

HOW INDUSTRY AND URBAN FORM CO-EVOLVE: THE CASE OF THE SILK INDUSTRY TOWN OF SHENGZE, CHINA (1)

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1. This research is supported by the China Scholarship Council and the Open Topic of Hunan Key Laboratory of Land Resources Evaluation and Utilization (NO.: SYS-ZX-202307.)

2. In this paper, urban evolution refers to the continuous development and changes of settlements over a long period of time in a broad sense, and use different phase to distinguish significant shift in the inherited characteristics.

INTRODUCTION

Industry plays a significant role in shaping urban form. While numerous studies have explored the effects of industrial location, transformation, and transference on urban form (Wiedmann et al., 2012; Adrian et al., 2019), few have undertaken a comprehensive analysis of the ongoing interplay between industry and urban form within the context of urban evolution (2). This gap is particularly significant, as it addressing this issue not only enhances our comprehension of the inherent logic of urban form but also provides insights into contemporary urban phenomena.

The existing research method used to examine urban evolution have roots in historical geography or political economy, both of which, however, have their respective limitations. Historical geography predominantly focuses on describing the physical space, giving relatively less attention to understanding the underlying mechanisms. Conversely, the political economy method emphasizes the forces influencing the space but tends to overlook the spatial dimension. Moreover, its application is primarily confined to contemporary urban contexts.

To move beyond this alternative, as elaborated in the literature review, this study employs path-dependency theory to reconstruct a series of explanations for the evolution of urban form influenced by industry over extended periods. The concepts of critical juncture, driving mechanism, and Lock-in impact, emphasized in path dependence theory, illuminate the background, causes, and outcomes of urban evolution. These concepts serve to explain both the urban evolution process, and the mutual, sequential influences of industry on urban form and vice versa. Method section introduces the case of Shengze, while findings section, grounded in the path-dependency framework, delves into how its silk industry has shaped the contemporary form of Shengze a throughout the ages.

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LITERATURE REVIEW

Approaches to Analyzing Urban Evolution

Urban evolution has drawn continuous attention in the field of history. The substantial transformations experienced by cities during the 18th and 19th centuries, catalyzed by the Industrial Revolution (Ch, 1907), garnered considerable attention in early 20th urban evolution studies, especially in Western Europe and North America. These studies aimed, firstly, to determine the underlying logic of urban evolution as a basis for informed policy decisions (Glass, 1964), and, secondly, to explain contemporary urban challenges faced by a fragmented and alienated society (Marshall, 1937).

Subsequently, post the mid-20th century, the burgeoning movement to preserve cultural heritage heightened the practical significance of historical geography. Regional planning and human geography necessitated a more profound comprehension of historical changes in local economic structure, population distribution, society, and the natural environment. It was acknowledged that predicting the social and economic phenomena would be incomplete and unreliable without a thorough understanding of development processes concerning the interconnected natural elements within historical geography. Thus, urban evolution emerged as a significant theme in the disciplines of historical geography and urban planning.

Historical geography studies primarily focus on changes in territorial structure related to urban functional activities. For example, Shen and Karimi (2018, 42) explored the transformation of the “urban centrality structures” of Shanghai from the 1880s to the 2010s, demonstrating the dynamic interplay these centrality structures concealed within spatial networks and land-use distributions. In contrast, studies in urban planning place more emphasis on the resultant urban form, with focus on visual representation and physical order. For example, in a comprehensive analysis, Sintusingha (2011, 134) examined of the physical evolution and transformation of Bangkok, progressing from an indigenous city to a transition city, and finally to a modern city after 1782. The study identifies three patterns of spatial transformation: lateral expansion, movement and suburbanization. Similarly, Korah et al. (2019, 2) analyzed how spatial development patterns evolved in Accra, from the inner city to the peripheries, and assessed what insights the evolution revealed about the urban form.

While some new spatial analytic methods, such as GIS or Space Syntax, have been developed recently to analyze urban evolution (Pacheco and Heitor, 2012; Ferdous, 2012), the advancements allow for more detailed studies than before. However, the primary limitation in studies of this nature, emphasizing historical geography and urban planning was obvious. These studies tended to emphasize the issue of space itself while neglecting the multifaceted factors influencing its evolution. Understanding the extent and ways in which each factor affected the space proved challenging, as it necessitated not only an awareness of the unfolding progress and process but also an understanding of the underlying causes.

Adversely, following Henri Lefebvre’s (a representative of the Neo-Marxist school), introduction of the theory of the production of space in the 1970s, scholars began realizing the complexity of space, leading to the development of a new interpretive framework. David Harvey further

advanced the theory of political economy, establishing a world-leading perspective on how space functions as an important factor in promoting capital operation and giving rise to specific modern phenomena. As Jiang (2015, 64) posited, “the process of urban space evolution means a process of adjustment of spatial property rights.”

Unlike historical geographical studies, the political economy perspective places more attention to the interplay between space and influencing factors. For example, in terms of political space, Monclús (2003, 418) used Barcelona as a case study to demonstrate how unique flagship events (a kind of short-term policy) affect urban evolution; indicating that culture drives industrial, economic and tourism development. From an economic space perspective, Wiedmann et al. (2012, 35) observed that distinct stages of economic transformation have influenced the structure Doha, impacting its society and built environment. They demonstrated that each period of urbanization was driven by a specific economic activity and was grounded in key governance and planning strategy, resulting in particular impacts on urban structure and architecture. In terms of social space, Wang and Liu (2017) revealed the evolution of the urban socio-spatial structure of Xi’an by comparing the spatial distribution of the population in different periods. They then analyzed the evolutionary mechanisms of the urban socio-spatial structure, considering historical development, economic development, the policy system, and various social classes. These studies collectively contributes to a more nuanced understanding of how diverse factors intricately shape urban space.

While political economy studies have bridged the gap between external factors and urban form, the predominantly operate on the fundamental premise that urban form is solely an outcome of external factors. Therefore, we contend that our understanding of the evolution of cities remains at surface level.

The development of urban form is not merely a response to external factors such as economy, politics and demographics. It is also a result of how the various newly introduced elements interact, either enabling or constraining each other progressively along the way. Every new phase of urban evolution is bound by the built legacy of the phase before it. Evidently, the basic topography of a city’s location, such as been situated on a peninsula, island, steep slopes, clear water creeks, and meandering rivers, influences industrial settlement patterns. These, in turn, leads to investments in landfills, bridges, and canals shaping the spatial context for subsequent patterns and future investments.

This perspective markedly prioritizes the spatial and urban fabric, surpassing the current literature by embracing a more extensive temporal framework. An in-depth exploration is integral to unveil the holistic evolution of urban space, probing into both its complex processes and causal determinants. Consequently, an objective assessment of these causes is crucial, taking into account the external factors and adhering to the laws of evolution.

Key Path Dependency Concepts

We propose that a spatial perspective on the longitudinal interaction between constituent parts of cities require us to expand the analytical tools to include those that can reveal these types of interactions. In this respect, path dependency is a theory which has been used by various disciplines to describe constraints on future options based on the consequences of

a previous decision. Since this theory not only emphasizes the influence of external environment but also the laws of evolution, it could provide a valuable approach to explain processes and causes underlying urban evolution.

While it remains an internally diverse concept, the core idea of path dependency posits that institutions may not always be optimal given the circumstances. Once established, institutions become increasingly resistant to change (“locked in”). Consequently, seemingly inconspicuous decisions made early on can exert significant and enduring impacts (Sorensen, 2015). Evidence to of this is the classic example of the QWERTY keyboard. As explained by David (1985) in the case of the keyboard, being “the first” was more important than being “the best”. The initial design attained a dominant position and subsequently became the standard for the majority of typewriters and subsequent keyboards. As numerous individuals and firms embraced this layout, its dominance became increasingly challenging to contest over time, persisting even after the particular technical limitations that prompted its design were no longer relevant.

While various interpretation of the concept of path dependency exist, it seems unanimous that the “canonical” model comprises three main features or steps (Martin, 2010, 4). First, a seemingly minor event has significant and unpredictable long-term effects (known as the “butterfly effect”). Second, the event results in a certain development path becoming “locked-in” through various self-reinforcing mechanisms that limit the potential for alternative development paths. Finally, this pattern is assumed to remain stable (excluding changes) until disrupted or dislodged by a shock of some kind. In this respect, there are three related concepts we will apply in the findings section.

