Spatial Distribution of Economic Activities in Japan and China

Masahisa Fujita, J. Vernon Henderson, Yoshitsugu Kanemoto, Tomoya Mori

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1. Introduction (to be completed)

2. Distribution of Economic Activities in Japan

The purpose of this section is to examine the distribution of economic activities in Japan. Rapid economic growth in the 20th century was accompanied by tremendous changes in spatial structure of activities. In Section 2.1, we examine the regional transformations that arose in postwar Japan. Roughly speaking, after WWⅡ the Japanese economy has experienced two phases of major structural changes. For our purpose, the interesting aspect is that *each phase of industrial shift has been accompanied with a major transformation in the nationwide regional structure*. The Japanese economy now seems to be in the midst of a third one and we offer some conjectures about its possible evolution.

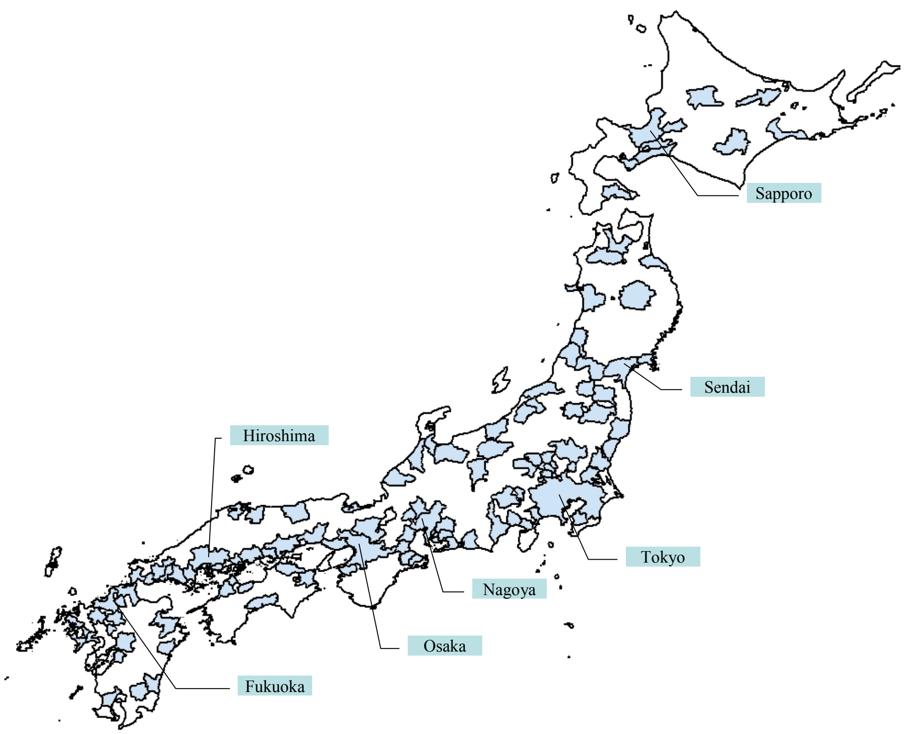
Perhaps the most important public policy issues concerning urban agglomeration in Japan is the Tokyo problem. Indeed, Tokyo is probably the largest metropolitan area in the world with a population exceeding 30 million. The dominance of Tokyo has increased steadily over the 20th century, ultimately absorbing a quarter of the Japanese population in 2000. In Section 2.2, we discuss attempts made to test empirically the hypothesis that Tokyo is too big. A test of this kind involves the estimation of urban agglomeration economies and we also review the empirical literature in this area.

In Section 2.3, we move to the spatial distribution of industries among cities. Some metro areas have attracted a disproportionately large number of industries, leading to great variations in industrial diversity among metro areas. The most diverse metro is obviously Tokyo, with positive employment in 122 industries out of the 125 manufacturing 3-digit sectors considered, while the least diverse is Iwamizawa with only 46 industries---(the average diversity of 82 industries across metro areas). In elaborating more on that point, we will report on the two main empirical regularities regarding industrial and population distributions across locations. First, there is a strong negative log-linear relation between the number of metro areas occupied by an industry and the average population size of the corresponding metro areas. This regularity has itself remained very stable in the period 1980-2000. Second, the industrial location patterns observed during this period are highly consistent with Christaller (1933)'s *Hierarchy Principle* of industrial location behavior, which asserts that an industry found in any given metro area will also be found in all larger metro areas.

2.1. City Size Distribution and Regional Transformations in Postwar Japan

2.1.1. Evolution of City Size Distribution in Japan

We start with a brief examination of the evolution of city size distribution in Japan in the 20th century. To do so, we have to define urban areas. Here, we adopt a recently proposed version called Urban Employment Area (UEA)[1]. The UEAs are divided into Metropolitan Employment Areas (MEAs) whose central cities have DID (Densely Inhabited District) populations exceeding 50,000 and Micropolitan Employment Areas (McEAs) with the DID populations between 10,000 and 50,000. In 1995 there are 118 MEAs and 160 McEAs. Figure 2.1.1 shows all MEAs except those in Okinawa Prefecture. (For more detail, see the color map at the end of the volume.)



[1] Unlike in the United States, the Japanese government provides statistics only for legal jurisdictions, i.e., cities and prefectures, and no official data are available for metropolitan areas. A number of researchers have developed their own definitions, however. Examples are the Standard Metropolitan Employment Area (SMEA) by Yamada and Tokuoka (1984), the Functional Urban Core (FUC) by Kawashima (1982), and the Integrated Metropolitan Area (IMA) by Suzuki and Takeuchi (1994). Recently, Kanemoto and Tokuoka (2002) proposed a new version called Urban Employment Area (UEA) which we adopt in this article.

