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The Location Dynamics of Firms in Transitional Shanghai, 1978-2005

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Abstract
China's economic reform started in 1978 has brought in profound changes to firms by transforming the state-owned-enterprises and by encouraging the growth of the non-state sector business. These changes have been accompanied by broader institutional changes and economic restructuring in the cities, especially in the larger ones. This paper focuses on the changing spatial distribution patterns and the underlying location factors of firms in different sectors within Shanghai, one of China's largest and most dynamic cities. The central research question is raised as do the rapidly changing spatial patterns of corporate activities within Shanghai since the onset of China's economic reform reflect the influence of market forces? Data were collected from Shanghai Administration of Industry and Commerce. Both GIS mapping and statistics (i.e. Moran's Index, density gradient) were used to assess the spatial distribution pattern of firms in Shanghai. An empirical model derived from neo-classical location theory is employed to examine the location factors of firms in different sectors. Findings of the paper indicate that the spatial distribution and location factors of firms in Shanghai demonstrate the city's unique urban restructuring process, which is closely related to the city's specific economic stage and unique "transitional" characteristics. However, market forces do play an increasingly import role in firm's location-choice behavior in Shanghai. This study contributes to the understanding of firm location dynamics in post-socialist cities.

Keywords: spatial distribution pattern, location factor, transitional economy, Shanghai

Economic Transition and Enterprise Reforms in Shanghai

Shanghai, the largest industrial city and economic powerhouse in socialist China, has changed profoundly since 1978, when the central government began to introduce reform and openness policies to liberalize gradually the highly controlled economy. The economic liberalization has introduced dynamic forces and has fundamentally changed the relationship between government and firms in Shanghai.

A series of reforms on enterprise system (e.g. enterprise contract responsibility system reform, modern enterprise system reform) empowered State-Owned Enterprises (SOEs) by relaxing governments' control over resource allocation, R&D, product marketing, pricing, salary, bonus schemes, etc. Besides the development of SOEs, private enterprises which barely existed before 1978 have emerged rapidly (Ming and Zhang 1999). In 1978, the state sectors contributed 99.0% to Shanghai's GDP; while in 2007, the state sectors' proportion decreased to 54.9% (SHSB 2008).

Institutional reforms were introduced hand in hand with enterprise reforms in Shanghai. Various markets, such as capital market, labor market, as well as land and property markets have been established, which provided a new environment for the operation of firms. The price of firms' products was no longer a planned outcome of

government intervention; rather, it was determined by the supply and demand conditions of the various markets.

With the reforms, firms in various industries, including both SOEs and non-state sector, gained more self-determination power and became more market-oriented in Shanghai, i.e., *bu kao shizhang, kao shichang* (literally responding to market rather than to mayor's instructions). Firms tend to be "free to choice" on their own issues, such as what to produce, who to hire, when to buy and sell, and where to locate.

Nevertheless, knowledge on the location of firms in Shanghai is yet paucity, probably because of data unavailability. This knowledge is not trivial, as it not only complements the growing number of studies which have examined the changing spatial structure of cities in transitional China (Han 2000; Lin 2002; Ma 2002), but also enhances our understanding on firm location-choice, a long-time theoretical issue in Economic Geography. To fill up the knowledge gap, research questions addressed in this paper include what are the location trends of firms in different sectors of Shanghai's economy? To what extent can conventional market forces explain these overall trends? How are they affected by Shanghai's distinctive institutional conditions?

Changing Spatial Pattern of Firms in Shanghai from 1978

It is difficult to study the spatial pattern of firms in Shanghai when it was in centrally-planned economy, due to the data unavailability. On the basis of secondary data, this section tries to summarize the existing knowledge on changing spatial pattern of firms in Shanghai from 1978 to early 1990s.