The first concept is “critical junctures”. Collier and Collier defined these junctures as “a period of significant change, which typically occurs in distinct ways in different countries (or in other units of analysis) and which is hypothesized to produce distinct legacies” (Collier and Collier, 1991, 29). A critical juncture signifies a temporary “window of opportunity,” as conceptualized by Kingdon (2003), wherein certain categories of events are feasible during a certain period, while the emergence of others is hindered. Therefore, an analysis of the specific circumstances, timing, and configurations of actors during significant critical junctures is deemed crucial for identifying path dependency. The emphasis lies not in explaining every event through another but in attending to how early events along the path impact the likelihood of subsequent events (Klimek and Hansen, 2017, 112).

The second concept pertains to the “driving mechanism”. Arthur (1994, 112) summarizes it as “increasing returns” (3), highlighting four characteristics: 1) Large initial fixed setup costs, essentially representing the inertia of sunk costs. 2) Dynamic learning effects, wherein learning by doing or using and learning by interaction tend to entail positive feedbacks. 3) Coordination effects, conferring advantages to aligning with other economic agents taking similar actions. 4) Self-reinforcing expectations, where the increased prevalence of a product, technology, process, or practice enhances beliefs of further prevalence. Many scholars have substantiated this theoretical hypothesis through their own case studies. For example, Aghion et al. demonstrated in the automotive industry that, giving the stock of polluting innovation was greater than that of clean, the path-dependency effect would tend to lock economies into high carbon

3. Means each additional unit of investment will yield more output.

4. The Jiangnan area refers to the southern Jiangsu province, northern Zhejiang province and Shanghai, located in the Yangtze River Delta. It is the most developed area in China.

emissions to garner increasing benefits, even after the introduction of mild carbon tax or R&D subsidies for clean technologies (Aghion et al., 2016).

Finally, the third concept is the “lock-in impact”. Can a trajectory, once established, only reinforce itself while excluding other options? Mahoney (2000) provided a relatively comprehensive answer. He concluded that there were two types of path dependency: the self-reinforcing and the reactive, closely related to path directions. The self-reinforcing type aligns with David’s (1985) and Arthur’s (1988 or 1989) original assumptions, signifying that initial steps in a particular direction induce further movement in the same direction, making it difficult or impossible to reverse over time. “Reactive” means that each event in the sequence is both a reaction to antecedent events and a cause of subsequent events, following the logic of A leading to B, which leads to C, then to D, and so forth (Mahoney, 2000, 526). Whether a trajectory is determined by a distinct deviation from (reactive) or gravitation towards (self-reinforcing), path dependence characterizes specifically those historical sequences in which contingent events set in motion institutional patterns or event chains with deterministic properties (Mahoney, 2000, 507).

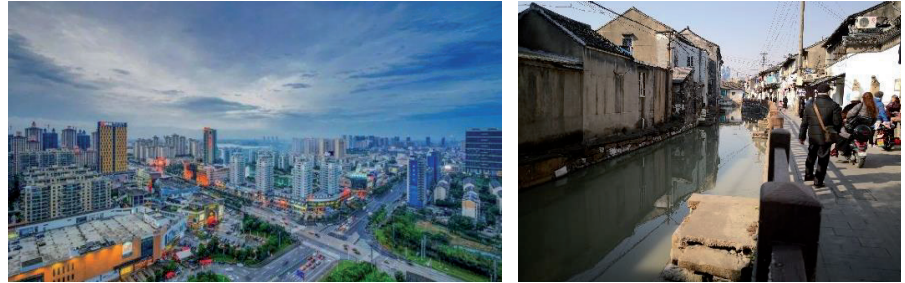
METHOD

This paper takes Shengze as a case study, obtaining information on the evolution of the town and its silk industry through data collection, on-site inspection and personal interviews. Shengze is located in Wujiang County, Jiangsu Province, China (Figure 1). Despite its administrative designation as a town only in the Jiangnan area (4), Shengze possesses the scale and developmental characteristics typical a city. Four reasons underlie the selection of Shengze: firstly, its relatively homogeneous industrial structure, particularly the silk industry, establishes a direct and discernible impact on urban form, thus making it easier to identify the corresponding



Figure 1. Location of Shengze (prepared by authors)

Figure 2. Comparison of the new district and the old district of Shengze ((left) QIAN Yunwei, https://www.sohu.com/a/325077818_349681, (right) author's personal archive)



relationship between them. Second, Shengze initially took the form of an old town, and despite noticeable expansion in recent decades, its spatial structure remains simple and easier to grasp compared with larger cities. Thirdly, both the town and its silk industry boast a lengthy history, well documented and providing a robust basis for historical evolution research. Lastly, present spatial contradictions in Shengze are pronounced, manifesting in the comparison between the old district and the new district, as well as in the conflict between conservation and development (**Figure 2**). Only through an in-depth understanding of the spatial history and spatial logic can we resolve the aforementioned dilemmas, thereby enhancing the practical significance of this research.

The case study employs various data collection techniques, including local chronicles, historical maps, historical satellite images, and existing related research, such as Shengze Chronicle, Wujiang Silk Chronicle, historical map of Shengze in 1911, and in 1990. On-site inspection involved visits to historical workshops, factories, market sites, and production spaces that are still in daily use. In person interviews were conducted with president Cai Xuexiong, Secretary-general Wu Xuesen of Silk Association in Wujiang, and local elderly figures who were familiar with the industrial development history in Shengze.

In the analysis process, the path-dependency concepts discussed in the literature review will be applied to examine urban evolution and the continuous interplay between industry and urban form. Initially, the concept of 'Critical Juncture' will be introduced to highlight the pivotal event at each phase, serving as the backdrop for the industry's evolution. Subsequently, we will analyze the industrial adaptation process using the concept of 'Driving Mechanism,' identifying the specific type of increasing returns that resulted in path dependence and underscoring the connection between the preceding and the subsequent phases.

Indeed four types of industrial changes corresponded to distinct forms of "Increasing Returns": scale production reflects large initial fixed setup costs, industrial upgrading reflects dynamic learning effects, industrial cooperation manifests coordination effects, and industrial recovery signifies self-reinforcing expectations. Finally, we will attempt to analyze the changes in urban form induced by industrial changes using the concept of 'Lock-in Impact'. This involves distinguishing whether it is a self-reinforcing mode (the expansion or reduction of urban scale) or a reactive mode (the emergence of new urban functions). Special emphases will be placed on the impact of industry on urban form and how urban form reacts to the subsequent development in the industry (**Figure 3**).

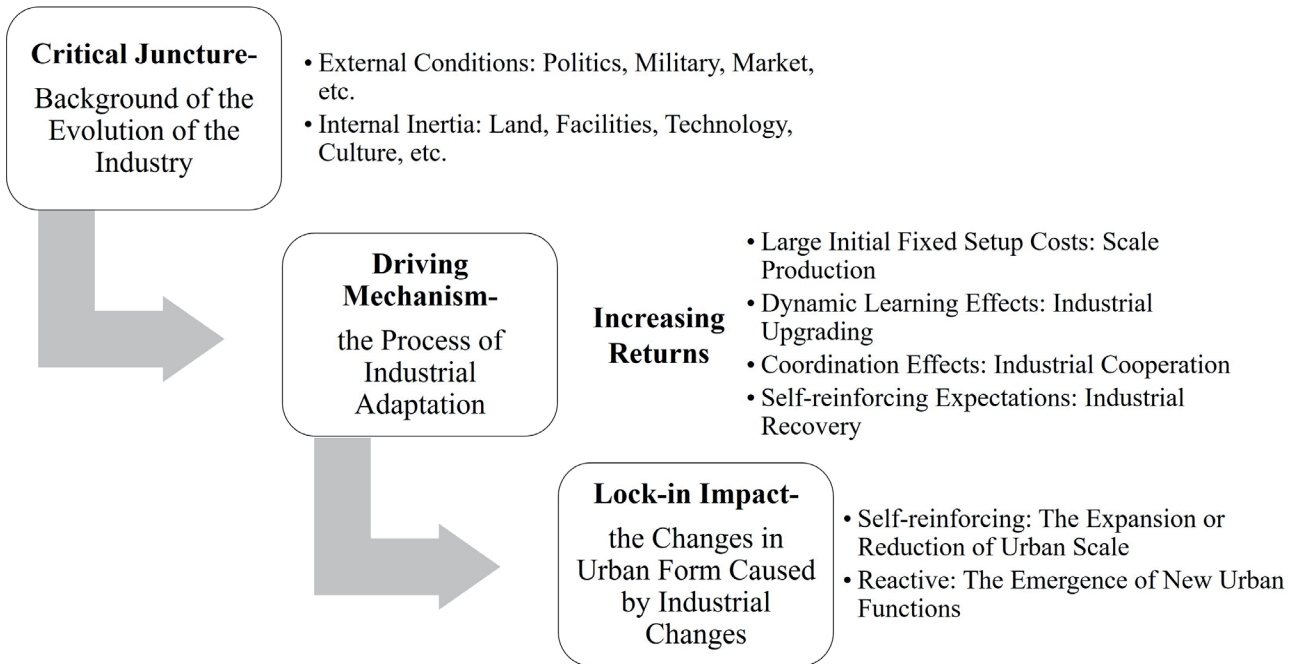


Figure 3. Analyze framework for industry and urban form evolution (prepared by authors)

FINDINGS

Based on the history of the historical development of the silk industry in Shengze and the changes in the urban form characteristics, the overarching evolution process is categorized into four phases. The first phase concerns the Qing Dynasties, followed by the second phase encompassing the modern period from 1840. The third phase spans from the establishment of the People’s Republic of China in 1949, while the fourth phase extends over the Reform and Opening Up period from 1978.