Figure 2.1.1 Metropolitan Employment Areas

Figure 2.1.2 shows the population shares of the three largest metropolitan areas, Tokyo, Osaka, and Nagoya, and other categories of MEAs from 1920 to 2000, using the 1995 MEA definition. The block core in this graph consists of Sapporo, Sendai, Hiroshima, and Fukuoka that are the regional centers of four regions, Hokkaido, Tohoku, Chugoku, and Kyushu. Prefectural capitals include 33 MEAs that are prefectural capitals (47 prefectures in Japan) and do not belong to other categories of MEAs.

From 1920 to 2000, the share of non-metropolitan areas decreased from 36.4% to 17.9%, most of which was captured by Tokyo that increased its share from 11.8% to 25.1%. Block Core MEAs that grew from 3.0% to 6.1% in the same period constitute another high growth category. Osaka showed considerable growth between 1920 and 1970 (from 6.0% to 9.5%) but stagnated since then. Smaller size MEA decreased their share slightly from 20.0% in 1920 to 18.0% in 2000 while prefectural capitals kept their share from 1940 on after an 1.7% drop between 1920 ant 1940.

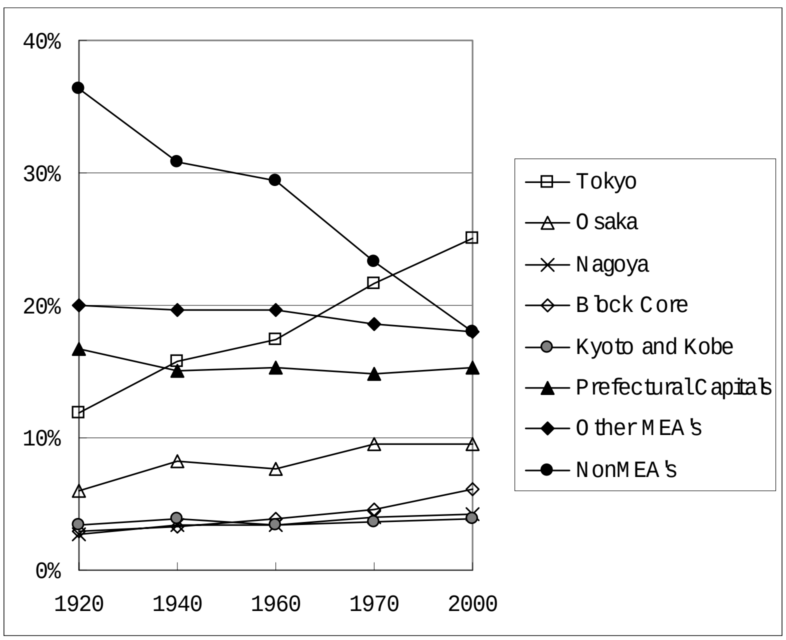


Figure 2.1.2 Long-term trends in Japanese metropolitan areas

Table 2.1.1 looks at the largest 20 MEAs in more detail. Tokyo is by far the largest metropolitan area with population exceeding 30 million in 2000. Over the 1970s, most of the major metropolitan areas experienced significant population growth. The Tokyo metropolitan area gained about 4.5 million, which is about the size of Nagoya that is the third largest metropolitan area. Sapporo, Fukuoka, and Sendai (which with Hiroshima constitute Block Cores in Figure 2.1.2) had higher rates of growth than Tokyo, however. These three cities have experienced very high rates of growth also over the 1980s and 1990s, when Tokyo's growth rate has decreased.

The high growth rates of metropolitan areas over the 1970s and 1980s are exaggerated because the national population size grew considerably. The last three columns show growth rates in excess of the national rate. A few metropolitan areas, i.e., Osaka, Kitakyushu, Shizuoka, Gifu, and Himeji, had growth rates lower than the national average in some periods.

UEA	Population				Rate of Increase			Difference from national average		
	1970	1980	1990	2000	1970-80	1980-90	1990-2000	1970-80	1980-90	1990-2000
Tokyo	22,611	27,141	30,218	31,664	20.0%	11.3%	4.8%	7.2%	5.7%	2.3%
Osaka	9,966	11,324	11,896	12,115	13.6%	5.1%	1.8%	0.8%	-0.5%	-0.7%
Nagoya	4,153	4,759	5,098	5,319	14.6%	7.1%	4.3%	1.7%	1.5%	1.8%
Kyoto	2,041	2,362	2,495	2,583	15.7%	5.6%	3.5%	2.9%	0.0%	1.0%
Fukuoka	1,313	1,743	2,028	2,329	32.8%	16.3%	14.8%	19.9%	10.7%	12.4%
Kobe	1,790	2,053	2,227	2,296	14.7%	8.5%	3.1%	1.8%	2.9%	0.6%
Sapporo	1,315	1,763	2,052	2,217	34.0%	16.4%	8.1%	21.2%	10.8%	5.6%
Hiroshima	1,126	1,378	1,516	1,586	22.4%	10.0%	4.7%	9.5%	4.4%	2.2%
Sendai	973	1,230	1,402	1,550	26.4%	14.0%	10.5%	13.5%	8.4%	8.0%
Kitakyushu	1,381	1,458	1,432	1,416	5.6%	-1.8%	-1.1%	-7.3%	-7.4%	-3.6%
Kumamoto	736	851	939	1,007	15.6%	10.3%	7.2%	2.8%	4.7%	4.7%
Shizuoka	852	951	992	999	11.5%	4.4%	0.7%	-1.3%	-1.2%	-1.8%
Okayama	743	865	916	949	16.4%	5.9%	3.6%	3.5%	0.3%	1.2%
Niigata	767	866	915	947	13.0%	5.6%	3.5%	0.1%	0.0%	1.0%
Hamamatsu	705	811	889	939	15.0%	9.6%	5.7%	2.2%	4.0%	3.2%
Utsunomiya	639	758	836	876	18.5%	10.4%	4.7%	5.6%	4.8%	2.2%
Gifu	665	769	809	821	15.6%	5.2%	1.5%	2.7%	-0.4%	-1.0%
Naha	490	617	699	747	25.9%	13.2%	6.9%	13.1%	7.7%	4.4%
Himeji	639	704	722	745	10.3%	2.5%	3.2%	-2.6%	-3.1%	0.7%
Kanazawa	532	639	697	734	20.1%	9.1%	5.3%	7.2%	3.5%	2.8%
MEA Total	80,302	93,007	100,032	103,800	15.8%	7.6%	3.8%	3.0%	2.0%	1.3%
Japan Total	103,720	117,060	123,611	126,697	12.9%	5.6%	2.5%	0.0%	0.0%	0.0%