As a "proletarian city" in the socialist ideology, most of the factories in Shanghai were primarily located in the central city in 1980s. When problems caused by manufacturing factories (e.g. pollution, noise) had become severe, the municipal government convened a conference on coordinating urban and rural industries in 1986, which put forward a plan to relocate and decentralize the factories from central Shanghai (Shanghai Almanac 1999). As a result, from 1983 to 1990 the proportion of central Shanghai in total manufacturing output value decreased from 78% to 55%, while the proportion of outer suburbs increased from 14% to 28% (Chen 2004:40). During this period, the main motivation of factory relocation was to avoid environmental problems. However, relocations were often hindered by the shortage of financial support.

Untill early 1990s, most of the manufacturing firms were concentrated in the central city. At that time, industrial classification categorized the manufacturing as light industries (e.g. household commodity, agricultural product processing) and heavy industries (e.g. machine & electric industry, steel, chemicals). The spatial distribution pattern of firms in light industries of Shanghai in 1990 is shown in Figure 1. Luwan, Huangpu, and Jing'an, the three inner city districts, all contained a large amount of the factories. Not only were the light industries concentrated in central city, but also were the heavy industries (Yang et al., 1991).

After the urban land-use reform in early 1990s, the factories located in central Shanghai found it profitable to sell their land and thus had the incentive to move to the suburbs. Meantime, development of the tertiary sector has been accelerated, which creates great demand for land redevelopment in the central city. As such, the dispersal of manufacturing was sped up. From 1990 to 2000, the proportion of central Shanghai in total manufacturing output value decreased further from 55% to 22%, while the proportion of outer suburbs increased from 28% to 56% (Chen 2004: 59).

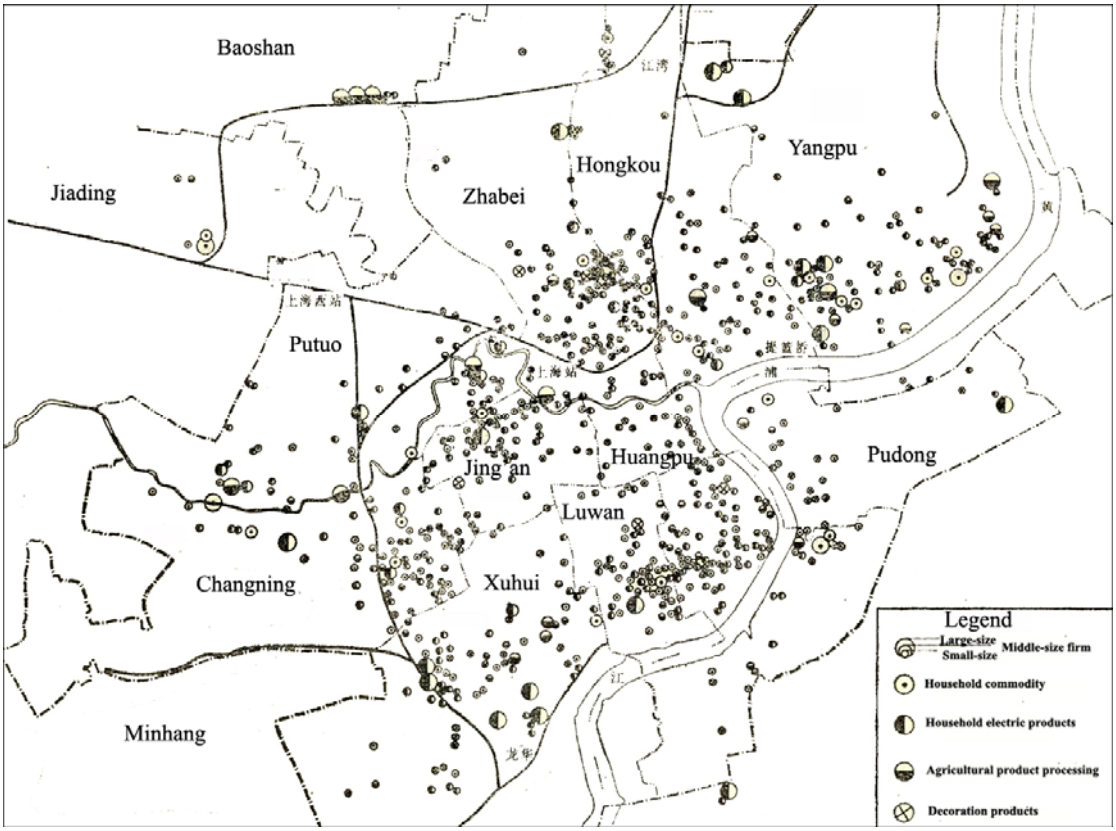

Figure 1: Distribution pattern of factories in light industries in Shanghai (1990)
Source: Adapted by the author from Yang, et al., 1991.

