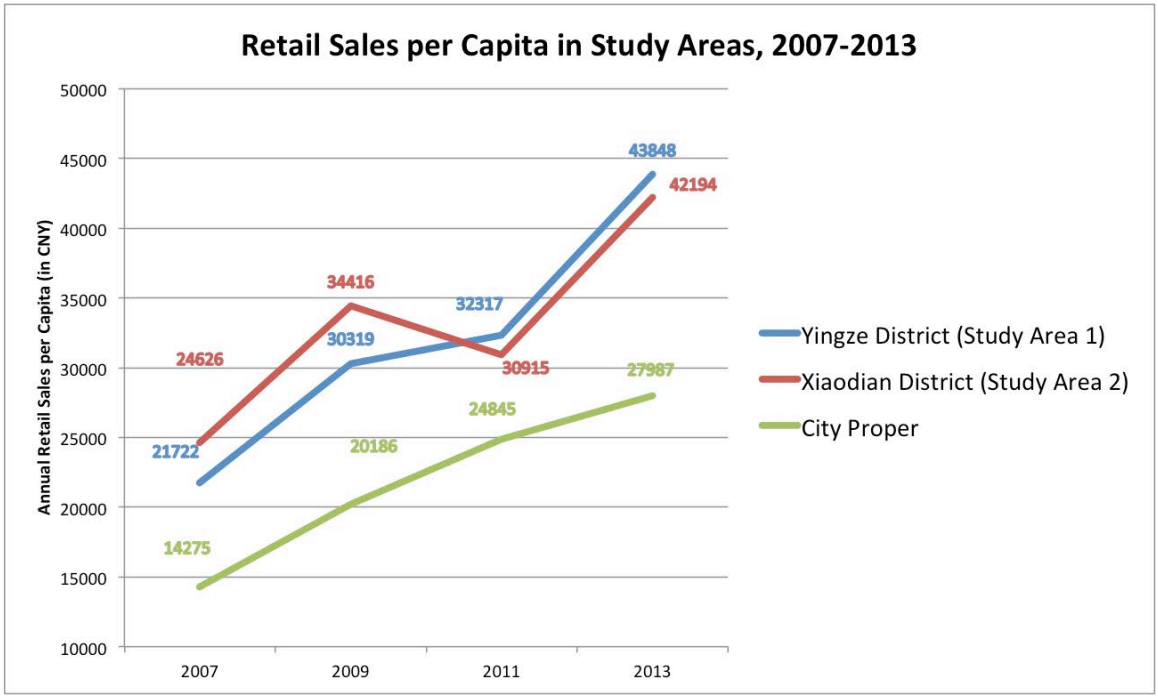


Figure 113: Retail Sales per Capita in the Study Areas show a slightly different picture of Xiaodian's economic fortunes than simply retail sales. Statistical Yearbooks 2007-2013.

The situation changes slightly when examining Retail Sales per Capita in Figure 113. Xiaodian District is significantly higher than Yingze District until approximately 2010, after which both districts have an increasing trend. This is because Xiaodian's population begins to grow at a faster rate than Yingze District's. In 2006, Xiaodian's population overtook Yingze District's, increasing sharply after 2009 (see Figure 65, page 73, from earlier chapter). Although Xiaodian has higher retail sales, it has lower retail sales per capita compared to Yingze. Still, Yingze District is only leading Xiaodian by 4.5% in 2011, and 3.9% in 2013.

Considering that the population in Xiaodian is likely to continue to increase at a faster rate than Yingze, if retail sales per capita in Xiaodian once again exceed Yingze's in it would be a sign that more economic activity was moving south despite growing population. That scenario is extremely likely as Shanxi University City moves towards completion; once all 100,000 students and some 20,000 teachers and staff are in place, with the estimated 900 million CNY being spent in the region, Xiaodian's already high

retail potential would almost certainly exceed Yingze's and remain the highest for the Municipality. Not surprisingly, both districts are far higher than the City Proper; there are few retail opportunities or attractions in Wanbailin, Xinghualing, Jiancaoping or Jinyuan, at least compared to the Study Areas.

Conclusions

Although Yingze District has completed major renovation and restoration projects that injected new vitality into its historic shopping streets (renovations that retained or improved on the character of the streets, as opposed to the much decried "renovation" of *hutong* in Beijing that destroyed the cultural significance of the areas it was supposedly saving), the reality of the situation is that Yingze is a dense district, and these historic areas have already been built up to their limits. There are fewer and fewer locations in Yingze where it is appropriate, or even possible, to put a six story, 50,000 square meter shopping mall.

This situation is further complicated by the fact that so much of the most valuable accessible land in Yingze is occupied by institutional users, such as hospitals, secondary schools, which are very difficult to move. On the other hand, in Xiaodian District on Changfeng Jie (road), developers were able to construct two major malls. As Study Area 2 continues to be developed, there are strong indications that more areas like Beimei Xintiandi and Tianmei Xintiandi will be constructed, especially with the Southern Railway Station completed.

CHAPTER 8

CONCLUSION: A PERSONAL PERSPECTIVE

The original premise from this research came from multiple trips down Bingzhou Lu, towards Wusu International Airport. I lived in Taiyuan from 2007 to 2011, and in four years, I had made that trip dozens of times. At 11km from city center, with typically 6am departing flights, I'd be driving on near-empty roads at 5am and watching the built-up towers of Yingze Dajie fade first into six-story residential blocks, and then finally into nothing but highway.