Table 2.1.1 Population in large metropolitan areas in Japan: 1970 to 2000

2.1.2. Three cycles of regional transformation in Postwar Japan

In order to understand the basic trends in the regional transformation in postwar Japan, it is best to start with Figures 2.1.3 and 2.1.4.[2] First, Figure 2.1.3 shows the net migration to each of the three largest metropolitan areas (MAs), Tokyo, Osaka and Nagoya, over the period of 1955 to 2001. [For the Japanese map, see Figure 2.1.1.]

[2] This section is mainly based on Fujita and Tabuchi (1997).

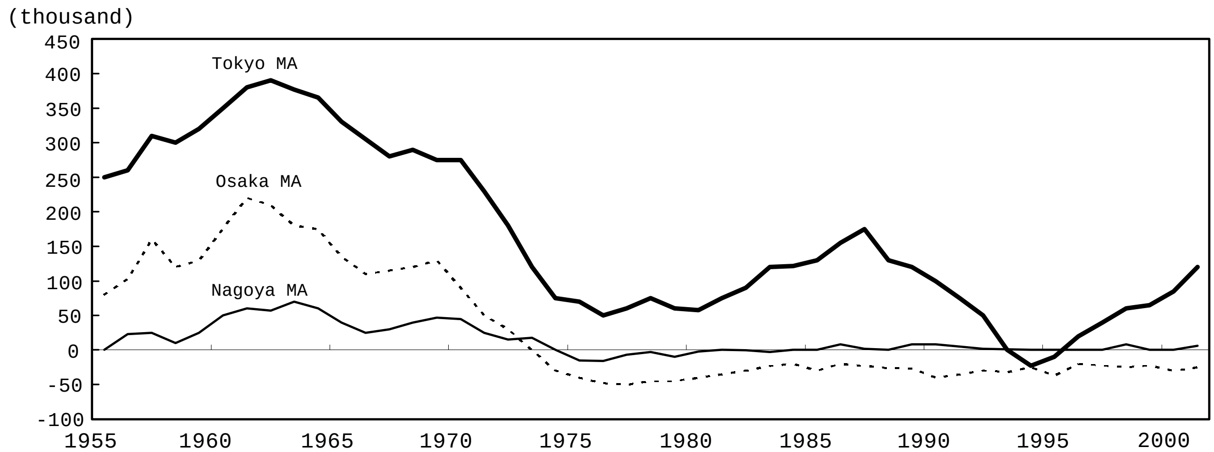


Figure 2.1.3 Net migration to the three largest metropolitan areas

Note: Tokyo MA: Tokyo, Kanagawa, Saitama, and Chiba prefectures; Osaka MA: Osaka, Hyogo, Kyoto and Nara prefectures; Nagoya MA: Aichi, Gifu and Mie prefectures
Source: Ministry of Home Affairs (2002)

This figure indicates that Japan had experienced two cycles of regional transformation since the mid 1950s, and is now in the midst of the third. That is, in the first cycle from the mid 1950s to the mid 1970s, each one of the three MAs experienced a high rate of net migration until 1970 with the peak in the early 1960s, followed by a sharp drop. In this first cycle, the roughly inverse-U-shaped pattern of net migration was synchronized among the three MAs. However, in the second cycle from the mid 1970s to the mid 1990s, such synchronization among the three MAs was totally disrupted. That is, only the Tokyo MA exhibited the same characteristics of the net migration curve as in the first cycle (but with a lower volume than the first). In contrast, the Nagoya MA had a nearly zero rate of net migration, while the Osaka MA changed to a significantly negative rate of net migration. Finally, the third cycle that started in the mid 1990s exhibits, so far, a pattern similar to the first part of the second cycle.

Figure 2.1.4 depicts the sum of the net migration flows to the three MAs in Figure 2.1.3 and the interregional income differential represented by Theil's measure of the per capita real income differential across prefectures. This figure indicates a clear synchronization between the net migration to the three MAs and interregional income differentials, which again suggests the three cycles of regional transformation in Japan after WWⅡ.

We examine each cycle of regional transformation in turn.