The existing knowledge and research on spatial pattern of service firms is scant, partly because of the traditional depreciation of services in communist ideology. According the Marxism, services are "unproductive", and exist only to supply the basic needs of "proletarian workers". Before 1978, personal services (e.g. retail stores, food and vegetable outlets, barber shops, and bicycle repairing shops) were set to deal with planned delivery of consumer goods and services. Therefore their locations were distributed in a planned hierarchy in order to cover the needs of community, based on a least-transportation and egalitarian principles (Wang and Jones 2002). Shanghai was no exception as retail stores were distributed dispersedly and the traditional commercial centers withered. As to producer-services, they barely existed in Shanghai's economy before 1990s, let alone any research on their spatial distribution pattern.

The 2005 Firm Inventory and Analysis Methods

Nowadays, an authority holding comprehensive data of firm inventory is the Shanghai Administration of Industry and Commerce (SHAIC). Under the Shanghai Municipal Government, the SHAIC is mainly responsible for firm registration and market supervision. For the registration, firms are required to furnish basic information such as the name, postal code, telephone number, and sector type. The 2005 firm inventory maintained by SHAIC lists all the 573,949 firms registered in Shanghai up to March, 2005. In the database, the types of industry are the 4-digit codes defined by the National Statistical Bureaus of China. The first two digits are used to regroup the 1047 sub-categories into 88 broad types, some of which are further categorized into three main urban economic sectors, i.e. manufacturing, producer services and personal services.

To describe and measure the spatial pattern of firms is no easy task. Mapping is the most basic and straightforward way to describe the spatial patterns, but it is hard to compare across industrial sectors. In this study, GIS is employed to map out the firms which are geocoded according to postal code districts. The density gradient method is another widely used method to describe and to measure spatial pattern because it is relatively simple and easy to compare (White 1999). In the method, the spatial distribution of firm density is regarded as an exponential form,

$$D(r) = D_0 \exp(a \cdot r)$$

where r is the distance from the CBD, D_0 is the firm density at the urban center, and a is the density gradient which represents the constant percentage change in the firm density per unit change in distance from the CBD.

An empirical model is employed to investigate location factors of the firms:

$$\ln(D_i) = f(Z_i) + e_i,$$

where D_i is the density of firms in site i and Z_i represents the site characteristics. In this study, the independent variables, D_i, the firm density in postal district i, contains three main urban industrial sectors: manufacturing, producer services, and personal services. The independent variables, Z_i, are decomposed into two groups of explanatory variables, i.e. natural endowment variables and agglomeration economies variables. Table 1 reports the list of explanatory variables used in this study:

Table 1: List of explanatory variables used in the regressions

Variable	Description
1) Natural endowment variables	
DCBD	Distance to the CBD (unit: kilometer)
DHIGHWAY	Distance to the nearest highway (unit: kilometer)
DAIRPORT	Distance to Hongqiao Airport (unit: kilometer)
ETDZ	A dummy variable=1 if the postal district is located within Economic and Technological Development Zones, 0 otherwise
NEWTOWN	A dummy variable=1 if the postal district is located within the New Towns, 0 otherwise
2) Agglomeration economies variables	
P	The population agglomeration economies, with distance-decay coefficient as -0.50 (unit: 100,000 persons)
M	The manufacturing agglomeration economies, with distance-decay coefficient as -1.00(unit: 1,000 firms)
PD	The producer services agglomeration economies, with distance-decay coefficient as - -1.00 (unit: 1,000 firms)
PS	The personal services agglomeration economies, with distance-decay coefficient as -1.00 (unit: 1,000 firms)
P*	Net force of the population agglomeration economies, with distance-decay coefficient as -0.50 (unit: 100,000 persons)
M*	Net force of the manufacturing agglomeration economies, with distance-decay coefficient as -1.00(unit: 1,000 firms)
PD*	Net force of the producer services agglomerations, with distance-decay coefficient as -1.00 (unit: 1,000 firms)
PS*	Net force of the personal services agglomeration economies, with distance-decay coefficient as -1.00 (unit: 1,000 firms)