Phase One: Natural Topography Explains Silk Industry (1450-1840)

Critical Juncture

Before the Ming Dynasty (1368-1644), the Jiangnan area was the most important grain producing area in China. The climate in the area was mild and humid, with sufficient sunlight and frost-free periods suitable for crop growth. The area was endowed with abundant water resources, featuring a dense network of rivers and lakes, particularly centered on Lake Tai. This not only provided convenient conditions for agricultural irrigation but also established favorable transportation conditions. However, after the Ming Dynasty, around 1450, factors like population increase and tax pressures (Song and Zhuang, 1990; Fan, 2005,100) led to a significant transformation in the agricultural structure. The focus shifted from subsistence farming to industrial crops, including mulberry and cotton, while grains were imported from other provinces.

Driving Mechanism

In an era characterized by relatively low productivity, the silk industry had distinct requirements. The silk industry, as a whole, encompasses a lengthy industrial chain comprising three major phases: the mulberry industry, the silk reeling industry, and the silk weaving cloth industry (Figure 4). In the first phase, the mulberry industry needs to supply fresh leaves to nourish feed silkworms. For obtaining better quality leaves, elevated terrain is necessary to ensure adequate sunlight, and the preferred soil is

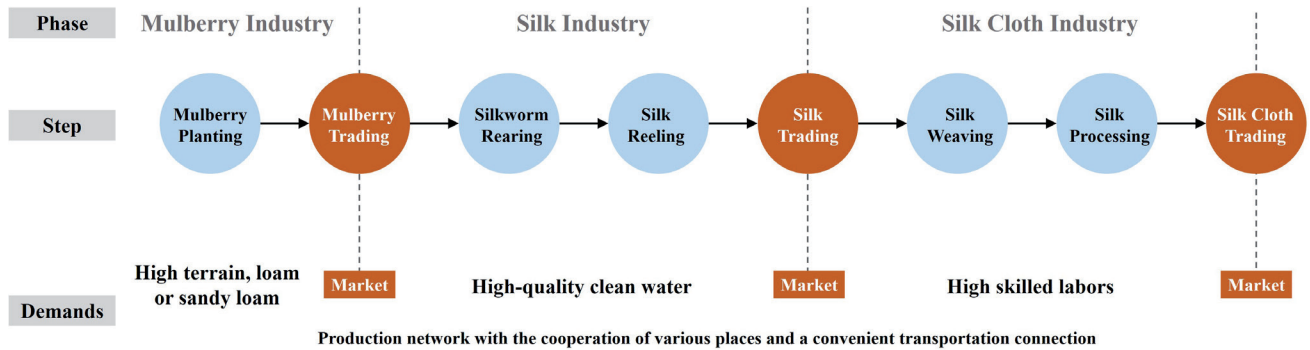


Figure 4. Silk industrial relationship (prepared by authors)

loam or sandy loam with relatively high moisture content. The second, and crucial, phase involves both silkworm rearing and silk reeling, producing the silkworm egg, the cocoon, and the raw silk. A paramount consideration in this phase of the silk industry is the availability of high-quality, clean water. The final phase encompasses the silk cloth industry, where, following weaving and processing, silk cloth emerges as the final product. An indispensable element for the silk cloth industry is a highly skilled labor force. Given the impracticability of centralizing all these activities in one location, the industry necessitated a vast production network and collaboration between different regions, along with efficient transport connections.

Thus, the prominence of the southeast coast of Lake Tai as the silk industry hub was primarily a result of geographical factors that satisfied all the aforementioned prerequisites. Firstly, despite being low lying, which traditionally is not suitable for planting mulberry, the people creatively used the historically formed polder system to create the Mulberry Dike and Fish Pond ecosystem. This innovative approach enabled the cultivation of mulberry trees on surrounding polders, fostering a relatively cool environment and concurrently strengthening embankments to prevent soil erosion. Secondly, the area boasted numerous lakes with effective purification functions, ensuring an abundant supply of clean and high-quality water for silk reeling. Thirdly, its proximity to Suzhou, the most developed city at that time a longstanding tradition of silk weaving, further contributed to its suitability for the silk industry. Finally, the Grand Canal, constructed as early as 610 AD, stretches through the area, providing a significant transportation advantage (Figure 5).

The complexity of the production process necessitated the concentration of specialized facilities and craftsmen and women, making it challenging to transition to alternative production lines. Through collaborative efforts across different industrial sectors, every town benefited from economies of scale. Thus, with both initial fixed setup costs and coordination effect, it undoubtedly it undoubtedly represents a form of increasing returns.

Lock-in Impact

As with all traditional Jiangnan towns, their primary function is to serve as a commercial center for the surrounding rural areas. A common feature of such towns is a main commercial street connected to the main municipal river, forming the axis of the urban layout. However, as a silk cloth industry town, Shengze also developed two additional specialized functions beyond retail business, which can be considered in terms of reactive path dependency for a traditional town.

The first

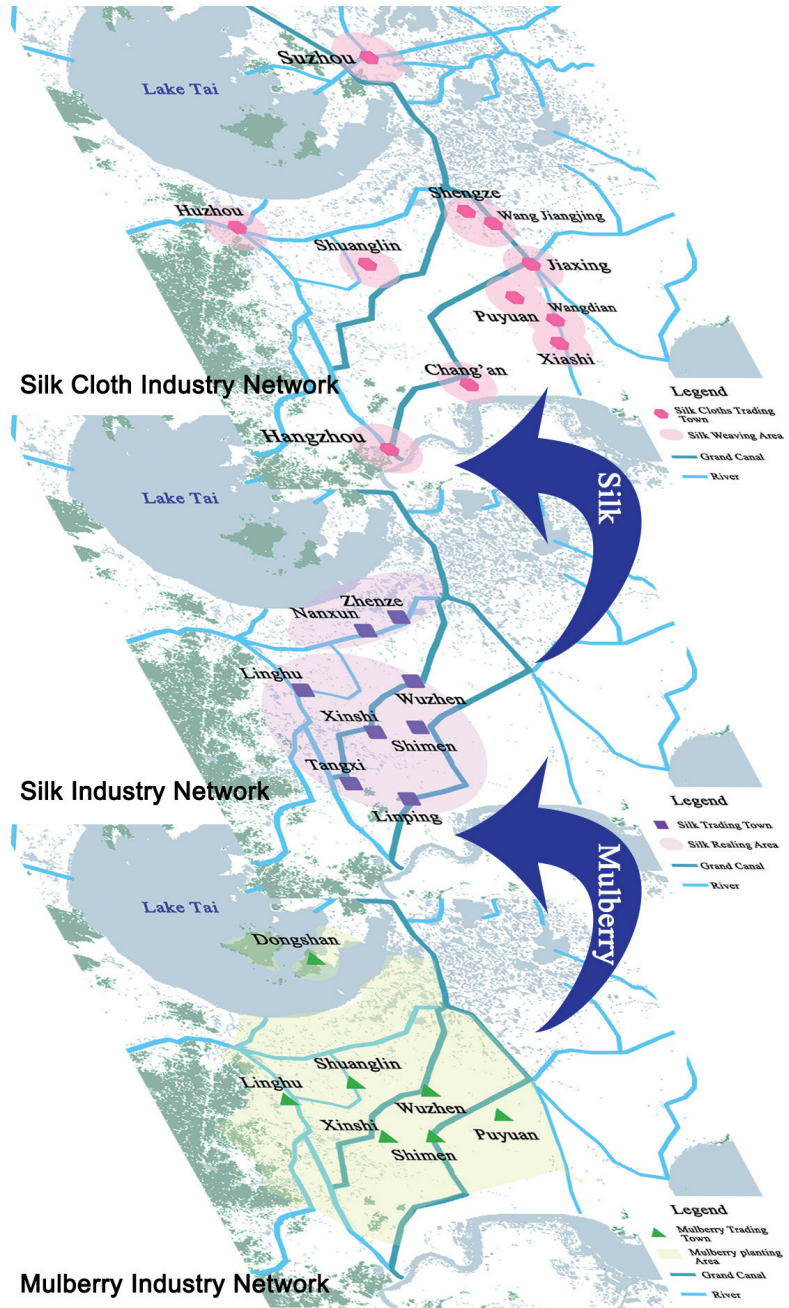


Figure 5. Silk Industry layout in Wujiang County in Qing Dynasty (prepared by authors, the original map is from Suzhou Chronicle in Qing Dynasty.)