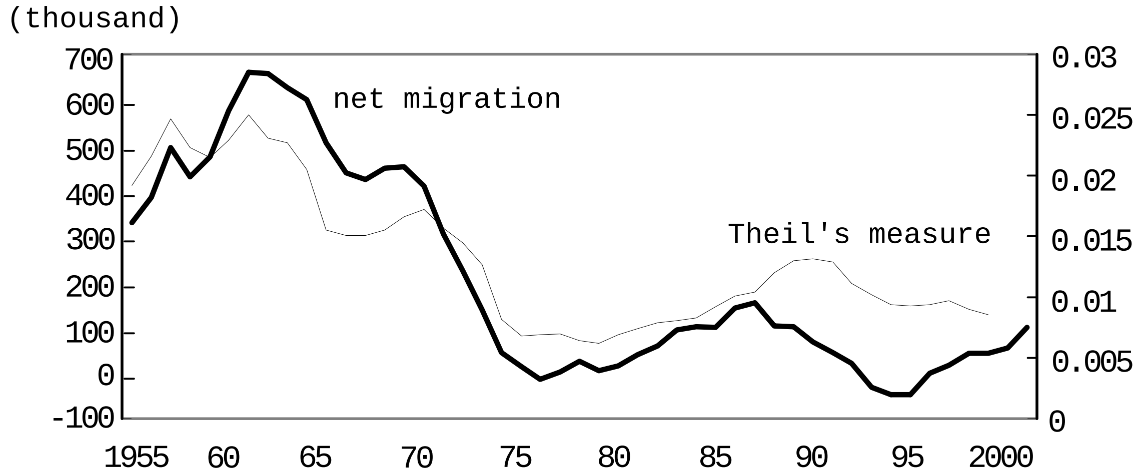


Figure 2.1.4 The net migration to the three largest MAs and the Theil's measure of the interregional per capita real income differential; source: Economic Planning Agency (1997) and Tanioka (2002)

□. The first cycle (the mid 1950s to the mid 1970s): Agglomeration into the three MAs, and then the expansion to the Pacific industrial belt

Soon after the war-shattered Japanese economy recovered to prewar levels in the mid 1950s, the Japanese economy started growing rapidly— a trend which continued until the early 1970s. (Over the period of 1956 to 1970, the average annual growth rate of real GNP was 9.7%). During this period of rapid economic growth, as shown in Figure 2.1.5, Japanese industries experienced a major shift from the primary (mainly agriculture) to the secondary (mainly manufacturing) and the tertiary (mainly service) industries. In particular, the GDP share of the secondary industry increased significantly over the period of 1955 to 1970.

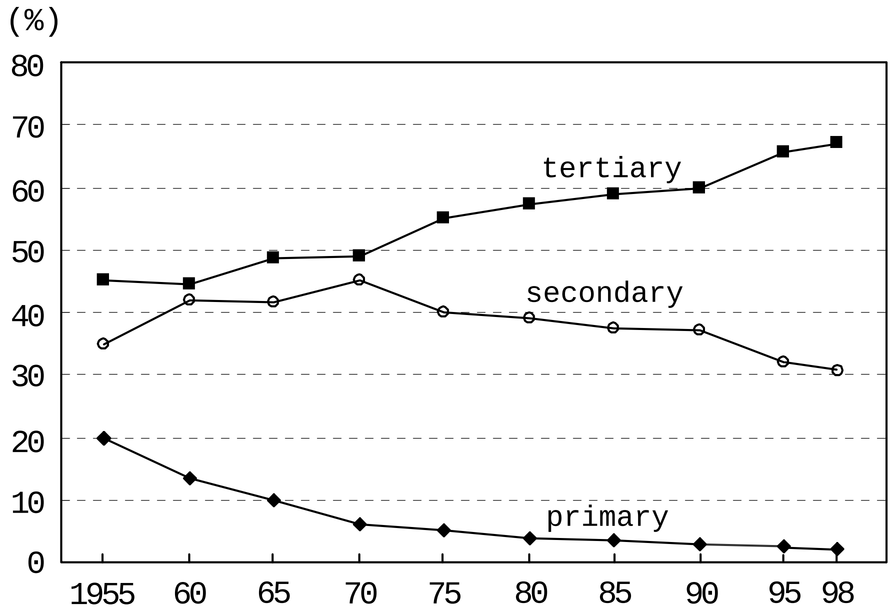


Figure 2.1.5 Industrial GDP shares; source: Annual Report on National Accounts (1999)

In order to examine the changes in the composition of the manufacturing sector, we show in Figure 2.1.6 the GDP shares by manufacturing industries. This figure indicates that the rapid growth of the manufacturing sector over the period of 1955-1970 was led by the high growth rates of electrical•transport•general machineries, supported by the corresponding growth of material industries, or 'heavy industries', such as iron•steel, fabricated metals and petrochemicals. Over the same period, the relative share of the textile industry (i.e., the most labor-intensive one) declined sharply. [It must be noted, however, that in Figure 2.1.6, if an industry kept the same share from 1955 to 1970, for example, its GDP (in real terms) would increase about 10 times over the same period.]