The natural endowment variables include two categories: one caused by spatial accessibility (market forces) and the other caused by government policies (state forces). The first category includes accessibility variables such as DCBD (distance to CBD), DAIRPORT (distance to airport), and DHIGHWAY (distance to the nearest highway). The second category includes variables related to preferential policies, i.e. ETDZ (distance to the 14 national-level and 15 municipal-level Economic and Technological Development Zones) and NEWTOWN (distance to the 11 new towns defined according to Shanghai's Master Plan 1983). Two variables representing the state forces are dummy variables. The postal districts with their centroids falling in the ETDZs or NEWTOWNs are given one to its value, otherwise zero.

The agglomeration economies variables intend to measure the role of market potentiality (i.e. population agglomeration economies) and inter-sector linkages among the three sectors (i.e. manufacturing, producer services, and personal services) in firm's spatial pattern. A widely used form to measure market potentiality is the "gravity model" (Wu 2000):

$$P_i = \sum_{j=1}^{n} A_j \exp(-\beta d_{ij})$$

where P_i is the potentiality at location i; A_j can be the population of street office district j or the firm number of postal district j; d_{ij} is the distance between districts i and j; and β is the distance-decay parameter. Here the β for population is set as 0.5 and the β for firms is set as 1.0. To keep the results commensurable, the unit for population agglomeration economies (P and P*) is set as 100,000 persons and the unit for firm agglomeration economies is set as 1,000 firms.

Taking the manufacturing firms as an example, the empirical regression is the following:

$$\ln(D_M) = a_0 + a_1 DCBD + a_2 DHIGHWAY + a_3 DAIRPORT + a_4 ETDZ + a_5 NEWTOWN + a_6 P^* + a_7 PD^* + a_8 PS^* + \varepsilon$$

CBD, HIGHWAY and AIRPORT represent the natural endowment factors associated with spatial accessibility, while the ETDZ and NEWTOWN represent the endowment given by preferential policies, or the state force. Conceptually, these natural endowment variables contain the combined influences of net force of natural endowment and the influences of agglomeration economies via the endowment, because natural endowment advantages are both the cause and the result of agglomeration economies (Roos 2005). Statistically it may cause the problem of collinearity. Therefore, P*, PD* and PS* are created to represent the influences of net force of agglomeration economies, which are the residuals calculated from P, PD and PS respectively in the following way:

$$P = a_0 + a_1 DCBD + a_2 DHIGHWAY + a_3 DAIRPORT + a_4 ETDZ + P^*$$
$$PD = a_0 + a_1 DCBD + a_2 DHIGHWAY + a_3 DAIRPORT + a_4 ETDZ + PD^*$$
$$PS = a_0 + a_1 DCBD + a_2 DHIGHWAY + a_3 DAIRPORT + a_4 ETDZ + PS^*$$

The Spatial Pattern of Firms in Shanghai 2005

Based on the analysis of the firm inventory collected from SHAIC, a concentration pattern of firm distribution in Shanghai is discernible. Table 2 reports the statistics summary of the firm densities grouped into three broad geographic belts.

Within the inner belt which is bounded by the Inner Ring Road, the densities ranged from 319.70 to 5,236.29 firms per sq.km. In between the Inner Ring Road and the Outer Ring Road, the densities ranged from 33.67 to 1,334.04. In the areas beyond the Outer Ring Road, the densities ranged from 0 to 502.90. The mean of firm densities decreased remarkably from 1,592.71 in the central to 367.37 in the middle and 75.70 in the fringe. All these indicators indicate a descending spatial pattern of the densities from the center of the city to the fringe area.