function was silk trading; larger in scale and more complex in relation with the retail industry. In the silk trading system, silk brokers acted as intermediaries between producers, merchants, and the government in the process of silk trading, earning commissions for their service. The daily business of silk brokerage included receiving, arranging for processing, inspecting, shipping, and settling accounts. During the Qing Dynasties, dozens of silk brokers were discretely distributed in the town of Shengze. With increase in trading volume, the receiving function was separated. This was done by all of the silk brokers by collectively investing in the construction and shared use of a public silk trading market called Zhuangmian. It was a closed area with rows of stalls arranged side-by-side, The main gate to the north led to the main passage from north to



Figure 6. Trading area, Zhuangmian (Source: Wujiang Silk Chronicle)

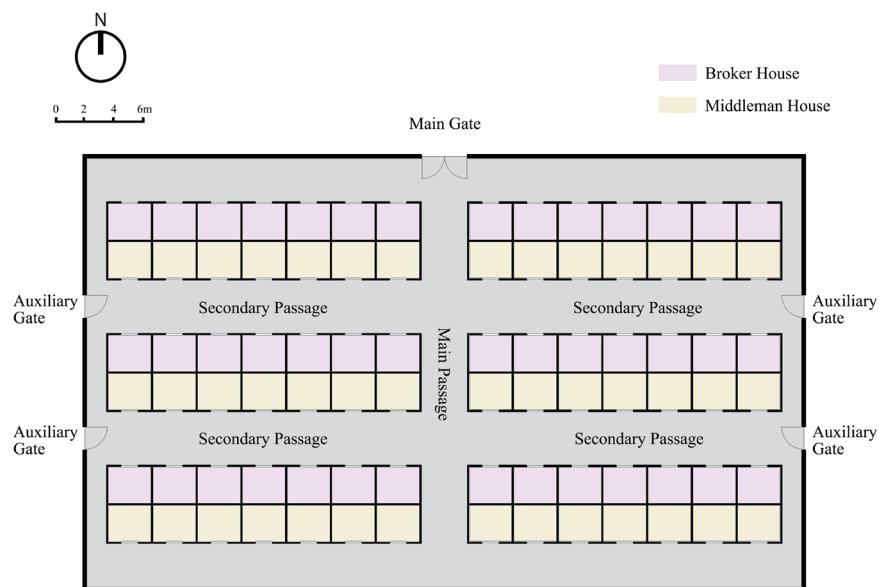


Figure 7. Layout of Zhuangmian (prepared by authors, drawn according to the text description in Shengze Chronicle)

south, while two auxiliary gates to the east and west led to two secondary passages from west to east (Li, 1991, 186) (**Figure 6, Figure 7**).

The second function was silk processing. The raw silk cloth produced by farmers was hard and wrinkled, requiring several processing steps, including degumming, polishing, and softening, to transform it into finished silk. Workshops handling these processing were typically contracted by the silk brokers. Specific technical requirements dictated that these workshops had to be in proximity to water, for both water use and drainage, and also required access to larger sites for drying. Therefore, dozens of the workshops were concentrated along the Xi gang river on the east side of the town, providing convenient for picking up and delivering goods from the silk market (**Figure 8, Figure 9**).

Therefore, the overall urban layout could be described as follows: the retail business linked to the main municipal river forms the axis of the urban



Figure 8. Traditional silk dyeing workshop in Shengze (Source: Wujiang Silk Chronicle)

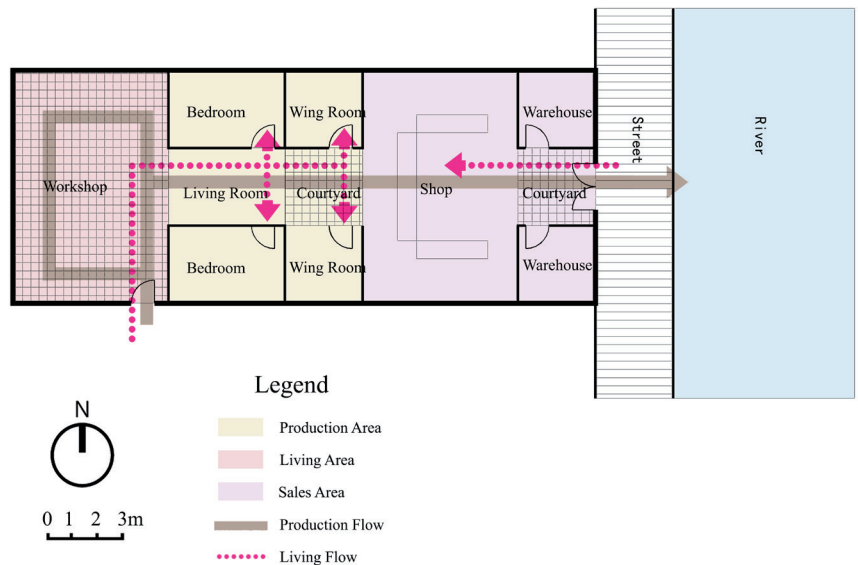


Figure 9. Layout of silk dyeing workshop (prepared by authors, drawn according to the layout of Dongmen dyeing workshop in Pukou District, Nanjing.)

layout. Apart from this, the silk trading and processing were two unique functional nodes compared with other towns, with the former in the south of the town and the latter mainly along the Xi gang river on the east border (Figure 10).

Phase Two: Geo-politics Explains Boom in Silk Industry (1840-1950)

Critical Juncture

While the first phase was defined by topographical conditions, the second phase was influenced by geo-political critical junctures. After the Sino-British Opium War in 1840, China was forced to open its borders to international trade, leading to rapid increase in export volumes of tea, silk, cotton and other commodities. For example, the export amount of raw silk in 1894 was about 10 times the amount before 1840 (Xu and Wu, 1990).

Meanwhile, in the 1870s, the Second Industrial Revolution had started in Europe, bringing forth various new technologies and inventions that were widely applied in industrial production. On the one hand, this led to the

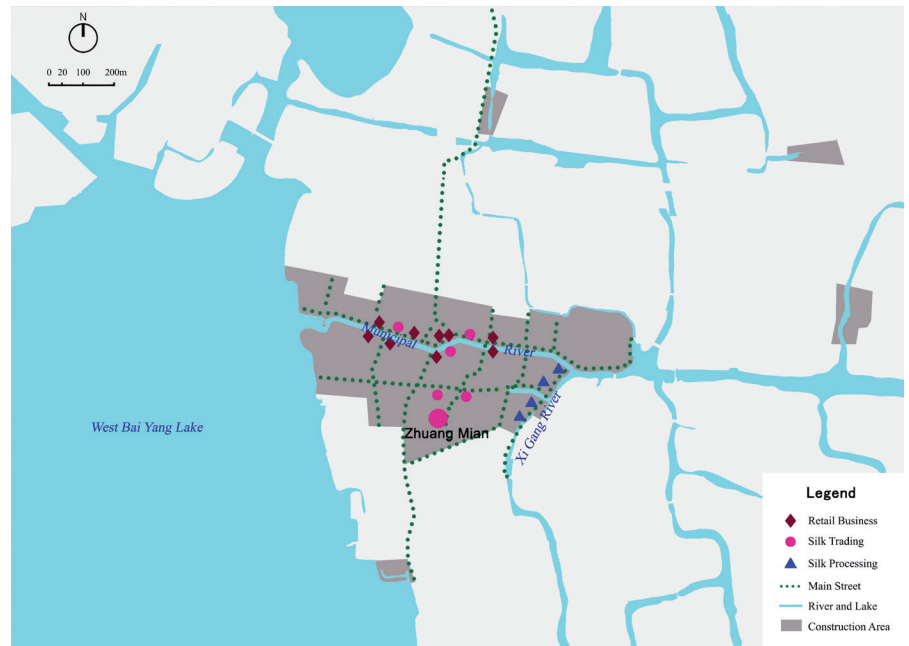


Figure 10. Urban form of Shengze in the Qing Dynasties (prepared by authors, drawn according to the text description in Shengze Chronicle)

explosive industrial growth, while on the other, it had an increasingly serious impact on traditional handicrafts, such as silk reeling, ginning, and cotton textiles. According to statistics from China Customs, in 1894, factory silk only accounted for 4.37% of the total export volume of raw silk, while hand-made silk accounted for 95.63%. However, by 1914, the export volume of factory silk exceeded that of hand-made silk for the first time. Moreover, by 1930, the export volume of factory silk reached double that of hand-made silk (Xu et al., 1985) (**Figure 11**).