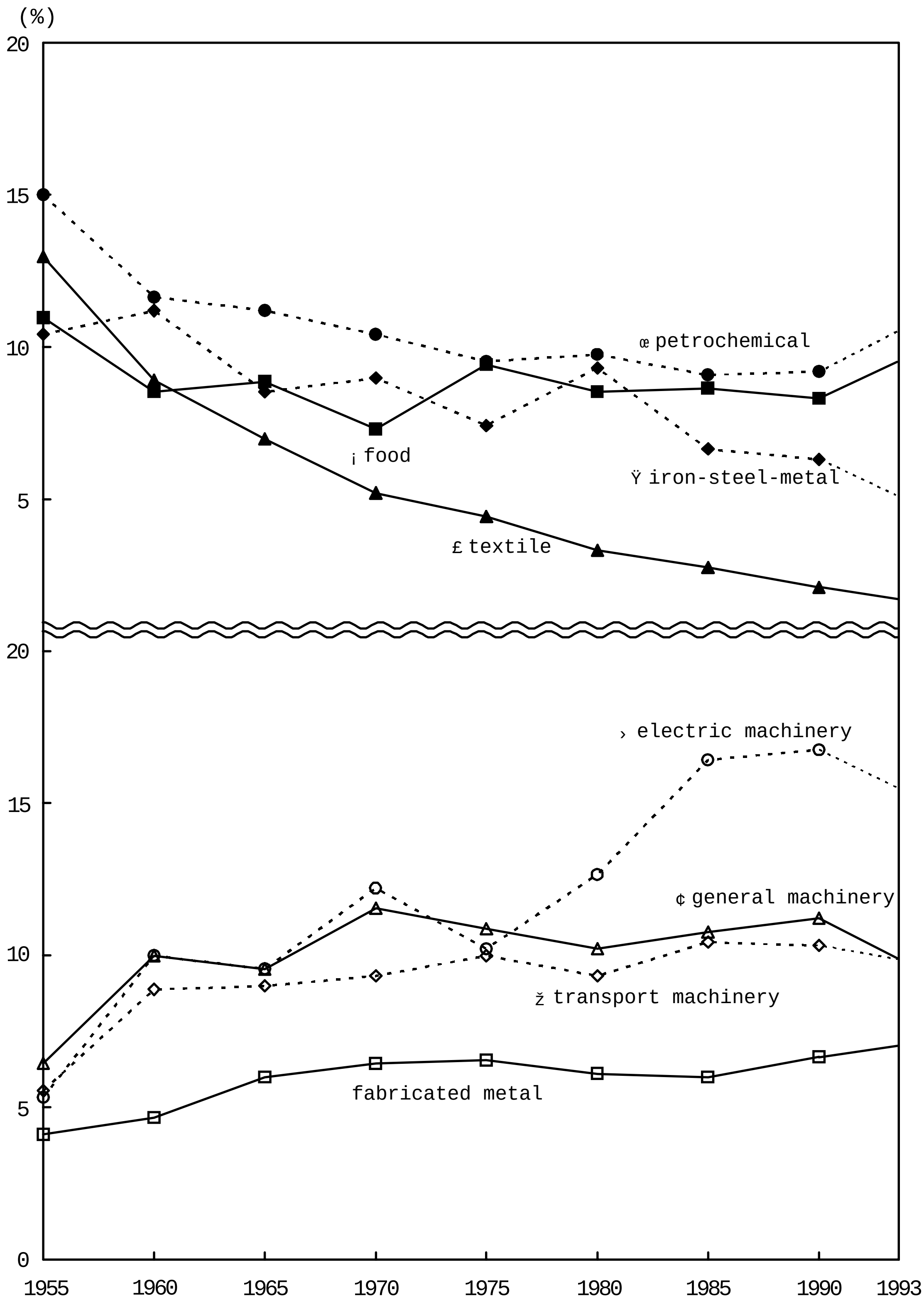


Figure 2.1.6 GDP shares by manufacturing industries;

Source: Census of Manufactures, 1955-1993

Figures 2.1.3 to 2.1.6 suggest that the first cycle of regional transformation was mainly lead by the linkage-based agglomeration economies, which conforms well with the basic result of the so-called New Economic Geography. [Refer to for example, Chapter 5 in Fujita, Krugman and Venables (1999) and Chapter 9 in Fujita and Thisse (2002)] More specifically, the main factors that propelled the rapid concentration of many industries and workers into the three largest MAs are the following:

(i) decrease in the share of the primary (i.e., land-based) industries, which freed a large number of rural workers,

(ii) substitution of imported raw materials such as coal and iron ore) for domestic ones, which made the availability of these raw materials free of location in Japan,

(iii) increase in the GDP shares of the secondary and tertiary (i.e., non-land-based) industries,

(iv) increase in the shares of manufacturing industries which have strong technological linkages (i.e., electrical, transport, general machineries and material industries), and

(v) improvement in the nationwide transport networks (of railways, highways and ports).

These five factors together created circular causations, for the agglomeration of industries (covering most types of manufacturing and services) and workers (=consumers) into the three largest MAs, through forward linkages (i.e., attraction of workers and firms to big cities due to good accessibility to a large variety of consumer/intermediate goods) and backward linkages (i.e., attraction of producers to big cities due to good accessibility to big markets), leading to a rapid growth of the three MAs.

However, in the mid 1960s, the growth rate of the three MAs started decreasing gradually because of the rising land prices and wages (i.e., local factor prices). This in turn promoted the expansion of the industrial sites (in particular, of land-intensive industries) towards the surrounding areas of the three MAs, eventually resulting in the formation of the 'Pacific industrial belt' connecting the Tokyo MA to the northern part of Kyushu, by the late 1960s. This process of industrial dispersion from the agglomeration core to the surrounding areas due to factor price differentials also conforms well with the basic result of the New Economic Geography.[3] [See Mori (1997), Chapter 7 in Fujita et al. (1999), and Helpman (1998) and Tabuchi (1998).]

In Figure 2.1.4, over the period of 1955 to 75, two curves are roughly bell-shaped and well-synchronized, supporting the inverse-U hypothesis of regional development by Williamson (1965) and Alonso (1980).

[3] It should be noted that several national comprehensive plans played a role in facilitating the relocation of industrial complexes, although their true economic impacts are uncertain and are difficult to measure. We may also note that he

Using Sim's test of causality, Tabuchi (1987) demonstrated that interregional migration in Japan over that period is a consequence of the income differential. That is, the rural-urban income differential statistically preceded the rural-urban migration by a few years.

Ⅱ. *The second cycle (the mid 1970s to the mid 1990s): development of the Tokyo-monopolar regional system*

During the second cycle of regional transformation in Japan over the period of the mid 1970s to the mid 1990s, only the Tokyo MA (among the three largest MAs) exhibited a significantly positive flow of net migration, leading to the development of the so-called 'Tokyo monopolar regional system.' Such a radical departure from the past trend of migration pattern reflected major structural changes in the Japanese economy which were, in turn, brought about through profound changes in the macro environments of the world economy since the early 1970s.[4]

The fundamental cause of such changes in both the world economy and Japanese economy has been, in short, the marked reduction in the (broadly defined) 'transport costs' for the international and interregional movement of information, goods, services, capital and people, which has been occurring successively since the early 1970s.