Table 2: Descriptive statistics of firm densities in the postal districts

	Number	Minimum	Maximum	Mean	Standard deviation	Coeff. of var.
Within the inner belt	29	319.70	5236.29	1592.71	897.74	0.56
Between the inner belt and the outer belt	39	33.67	1334.04	367.37	318.89	0.87
Outside the outer belt	173	0.00	502.90	68.60	75.70	1.10
Total	241	0.00	5236.29	313.52	618.63	1.97

Spatial pattern of firm densities among the postal districts in Shanghai is shown in Figure 2. The firm densities are organized into six density groups by cut-off points of 100, 200, 500, 1,000 and 2,000. The postal district (postal code 200001) that had the highest density of firms registered 5,236 firms per sq.km in the Huangpu District, while the postal district (postal code 202182) in Chongming Island had the lowest density as zero. The seven districts with the density between 2,000 and 5,236 per Km^2 were all located in the inner belt. All of the twenty one districts with the density between 1,000 and 2,000 Km^2 were either located in the inner belt or across the Inner Ring Road except the postal district 200540 in Jinshan District, which was the seat of Jianshan Petrochemical Corporation. Most of the postal districts with the density between 500 and 1,000 Km^2 were located either in the area between the Inner Ring Road and the Outer Ring Road or in the fringe area of the inner belt. An outlier was the postal district 201802, which was the government seat of Nanxiang Town, a key central town (*Zhong Xin Zhen*) according to Shanghai's Master Plan (1999). The postal districts with densities between 200 and 500 firms per Km^2 were made up of two groups. One group was located in the area between the Inner Ring and Outer Ring, the other was overlapped with the key towns in Shanghai's fringe areas. The towns included the satellite towns set up by the Municipal Government before 1978 (i.e. Minhang, Wujin, Anting, Baoshan, Jiading, and Jinshan) and also the new towns planned in later master plans (i.e. Qingpu, Chengqiao, Huinan, Nanqiao). The postal districts with densities between 100 and 200 Km^2 were either in the Outer Belt or in vicinity of the key towns. The rest were the postal districts with densities lower than 100 firms per Km^2.

As the spatial distribution of firms demonstrates a strong distance-decay pattern, density gradient method was employed to detect the extent of firms' concentration across industries. The results are reported in Table 3.