In addition, in the early 1860s, the Taiping Civil War took place, causing severe damage to some developed cities, towns and villages in the Jiangnan area. This led to an accidental readjustment of the urban system. In the case of Shengze, it was fortunate to avoid destruction in the war. Therefore, many silk merchants and wealthy machine owners fled from other silk towns to Shengze, allowing them to continue their business. As a result, Shengze transitioned from being one of several important silk cloth industry towns to becoming the sole silk cloth industrial center in the area after the war.

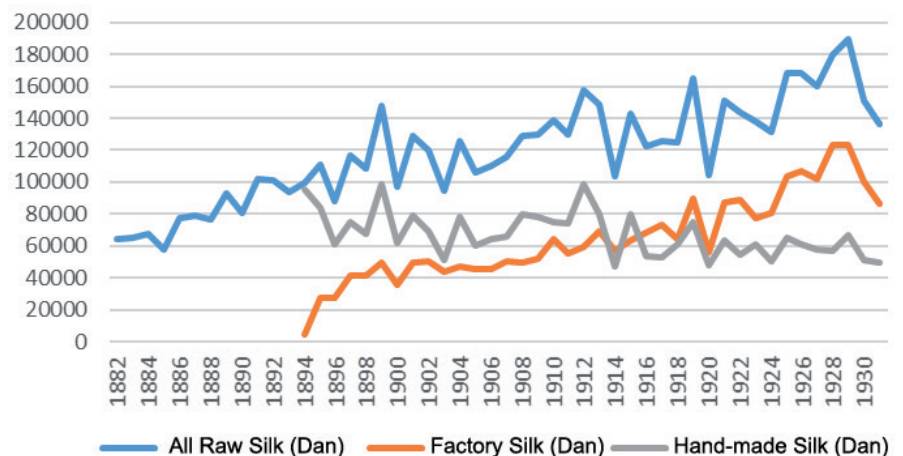


Figure 11. China's export of raw silk from 1882 to 1931 (prepared by authors, the data are from Xu et al., 1985)

Driving Mechanism

Since Shanghai opened as a port, leveraging its superior geographical location and vast economic hinterland, it not only replaced Suzhou as the center of Jiangnan trade but also surpassed Guangzhou as China's largest foreign trading port. In turn, the Jiangnan area has benefited from the rise of Shanghai. Due to its robust industrial foundation during the Qing Dynasties and the surge in the export volume of raw silk, the silk industry in the entire Jiangnan area experienced rapid growth from the 1840s to the end of the century, with Shengze playing a part in this.

Firstly, in response to a larger international market and more intense market competition, Jiangnan silk industry expanded its scale on the one hand, giving rise to many emerging silk producing areas, such as Wuxi and Changzhou. On the other hand, it quickly gained dominance in the market by relying on its excellent product quality. For example, the silk pattern produced by Wang Yongheng, a silk broker in Shengze, won the first prize at the Turin World Exposition in 1911, resulting in increased foreign orders. The persistence and reinforcement of the silk industry were still driven by large initial fixed setup costs and coordination effects

Secondly, under the impact of foreign factory silk, local hand-made silk initially suffered, affecting the entire industry. However, a new method of re-rolling into "Jing" was created and quickly replaced raw silk as the main export product for a period. Decades later, in order to ensure survival, the industry had to relinquish hand-made silk and transition to mechanized silk factories. For Shengze, due to its traditional strong function in silk trading and processing, especially the presence of printing and dyeing workshops, it attracted more silk merchants and machine owners from rural areas and other towns, leading to the establishment of additional silk factories. This transformation from a traditional silk cloth trading center to a modern silk cloth manufacturing town in Shengze was indeed a form of learning effect.

Lock-in Impact

The increase in silk trading and the arrival of additional silk merchants and producers further stimulated retail business and trade. For example, there were as many as 100 silk brokerage houses, a considerable increase compared to Qing Dynasties. To facilitate transactions, the silk brokers gradually clustered in a relatively concentrated spatial distribution around Garden Street and Bank Street near the professional market of Zhuangmian, thereby forming the second axis of the urban layout. The size of Zhuangmian also experienced significant expansion.

Meanwhile, there was reactive development due to the accumulation of industrial capital, further leading to an increase in production, the emergence of large-scale manual workshops, and the overall upgrading of looms. Subsequently, starting in the 1920s, as electricity became available in Shengze, some industrial capital that had been previously relocated to Shanghai or other major cities returned to Shengze to establish modern silk factories. Consequently, many manual workshops and even households upgrading to electric looms. By 1937, Shengze boasted of 46 mechanized silk factories distributed throughout the town, housing a total number of 1,145 looms. This accounted for 46.88% of the province and 6.76% of the entire nation (Wujiang Silk Chronicle Compilation Committee, 2015, 120).

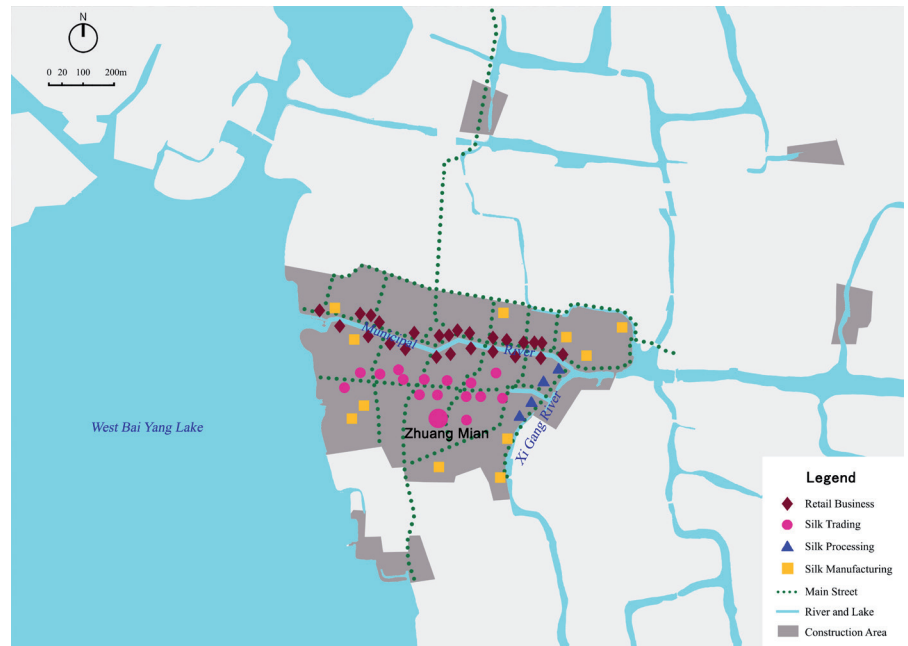


Figure 12. Urban form of Shengze in modern times (prepared by authors, drawn according to the historical map of Shengze in 1911.)

Thus, the overall urban layout underwent adjustments: retail, trading and processing activities were densified, with the trading system expanding from a node to a key axis, constituting the second axis of the urban layout. Concurrently, silk manufacturing emerged on the fringes of the town, and forming an “industry belt” around the town (**Figure 12**).

Phase Three: State-led Economy (1950-1980)

Critical Juncture

In the early years following the founding of the People’s Republic of China in 1949, the national government formulated a comprehensive economic plan aimed at realizing the objectives of national industrialization, with a particular emphasis on prioritizing the development of heavy industry, mainly located in inland provinces. This strategic move was necessary to garner surplus from commerce and agriculture, and it involved two steps.