Such a reduction in transport costs or trade costs is partly due to the political progresses towards the détente in East-West relations and the liberalization of global trade in goods, services and capital. More fundamentally, such a reduction in 'transport costs' has been realized through the revolutionary technological-development in computers, information processing and networking, and telecommunications, which opened the new age of the so-called information technology (IT) revolution. [Actually, the most basic technological cause supporting the IT revolution has been the phenomenal progress in the design and production of semiconductors or integrated circuits (ICs), which accelerated since the late 1960s.]

In particular, the rapid progress in telecommunications technologies has been vastly improving the speed, reliability and capacity of communications; furthermore, the costs of such communications are less sensitive to distance. In addition, the advancement of computer integrated manufacturing (CIM)

government policies usually follow, rather than precede, the actual transformation in the structure of industries, so we do not enter into details here.

methods enabled the complex production technologies to be embodied in machines, reducing the skill-requirements of workers in standard production operations. Therefore, by effectively combining CIM methods and modern telecommunications technologies, large firm (which have a sufficient capital and accumulation of know-how together with R&D capability) can rather freely organize the location of the various units of their entire operations, encouraging the formation of multi-location or multinational firms (MNFs).

Furthermore, the rapid technological progress in ICs and IT contributed not only to the vast technological progress in production and transportation (of goods and passengers), but also to the creation of a wide range of new industries such as the global financial industries, computer-soft and game-soft industries. Meanwhile, the globalization of the world economy due to the successive reduction in 'transport costs' has been accompanied by intensifying competition among the US, Japan, EC countries and the NIEs of East Asia, making innovations (for both products and processes) a key strategy for survival and growth of large MNFs.

In addition, several major changes occurred in the Japanese economy. First, the Japanese yen appreciated about 50% immediately after the start of the floating exchange rate system in 1970 (Nixon shock); it appreciated further about 100% after the Plaza Accord of 1985. Furthermore, through two oil shocks in 1973 and 1979, oil prices in Japan increased about eight times. Finally, the rapid growth of 'heavy industries' during 1960s caused severe environmental problems in Japan.

These profound changes in the macro environment surrounding the Japanese economy brought about the following major structural changes in the Japanese economy since the mid 1970s.

(i) Given intensifying competition in global markets together with the high valued yen, high wage rates, high energy costs, and severe environmental problems, Japanese manufacturing shifted from the traditional commodity production (which gradually moved to the Asian NIES and other developing countries) to 'high-tech' products based on the newest technologies. In particular, as shown in Figure 2.1.6, a phenomenal growth of the electric machinery industry occurred since the mid 1970s, reflecting the rapid growth of high-tech electronics products related to ICs and IT machinery.

(ii) Given the high valued yen and the high wage rate in Japan together with the successive

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[4] Cochrane and Vining (1988) reports that the renewed trend of the positive net migration to the core regions of an economy was observed in several developed countries starting around 1980. The international nature of this trend called 'population turnaround' indicates that such a trend reflects the structural changes in the world economy.

reduction in ‘transport costs’, many large manufacturing firms successively moved an increasing share of their labor-intensive operations to the low-wage countries (in particular, those in East Asia). Furthermore, the intensifying trade frictions with the US and EC countries and the growing markets there induced many Japanese manufacturing firms to establish their new production plants in these countries. Both movements expanded rapidly the number of Japanese MNFs as well as the extent of their overseas operations (see Section 4.2 for further details).

(iii) As noted previously, the intensifying competition in the global markets together with the successive expansion of the scientific knowledge base of society made technological innovations a key strategy for survival and growth of these MNFs. This induced firms to allocate an increasing proportion of their financial and human resources to R&D activities, while moving their labor-intensive operations to low-wage countries. In addition, global expansion of their operations required these MNFs to strengthen the management functions at their headquarters (HQs) located in Japan.

(iv) The liberalization of global financial and capital markets and rapidly expanding global operations of MNFs made financial industries (in particular, international finance) grow notably in Japan. In addition, the growth of high-tech industries and MNFs (focused on R&D and HQ operations in Japan) induced a notable growth of advanced producer services and business services in Japan. Such an expansion of financial industries, producer services and business services partly explain the significant increase (decrease) in the relative GDP-share of the tertiary sector (the secondary sector) in Japan since the mid 1970s, as shown in Figure 2.1.5.

(v) In addition to the growth of these advanced services, the technological development related to ICs and IT created new industries also in Japan such as computer software, animation and game development, as well as new types of information •communication services, all of which heavily involve knowledge-intensive activities.

(vi) Finally, the development of the nationwide high-speed transportation networks of railways (i.e., the Shinkansen), highways and airways mostly centered around Tokyo accelerated in the early 1970s.

All these factors worked together for the development of the Tokyo-monopolar regional system. That is, the marked decrease in ‘transport cost’ within Japan led, in effect, to the notable contraction of the ‘economic space’ of Japan, which, in turn, made *unstable* the previous regional system centered around Tokyo, Osaka, and Nagoya. Thus, in the process of reestablishing a new *stable* regional system of Japan, one of the three cities was destined to become the unparalleled top-ranked city, while the remaining two demoted to second-ranked cities. In this process of determining the top-ranked city of Japan, a number of factors favored Tokyo.

First, although Osaka was traditionally the economic center of the western half of Japan until the 1960s, Tokyo, the seat of the central government, was significantly larger than Osaka. Furthermore, Nagoya, situated in the middle of Tokyo and Osaka, was always much smaller than the two. Second, the expansion of the Shinkansen and airway networks since the early 1970s, which set most major cities in Japan within a one-day-trip business area, were mostly centered around Tokyo. Furthermore, only Tokyo had the first-class international airport until Osaka built one in 1994.