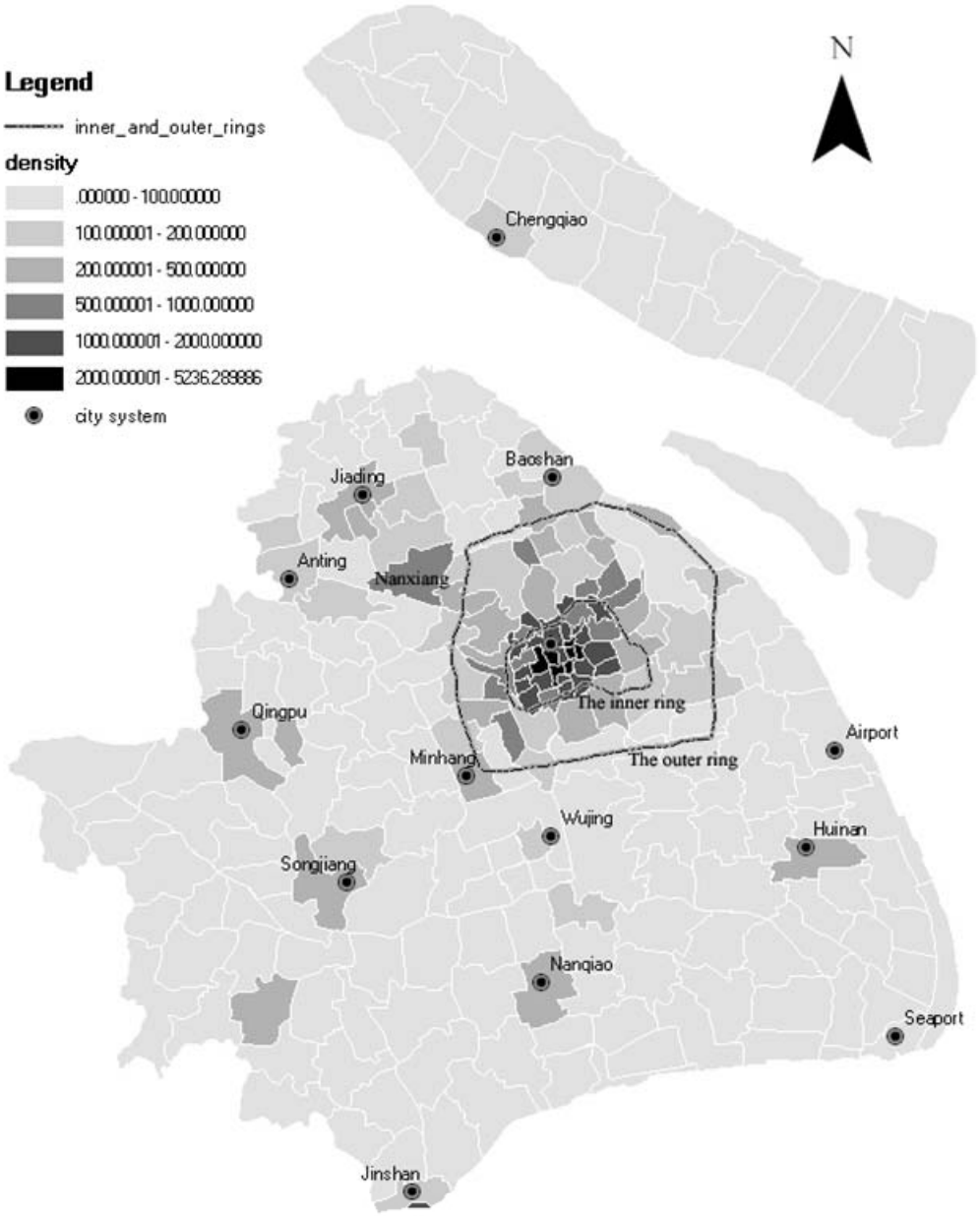

Figure 2: A choropleth map of firm densities distribution in Shanghai

As indicated in Table 3, personal services, producer services and manufacturing were orderly locating away from central city to peripheral area in Shanghai. A notable difference with the literature in Western cities is that personal services were more centralized than were the producer services. It may be attributable to two reasons. Firstly, producer services in Shanghai were in an early stage as they only started to develop after 1990s. They were more dependent on the distribution of manufacturing firms rather than on the central city's agglomeration atmosphere. Secondly, consumers' behavior in Chinese cities was different from that in western cities, as consumers in Chinese cities were more dependent on public transportation which has a strong orientation towards the central city.

Table 3: Density gradients of firms by the sub-sectors

Industries	Density gradient	Industries	Density gradient
Agriculture	-0.1565	Transportation auxiliary	-0.3836
Food processing	-0.0730	Storage and logistics	-0.0671
Food manufacturing	-0.1158	Post and telecommunication	-0.3012
Beverage manufacturing	-0.0741	Household commodity wholesale	-0.3454
Textile industry	-0.0567	Machinery and equipment wholesale	-0.2350
Apparel	-0.1125	Other wholesale	-0.2815
Timber& bamboo processing	-0.0233	Retails	-0.4354
Furniture manufacturing	-0.0266	Restaurants	-0.2944
Papermaking and products	-0.0385	Financial industry	-0.2908
Printing	-0.1469	Insurance	-0.3242
Cultural and sports goods	-0.0586	Real estate development	-0.2203
Petroleum processing	0.0876	Real estate management	-0.1715
Raw chemical materials	-0.0345	Real estate agent and services	-0.1392
Pharmaceutical products	-0.1140	Public services	-0.1832
Chemical fiber	0.0970	Household services	-0.1992
Rubber products	-0.0296	Hotel	-0.2999
Plastic products	-0.0262	Lease services	-0.8927
Non-metal products	-0.0447	Tourism	-0.5131
Ferrous metal processing	-0.0164	Entertainment	-0.1794
Nonferrous metal processing	-0.0270	Consultant services	-0.2598
Metal products	-0.0262	Computer application services	-0.2212
Ordinary machinery manufacturing	-0.0739	Other social services	-0.2526
Special equipment manufacturing	-0.0828	Health	-0.2192
Transportation equipment	-0.0574	Sports	-0.3213
Electrical equipment& machinery	-0.0962	Social security	-0.1669
Electronic& telecommunications equipment	-0.1396	Education	-0.1833
Instruments and office machinery	-0.1333	Cultural and art	-0.3022
Other manufacturing	-0.1093	Broadcast, movie and TV	-0.3571
Civil engineering& construction	-0.1255	Research organization	-0.1789
Pipeline construction	-0.1599	Technical services	-0.1742
Decoration	-0.1314	State organizations	-0.2962
Geological survey	-0.0990	Party organization	-0.6263
Irrigation management	-0.0447	Social organization	-0.3766
Road transportation	-0.0952	Grassroots community organization	-0.1216
Transportation on water	-0.2685	Representative& headquarter or others	-0.3768