It was in 2010 that I first noticed the bones of what would become Shanxi Hospital, a huge cement block rising up in the middle of nowhere. The large banners and signs near the expressway advertised the great provincial achievement that was to come.

"A hospital!" I thought to myself in disbelief. "*This* far away from the city?" If you were sick, it made no sense to be driving twenty minutes on empty roads (maybe twice as long with traffic) to reach a doctor, no matter how amazing the facility was supposed to be.

The rumors and information, unclear even to my Chinese friends who were native to Taiyuan, made its way to through the expatriate community. The city was "moving south", our Chinese co-workers would say excitedly. They would talk about expensive holding deposits they had placed on apartment towers not yet built. Sure enough, my rides to the airport soon saw twenty-story clusters of apartment buildings, isolated from the urban areas and bordered only by Bingzhou Lu.

"*This* far away from the city?" I thought to myself in disbelief. If you wanted to live out here, you would need to be wealthy enough for a car, which was still a goal out of reach for most Taiyuan residents.

The rumors began to be peppered by facts, news articles and construction signs. A new library, a new Olympic training center, a soccer stadium for fifty thousand people! It all sounded so unbelievable. How could Taiyuan afford to build these things when in the city center, most residents lived in buildings that had no elevators? When even new buildings, just one year later, looked decades worn from acid rain and questionable construction?

And so when it came time to do my research, my question and hypothesis were firm in hand: how could the city government be so ambitious as to embark on the Taiyuan Master Plan 2007-2020? So much of the Master Plan hinged on rapid population growth, but Taiyuan's reputation seemed immutable. This was a dirty, coal-covered city, a playground for the 暴发户(the coal-born nouveau riche) and a health hazard for everyone else. Nobody *wants* to move to Taiyuan; not when there are cities like Beijing, Xi'an, Chengdu, Shanghai, or Shenzhen to consider. Without people to fill the gaps between these new Master Plan destinations and the rest of the city, the Municipal Government would have residential complexes that would take years to fill. The city core, once dense, even walkable, and farther areas easily accessed by cheap buses, would be forcibly sprawled out and made inaccessible to all but the wealthiest car-driving citizens.

However, over the course of my research, the more that I learned about the specifics of the current Master Plan, the more I began to doubt my initial assumptions. In March 2014, when I arrived in Taiyuan to do field work, personally walking inside of the projects and elements of the Plan changed my view completely, and put me in awe of Chinese urban planning as a whole. With methodical strategies and long-term commitments, what had appeared to be overambitious and wasteful projects in 2010 were materializing successes in 2014.

My questions were, for the sake of my education and research, reduced to two: Would the current Master Plan have a negative impact on Yingze District? Would Xiaodian District, with these new elements, offer a modern, high-quality of life to residents?

TABLE 3: RESEARCH OUTCOMES

Study Area 1 Yingze District	Positive	Negative
Indicators		
Population	✓	
Average Real Estate Prices per Square Meter	✓	
Commercial Real Estate	✓	
GDP	✓	
Secondary Industry (Value Added)	✓	
Tertiary Industry (Value Added)	✓	
Fixed Investment		✓
Science & Technology Expenditures	✓	
Education Expenditures		✓

Study Area 2 Xiaodian District	Positive	Negative
Indicators		
Income per Capita		✓
Number of Hospital Beds	✓	
Residents per Health Personnel	✓	
Number of Middle Schools	✓	
Green Space per Capita	✓	
Annual Investment in Pollution Control		✓
Sulfur Emissions	✓	
Retail Sales	✓	
Retail Sales per Capita	✓	

Examining the indicators gave me enough evidence to conclude that in fact, Yingze District was not suffering from the infrastructure investment and growth of Xiaodian District. In many ways, it continuous to dominate the rest of the City Proper and grow. The few indicators where Yingze District was not performing as well as in the past, education expenditures and fixed investment, might be considered signals that the

district is approaching a “leveling off” of development, since it has no way of expanding and its population is already high and dense; but approaching a stable level is far from a decline. Likewise, in Xiaodian the quality of life is steadily improving. For residents who have put their deposits down in a new apartment complex, they move from buildings made of brick with poor insulation, no parking and no public space to private landscaped parks, airy apartments, and modern facilities.

There were still setbacks; the most foolish construction project was the 62,000 seat Red Lantern Soccer Stadium, a modern facility of over 1 billion CNY investment that has stood for two years in neglect, in large part because of Taiyuan’s lack of a soccer club. But most of the other projects have clearly benefited the city. What used to be an empty drive to the airport is now an expressway lined by row after row of high-rise residential complexes still being constructed, running parallel to the Fen River park.

Figure 114: New housing developments along the expressway, towards the airport. Site visit, 2014.

This examination of Taiyuan's Urban Master Plan 2007-2020 is not a Cinderella story; as a city capital with a rich cultural heritage and natural resources, Taiyuan may be one of dozens of third-tier Chinese cities, but it still possesses more advantages than hundreds of others.

In summary, Taiyuan has taken important and well-planned steps that can help it shed its national image as a polluted, almost obsolescent city. By 2020, with a subway system that connects all districts and counties together, an iconic, 310-meter tower in the heart of Wuyi Square, and a bustling University City, Taiyuan will have successfully made the transition from third to second-tier city, perhaps still playing a pivotal role in urban agglomeration for Shanxi and Central China.

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