Meanwhile, as noted previously, since the mid 1970s, the leading economic activities of Japan steadily shifted from the traditional commodity production (based on established technologies) to knowledge-intensive activities including the R&D of high-tech products, HQ operations of MNFs and other large firms, advanced business services, and IT-related new industries. For the productivity of such knowledge-intensive activities, the most crucial factor is the knowledge externalities which are created and accumulated locally through the exchange of tacit knowledge •information mostly via face-to-face communications among knowledge-workers. In contrast, using modern information technologies, explicit knowledge•information can be transferred with little obstacle of distance.[5] And, in the early 1970s, Tokyo had already the biggest concentration of such knowledge-intensive activities.

Therefore, being attracted by the synergy of Tokyo's centrality in transportation•information networks and the highest level of knowledge externalities there, a dominant share of growing knowledge-intensive activities started locating in Tokyo in the mid 1970s. In turn, this strengthened further Tokyo's centrality in transportation• information networks and knowledge externalities there, creating a snowball effect that reinforced Tokyo's dominance. On the other hand, Osaka (more precisely, the Osaka MA) unable to regain its prominence in present-day Japan, has been the biggest loser. In contrast, the Nagoya

[5] Note that in a country like Japan where the establishment of human relations is a precondition for conducting effective communication, the recent development of telecommunications technologies and air and high-speed transportation networks does not diminish, but even enhances more the necessity and value of face-to-face communications. The following (*Economist*, 1991 May 4, pp. 15-16) illustrates the importance of face-to-face communications (for operating financial offices) in the age of advanced communication technology: "The other centralizing force is, paradoxically, the computer itself. By and large, the computer is a leveler. By making information available to everyone, it makes it all the more important to get closer to the source of that information.

MA (having Toyota's HQs and mother plants) succeeded in keeping its relative strength by becoming the center of Japanese manufacturing in advanced transportation and general machineries.

As shown in Figure 2.1.4, the Theil's measure of the interregional per capital real income differential increased from the mid 1970s until 1990, indicating that the disparity between the core and non-core regions of Japan as well as the disparity among the three MAs increased over that period (see Fujita and Tabuchi, 1997, for the decomposion of Theil's measure into various components). This reflected the impact of decreasing 'transport cost' worldwide and the high wage rate in Japan, which caused the dispersion of commodity-production activities from non-core regions in Japan to the Asian NIEs and other developing contries, while the new knowledge-intensive activities kept concentrating into the core region of Japan(in particular into the Tokyo MA).

The continued growth of Tokyo, meanwhile, fuelled the ever rising land-prices there since the mid 1970s, which soon spread to other major cities in Japan. Such an accelerating increase in land prices ended up creating huge 'bubbles' in land markets in Japan by the late 1980s, which busted in the early 1990s. This burst of land markets (together with stock markets) destroyed the foundations of the traditional financial system of Japan (which has been based on financing through taking land assets as collateral), resulting in the prolonged recession since the early 1990s. As shown in Figure 2.1.1, the severe recession in the early 1990s quickly curtailed the net migration to the Tokyo MA, resulting in a negative rate of net migration to the Tokyo MA in 1994 which happened for the first time since 1955.

Ⅲ. *The third cycle (the mid 1990s to the present): renewed trend towards the dominance of the Tokyo MA*

The net migration to the Tokyo MA, however, turned positive again in 1996. And, it has been steadily climbing up since then, indicating a renewed trend towards the dominance of the Tokyo MA. We consider, tentatively, the period since the mid 1990s the beginning of 'the third cycle' of regional transformation in Japan.

One may suspect that 'the third cycle' would actually be the continuation of the second cycle which just suspended in the mi 1990s because of the severe recession after the bust of bubbles. There is, however, a significant difference between the past two cycles and 'the third cycle.' That is, although there was always a strong correlation between the rate of net migration to the Tokyo MA and the growth rate of

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Put another way, it makes lunch even more important. Moneymen closer together get a step ahead of the computer.

national GDP during the past two cycles, there is little such correlation in the third cycle. In particular, although the GDP growth rate was almost zero over the past several years (especially, −2.5% in 1998), the net migration to the Tokyo MA has been steadily climbing.

How do we understand the renewed trend towards the dominance of the Tokyo MA under the prolonged recession in Japan? We might interpret it as the ‘sinking ship syndrome’; people desperately climb to the top of the ship while it is slowly sinking. Such a sarcastic view might become the reality if Japan does not start growing soon by rebuilding her financial system. Anyway, it is too early to talk much about ‘the third cycle.’

In closing this section, it must be noted that the results presented in this section are not inconsistent with the comprehensive study of Japanese regional economy by Barro and Sala-i-Martin (1992, 1995) which reports, among others, the (absolute β) convergence of personal income across Japanese prefectures over the period of 1930 to 1990. That is, the convergence of personal income across prefectures which Japan experienced in the very long-run proceeded with a cyclical transformation of nationwide economic landscape discussed earlier in this section.

2.1.3. The evolution of the core-periphery pattern of regional system in Japan

The New Economic Geography predicts the formation of a core-periphery structure (CP-structure) at various scale of spatial economy.[6] In this section, first we consider the Japanese regional economy as a whole, and show that the economic growth of Japan was accompanied with the formation of a typical CP-structure at the nationwide scale, and that a systematic transition of industries occurred among macroregions of Japan. Then, we take the Tokyo MA as an example of a sub-economy, and show that a typical CP-structure was developed also within the Tokyo MA.

First, we device Japan into the following three macroregions by aggregating 47 prefectures:

Japanese Core (J-Core) = Tokyo and Kanagawa (the core of Tokyo MA) + Aichi (containing Nagoya MA) + Osaka and Hyogo (the core of Osaka MA)

Japanese Semi-Core (J-Semi-Core) = Pacific belt zone excluding the J-Core[7]

Japanese Periphery (J-Periphery) = the rest of Japan

That is why, if they have their way, they will stay in clusters.”