Note: Only the industries passed the T-test and F-test at 0.05 level are included in the table.

Location Factors of the Firms in Shanghai 2005

Location factors of the firms in the three industrial sectors are examined by the empirical model introduced in Section 3. Regression results are summarized in Table 4 and Table 5. All the regressions pass the F-test and the R squares are 0.581, 0.757, and 0.867 for manufacturing, producer service and personal service firms respectively.

Table 4 summarizes the regression results of natural endowment variables across sectors. DCBD is a significant factor for all the firms. In general, the personal service firms value the proximity to CBD more than the producer service firms do, and the latter value the proximity to CBD more than the manufacturing firms do. The distance to Hongqiao Airport is a significantly pushing factor for producer service firms and personal service firms. Both types of firms would like to locate farer away from the

airport, maybe because of the noise or other nuisances (e.g. traffic congestion) caused by the airport. The distance to the nearest highway is significant for all the sectors, which indicates that land transportation is a frequently used means for the firms in Shanghai. According to the coefficients, the degree of the influence of DHIGHWAY on spatial distribution of firms decreases in the order of producer services, personal services, and manufacturing. Surprisingly, ETDZ plays a negative role in the distribution of manufacturing firms, which may be due to the fact that the ETDZ policies have certain discrimination effect on the domestic firms or on small firms. NEWTOWN is significant for all the types of the firms. The eleven new towns defined in the Master Plan 1983 act as "magnet" points in suburban Shanghai. Although they are small in size compared with the central city, the new towns play an important role in shaping firm's spatial pattern in Shanghai.

Table 4: Estimation results of natural endowment variables across sectors

Variables	Manufacturing	Producer services	Personal services
DCBD	-0.035***	-0.067***	-0.094***
DAIRPORT	-0.003	0.037***	0.013*
DHIGHWAY	-0.068***	-0.145***	-0.121***
ETDZ	-0.151	-0.151	-0.400***
NEWTOWN	0.884***	1.448***	1.690***

Note: *** denotes significance at 0.01 level. ** denotes significance at 0.05 level. * denotes significance at 0.1 level.

Table 5: Estimation results of agglomeration economies variables across sectors

Variables	Manufacturing	Producer-services	Personal-services
P*	0.009	0.415***	0.510***
M*		0.804***	0.372**
PD*	-0.051		0.175*
PS*	0.380**	0.329*	

Note: Standard errors reported in parentheses. *** denotes significance at 0.01 level. ** denotes significance at 0.05 level. * denotes significance at 0.1 level.

Table 5 summarizes the coefficients and the significance level of four agglomeration economies variables (P*, M*, PD* and PS*) respectively. The linkages between population and firm agglomerations for firms in the three industrial sectors can be summarized in Figure 3. The extent of the influence is divided into three categories (i.e. strong, middle-level, and weak) according to the significance level. The thicker arrow line represents that the influence is more significant. Shown in Figure 3, the linkages that are the most significant for the firms are three: the positive influence of population on the personal services and on the producer services, and the positive influence of manufacturing on the producer services.