First, the country initiated the socialist transformation of agriculture, handicrafts and commerce, beginning in 1953. All private-based local economies were merged into public production units and included in the national plan. After the socialist transformation, the government encouraged the merging of scattered and small-sized businesses and factories into medium-size collective shops and factories.

Secondly, the government implemented a policy of unified purchase and sales, encompassing almost all of the country’s important products –no less than 132 kinds (Yang, 2008). The government would handle the both the purchase and sale of these products, controlling their prices to extract surplus from the market as required, at the expense of profits for farmers and merchant. As silk was among the 132 products, the traditional silk market in Shengze was abolished, and compulsory purchases under the planned economy took its place.

Driving Mechanism

The planned economy reduced the commercial atmosphere of the town and even lowered Shengze’s standing in the silk industry by abolishing

the silk market. However, due to its robust manufacturing and processing foundation, Shengze was officially designated as a silk manufacturing base by government. The manufacturing and processing capacity was further strengthened in the process of factory mergers. Unlike other typical commercial and industrial towns that were diversifying into more comprehensive industries, Shengze continued to maintain and strengthen its focus on the silk industry. This trend exemplified self-reinforcing expectations.

Indeed, after two decades of mechanization and standardization, labor productivity and production capacity improved significantly. By 1978, there were only four state-owned silk factories, boasting of 1,600 looms, and the output of silk cloth reached 20.2 million meters (Wujiang Silk Chronicle Compilation Committee, 2015, 121). This output was nearly equivalent to the highest annual production in modern times, but with only one-tenth of the earlier labor force. In addition, all auxiliary industries, including the printing and dyeing, electric machinery, and light chemicals, had successfully transitioned from manual workshops to modern factories. This transformation turned Shengze into a silk cloth manufacturing town with a comprehensive industrial system built around silk, solidifying its position as an important silk industry base of China.

Lock-in Impact

The planned economy led to a substantial decline in retail business, marking the end of silk trading. All silk brokers closed, and the professional silk market of Zhuangmian was transformed into residential area. The government established a silk purchase station to acquire silk products directly from the factories. However, in a self-reinforcing process, a batch of silk factories emerged, contributing to the establishment of a comprehensive silk manufacturing system in Shengze.

At the time, the weak economic conditions meant there was insufficient capacity to build new production space, and Shengze had to rely on what it had inherited from the modern period. Thus, it was primarily dependent on the previous foundation. If it had benefited from subsidies from the Republic of China, similar to Xinsheng and Xinhua, the production conditions would have been even better and more comprehensive. For example, the Xinsheng factory received a grant of 760,000 yuan from the Ministry for the Textile Industry due to its relatively superior technology and management. The factory used this funding to further revitalize its plant and equipment (**Figure 13**).

However, had the production system in Shengze been based on household production, as was the case in Xinlian and Xinmin, production conditions would have been much worse. For example, the Xinguang factory initially had ten workshops scattered in the south of the town, with most of them renting residential houses, resulting in a highly informal production system.

The overall urban layout underwent another transformation as retail business and trading declined, weakening the traditional structure that once aligned with Municipal River and Main Street. However, the integration of silk factories led to the expansion and reinforcement of the “industry belt” (**Figure 14**).

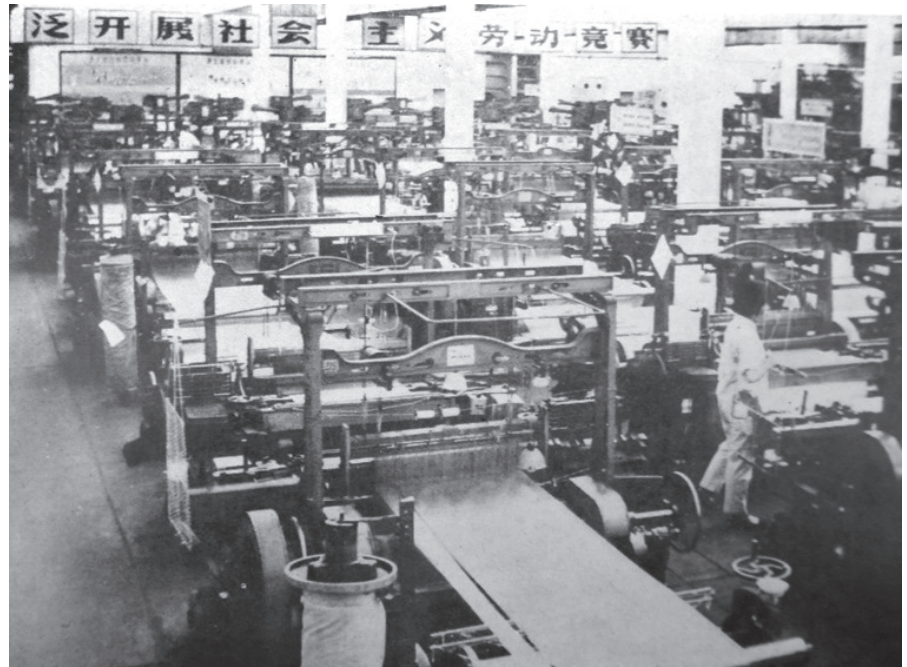


Figure 13. Xinsheng Silk Weaving Factory (Source: WANG Minsheng, http://www.Wujiangtong.com/webpages/wx_detail.aspx?id=642)



Figure 14. Urban form of Shengze from 1950 to 1980 (prepared by authors, drawn according to the text description in Shengze Chronicle.)

Phase Four: Decline of Natural Silk and Reinvention of City Center (1980-now)

Critical Juncture

In 1978, the reform and opening up period started in China. This led to two major adjustments in the economy.

First, the direction of the country's industrial development changed from heavy industry to export-oriented industries. Thus, the eastern coastal areas capitalized on their strategic location, pioneering rapid industrial development engendered by national policies. In particular, the textile

5. The dates are from the China Textile Industry Development Report, for the years 1982, 1994 and 2020.

and garment industry, leveraging its established foundation, emerged as a leading sector during that period.

Secondly, the solid foundations of the planned economy began to loosen, transitioning fully to a market economy from 1992 onwards. Upon China's accession to the WTO in 2001, the country rapidly embraced economic globalization. This change yielded significant benefits for rural industries that operated outside the planned economy in the 1980s, and subsequently for private enterprises that demonstrated more flexibility in management since 1990s (Cai, 1995; Qin, 1997).

For the silk industry, another substantial change occurred. Natural silk production witnessed a significant decline since the 1990s, while synthetic fiber silk experienced a sharp rise. National data shows that raw silk production decreased from 92.4 thousand tons to 53.4 thousand tons between 1993 and 2020, marking a decrease of 42.2%. In contrast, the production of synthetic fiber silk surged from 2.27 million tons to 60.25 million tons during the same period, reflecting a remarkable increase of 2555.8% (5).

Driving Mechanism

These changes impacted the silk industry in Shengze, manifesting in both the self-reinforcing expectations and the dynamic learning effects.

Firstly, Shengze's silk industry experienced a boom in the 1980s. Not only did the existing state-owned industries in the town enhance their capabilities, but they also attracted rural areas to reinitiate silk industry development, creating a self-reinforcing expectations effect. However, due to strict control of natural silk materials by state-owned enterprises at the beginning of 1980s, township enterprises opted for synthetic fiber silk as an alternative, reflecting dynamic learning effects. This choice led to a substantial increase in production scale for both the natural silk and synthetic fiber silk sectors in 1980s.

Secondly, since the 1990s, there has been a dramatic shift in the structure of the silk industry. Most natural silk factories, mostly state-owned enterprises, declared bankruptcy, and others transitioned from public to private ownership while simultaneously converting from natural silk to synthetic fiber. In contrast, existing synthetic fiber enterprises, mostly township and private enterprises, experience incredible development. By 2020, only nine natural silk enterprises remained. Conversely, a plethora of synthetic fiber silk industry enterprises emerged, including some massive large-scale enterprises. Thus, synthetic fiber silk replaced natural silk as the main industry in Shengze, which also made Shengze, establishing it as one of the most important synthetic fiber silk production sites in China.

Lock-in Impact

The surge in the silk industry, especially the substantial development of synthetic fiber, brought about two significant changes in the urban form of Shengze.