The results partly conform to the findings in other cities. The purpose of personal services is to serve local population so that the influence of population on personal services is significant and positive. In Shanghai, as the producer services are still in an early stage, they are more likely to serve the local needs, especially the local manufacturing firms. Besides the strong linkages, the manufacturing firms and personal service firms have middle-level linkages between them and the producer service firms and personal service firms have relatively weak linkages between them, which imply that the location with better personal services condition is valued by both manufacturing firms and producer services. It is also of note that population do not have influence on the distribution of manufacturing firms at the intra-city level, although they may have the influence at the inter-city level.

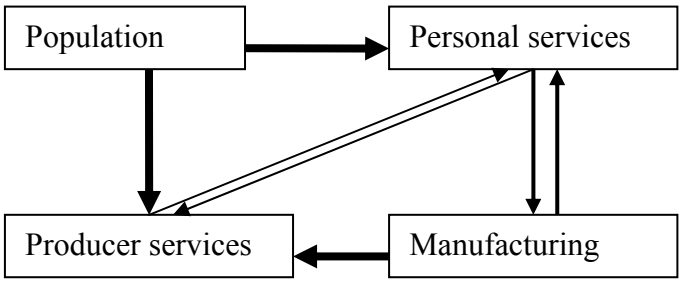

Figure 3: The linkages among population and manufacturing, producer service, personal service agglomerations for the firms in Shanghai

Concluding Remarks

This paper examines the changing location pattern of firms in Shanghai since China began to reform its enterprise system and centrally planned economy in 1978. The manufacturing firms dispersed to the suburbs in the 1980s, when Shanghai Municipal Government started to reduce industrial pollution and to develop tertiary activities in the central city. This process of dispersal was accelerated by the establishment of land/property markets, which made the relocation from central to suburban locations financially "advantageous" for firms. Market mechanisms started to play a role in firms' location decision making.

Based on a firm inventory from SHAIC, this study examines the location pattern of firms and the location factors in Shanghai in 2005. The results show an emerging concentration-dispersal pattern, which can be explained by spatial accessibility factors such as proximity to the CBD and the highways, by state policy factors such as the planning and development of development zones and new towns, and by inter-sector dependence factors. Statistical results indicate that with the establishment of market mechanisms, firms in Shanghai which gained more self-determination power made their location decisions based partially on logical factors similar to those firms in market economies- such as accessibility and scale economies associated with labor pool and firm concentration (Coffey and Shearmur 2002; Glaeser and Kahn 2000; Shukla and Waddell 1991).

In addition to market mechanisms, state intervention plays an important role in the location decision making of firms. By and large, the major nodes and infrastructures that orientate firm preferences in location selection are planned and developed by the state. For example, the CBD was planned by the Municipal Government in the Shanghai Master Plan. Its formation and development could not be realized without the help from the District governments and also the Central Government (Han 2000). In addition, special development zones, e.g. the Pudong New Area, were planned by the Central and the Municipal governments. This finding adds on to our understanding of the role of local government and organizations, which, on a micro scale, mediated among firms for their interactions (Wolfe and Gertler 2004).

In conclusion, the forces that have shaped the location of firms in Shanghai include: 1) "global forces", i.e. market factors, which have been observed in many cities in the world, and 2) "local forces", i.e. transitional factors, which were rooted in Shanghai's stage of development. In Shanghai, firms sought good locations proximate to the CBD, the highways, and the related customers/partners. This was similar to firms in other cities. However, the effect of the market factors unfolded in the broader context of state control – a spatial framework planned, developed and promoted by the state at central, municipal and district levels.

This study unfolds the various influences from the state and the market in the context of a given economic development stage, and thus contribute to understanding urban spatial restructuring in a transitional economy. The relation between industrial structure and spatial structure is revealed as well, which is significant for policy makers in Shanghai. For instance, if government plans to transform the city from a monocentric to polycentric form, the development of producer services needs to be promoted further.

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