The first change is urban sprawl. In the 1980s, the flourishing silk industry empowered the state-owned silk factories in Shengze town and the township silk enterprises in rural areas to build new factories and workshops (**Figure 15, Figure 16**).

Therefore, with the establishment of traffic road network, the urban structure became more reliant on it. Shengze filled in the municipal river



Figure 15. Xinmin silk weaving factory workshop (author's personal archive)

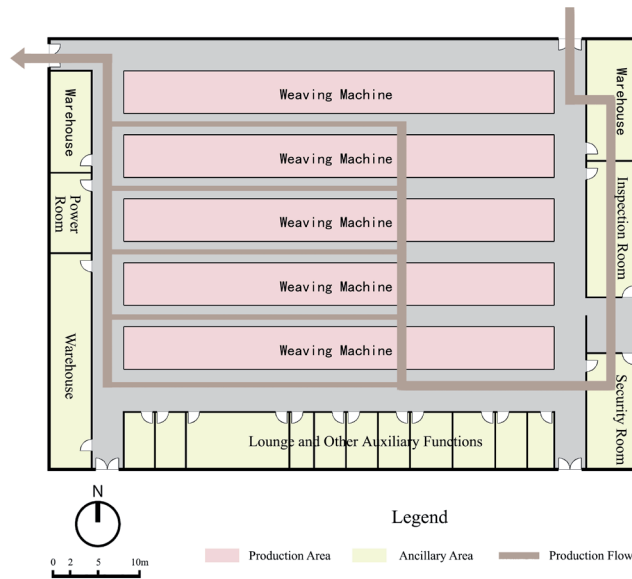


Figure 16. Layout of Xinmin silk weaving factory workshop (prepared by authors)



Figure 17. Urban form of Shengze from 1980 to 1994 (prepared by authors, drawn according to the historical map of Shengze in 1990.)

that had previously run directly through the center of the old town and constructed a regional traffic road outside the town. To further improve transportation, the majority of the new silk factories were established along outer roads, giving rise to new “industrial belt” formed around the old town (**Figure 17**).

Since the 1990s, due to the decline of natural silk, most state-owned factories in the vicinity of the old town were closed. This led to a decrease in demand for labor force, resulting in escalating social and environmental challenges for the old town. It gradually transformed into a dilapidating areas predominantly inhabited by older residents and migrant workers. Simultaneously, propelled by the booming of the synthetic fiber industry, which preferred to centralized arrangements in a planned industrial zone for streamlined heating and power supply, the town started to sprawl “crazily”. An overview of the spatial evolution of Shengze from 1984 to 2019, clearly illustrate a doubling and redoubling of urban construction scale, continuous expansion of the road network, and a persistent breach of the urban boundary . Over the span of 20 years, from 1994 to 2014, Shengze transformed from a town into a city-scale urban area, with the synthetic fiber industry emerging as the primary driving force. As the town continued to develop westward, the traditional old town transitioned from the central hub to the fringes (**Figure 18**).

The second significant change involves the re-establishment of silk trading space. In the 1980s, due to the planned economy, producers of synthetic fiber silk found themselves responsible for selling their products directly. Consequently, these silk enterprises had to create a market for synthetic fiber materials, fabrics and textile machinery accessories. Thus, the Oriental Silk Market spontaneously emerged in Shengze in 1986. This marked the revived of silk trading spaces after a 30 years hiatus, although with a shift in the main product. In subsequent years, in tandem with the rapid growth of the synthetic fiber industry, the Oriental Silk Market underwent successive expansions, eventually evolving into the largest professional textile market in China.

DISCUSSION AND CONCLUSION

The case of Shengze exemplifies the historical co-evolution silk industry and the urban form development. In general, external factors emerged as significant catalysts in the evolution of the industry. It is also apparent that every change in the industry directly impacted on urban form. Furthermore, the urban form in each phase acted as a constraining force that influenced the potentials and possibilities for the subsequent phase. This, in turn, became an important driving force influencing the evolution of the industry. Thus, a circulatory system was formed (**Figure 19**).

There are three key issues to highlight:

Firstly, how did the industry impact urban form? It is evident that the silk industry in the case of Shengze led to phase of self-reinforcing evolution and three phases of reactive evolution of urban form. In phase one, the prominence of silk trading town integrated the retail business along the main municipal river, establishing it as the axis of the urban layout. Simultaneously, silk trading and processing emerged as two unique functional nodes, reflecting a reactive effect. In phase two, the reinforcement of silk international trading expanded the trading system from a singular node to a linear structure, creating the second axis of the

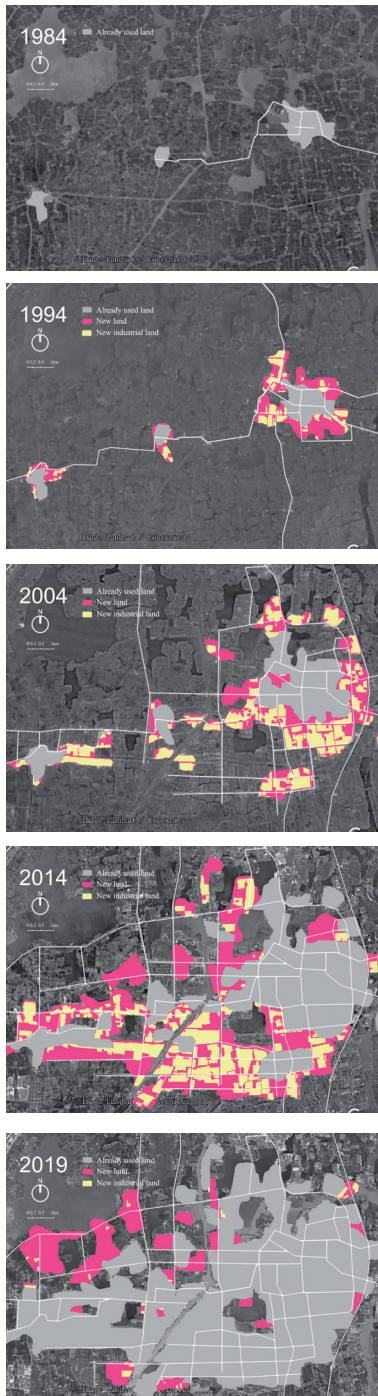


Figure 18. The footprint of urban space from 1984 to 2019 (prepared by authors, the original maps are from Google Map, 2022)

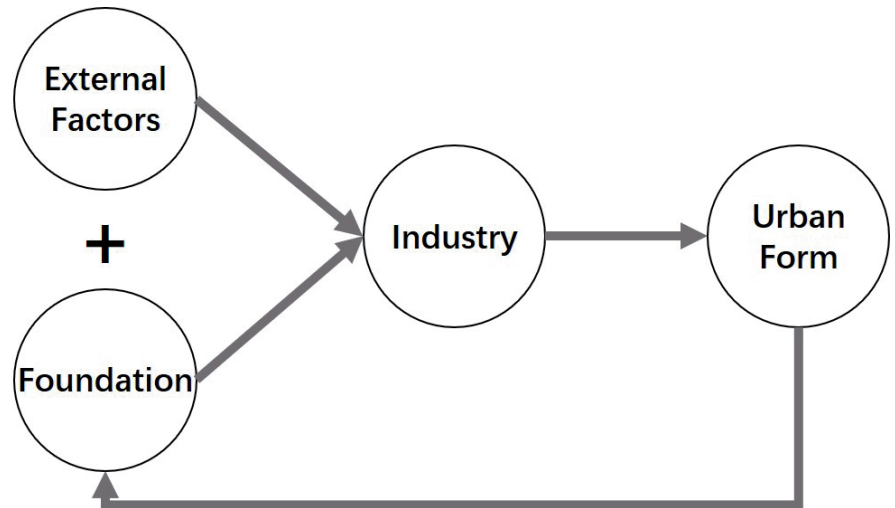


Figure 19. Relationship of industry and urban form evolution (prepared by authors)

urban layout. Concurrently, silk manufacturing found its place on the fringes, giving rise to an “industry belt” around the town as a reactive effect. In phase three, the establishment of a comprehensive silk industry system weakened the traditional structure’s coordinating with the municipal river and main street, but further reinforced the “industry belt.” Finally in phase four, synthetic fiber industry supplanted natural silk as the primary industry in Shengze. This shift resulted in the expansion of silk manufacturing and processing spaces, relying on traffic roads, thereby leading to urban sprawl. Additionally, the re-establishment of the silk trading market emerged as a reactive effect of this transformation.

Secondly, how did urban form impact the industry in subsequent phase? Shengze’s case also shows prominently the role of “Increasing Returns” as the main driving mechanism. In phase one, the interplay of silk industry relationship and geographical conditions propelled Shengze into becoming a silk trading town, leveraging both substantial initial fixed setup costs and coordination effects. In phase two, the existing foundation in trading and processing became an important factor in attracting more silk merchants and machine owners from rural areas and other towns. This gathering enhanced the silk industry, especially in the establishment of additional silk factories, a result of substantial initial fixed setup costs, coordination effect and learning effects.

Subsequently, in phase three, the silk manufacturing and processing factories directly inherited served as the industrial foundations for the establishment of the comprehensive silk industry system, which presented the self-reinforcing expectations. In the latest phase, the silk industrial system not only acted as the foundation for a silk industry experiencing periods of boom and bust but also brought about the emergence of synthetic fiber industry in rural areas. This, in turn, led to adjustment in the silk industrial structure, driven by self-reinforcing expectations and learning effects.

In addition, differences in “Increasing Returns” in different stages reflected the impact of external factors in each era. In phase one, limited productivity levels and market size resulted in a limited “increasing returns” effect. In phase two, as international trade promoted market expansion, industrialism brought about rapid increases in productivity, resulting in an expanded “increasing returns” effect. In phase three, although the

6. Which means although the absolute value of the industry has declined, its status in the industry has actually improved.

industrial layout developed towards the direction of decentralization, seemingly in violation of the agglomeration economy principle, the presence of a scale fixed market produced a unique, relative “increasing returns” effect (6). In phase four, within a market-led environment, capital operated in an unprecedented scale and speed, resulting in an unparalleled industry and urban scale expansion, thereby establishing a multiplied “increasing returns” effect (Figure 20).

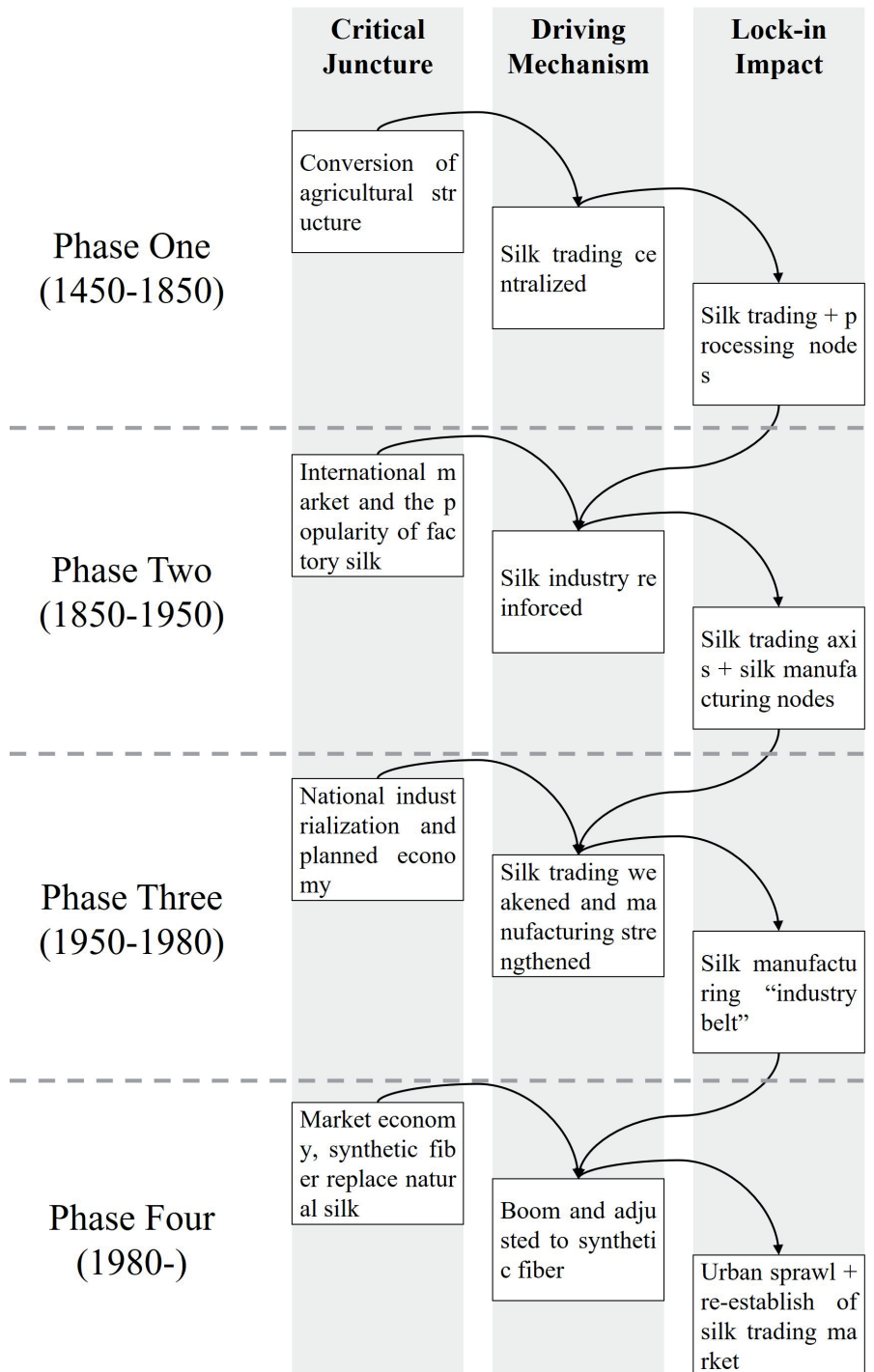


Figure 20. Path dependency of the silk industry and urban form of Shengze (prepared by authors)

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Anahtar Sözcükler: İpek endüstrisi; kentsel biçim; kentsel evrim; patika bağımlılığı

SANAYİ VE KENTSEL FORM NASIL BİRLİKTE EVRİLİR? ÇİN, SHENGZE İPEK SANAYİ KASABASI ÖRNEĞİ

Endüstriyel faaliyetlerin kentsel formun gelişimi üzerinde önemli bir etkiye sahip olduğu yaygın olarak kabul edilmektedir, ancak uzun kentsel evrim sürecinde endüstrinin kentsel formu nasıl etkilediği konusunda daha fazla araştırma yapılması gerekmektedir. Ne tarihsel coğrafya yaklaşımı ne de Marksist ekonomi politik bu soruya net bir yanıt vermektedir. İpek endüstrisinde uzmanlaşmış geleneksel bir Çin kasabası olan Shengze'yi vaka analizi olarak ele alan bu makale, endüstrinin ve kentsel formun eş zamanlı evrimini tartışmaktadır. Kentin gelişiminin birçok aşamasına ilişkin olarak "kritik birleşme", "itici mekanizma" ve "kilitlenme etkisi" gibi patika bağımlılığı kavramlarını kullanarak birlikte evrim mekanizmalarının aşamalarına ve türlerine ışık tutmaktadır. Çalışma, endüstrinin her aşamada kentsel formunu, zamanın bağlamına bağlı olarak nasıl farklı şekilde etkilediğini ortaya koymaktadır. Aynı zamanda, kentsel evrim sürecinin, kendi kendini besleyen bir mod ile tepkisel bir modun bir arada var olmasını gerektirdiğini göstermektedir. Burada uygulanan patika bağımlılığı analizi, tarihi coğrafyanın bilinen yöntemlerine değerli bir katkı oluşturmaktadır.

HOW INDUSTRY AND URBAN FORM CO-EVOLVE: THE CASE OF THE SILK INDUSTRY TOWN OF SHENGZE, CHINA

It is widely recognized that industrial activities exert a significant impact on the development of urban form; further research is still needed to understand how industry influences urban form during the extensive process of urban evolution. Traditional frameworks such as historical geography and Marxist political economy fall short in providing a definitive answer to this complex question. Using Shengze, a traditional Chinese silk industry town, as a case study, this paper explores the concurrent evolution of industry and urban form. The study introduces a nuanced analysis on the mechanisms of co-evolution through the lens of path-dependency concepts, including critical juncture, driving mechanism, and lock-in impact, shedding light on the multifaceted phases of the city's development. It unveils the context-dependent influence of industry on urban form at each phase and reveals a coexistence of self-reinforcing and reactive modes in the urban evolution process. The application of path-dependency analysis adds a sophisticated to established historical geography method.

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