[6] This Section is based mainly on Fujita and Hisatake (1999).

Figure 2.1.7 shows the national shares of each region in regional GDP, employment (EMP), manufacturing GDP (M-GDP), and manufacturing employment (M-EMP) over the period of 1955 to 1995.

[7] More precisely J Semi-Core consists of the following 18 prefectures: Ibaraki, Saitama, Chiba, Shizuoka, Gifu, Mie, Kyoto, Nara, Wakayama, Okayama, Hiroshima, Yamaguchi, Kagawa, Ehime, Fukuoka, Oita, Saga, Nagasaki.

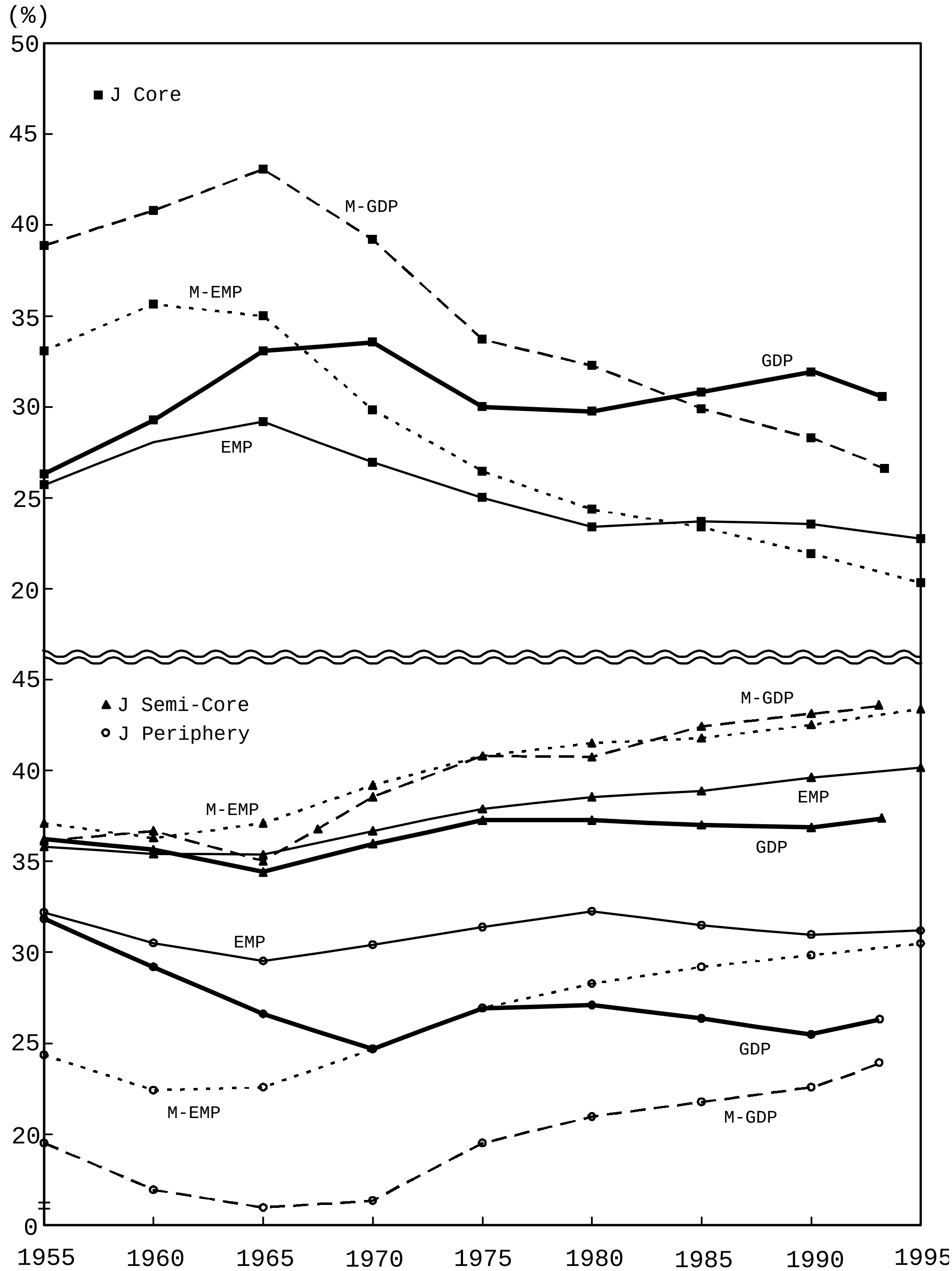

Figure 2.1.7 Regional shares of GDP, Employment, M-GDP and M-Employment;

Source: Annual Report on Prefectural Accounts (1995) and Population Census of Japan (1995).

As the figure indicates, in 1955 (when Japan just recovered from WWⅡ), each of the three regions had almost the same GDP-share and EMP-share in the national economy. This means that in 1955, the average labor productivity was almost the same in the three regions. However, we can see from the top part of the figure that the ratio of GDP-share over EMP-share, i.e., the average labor productivity, in the J-Core increased rapidly from 1955 to 1970, and it continued to increase slowly over the most period since 1975. In contrast, in the bottom part of the figure, from the GDP-share and EMP-share curves for the J-Periphery, we can see that almost the opposite trend occurred in the J-Periphery. Meanwhile, in the middle part of the figure, the ratio of GDP-share over EMP-share remains almost constant.

We can conclude, therefore, that after 1955, Japanese regional economy quickly developed a typical Core-Periphery structure (having a semi-core region in the middle), which essentially remains the same today. This also indicates that the J-Core rapidly developed strong agglomeration economies after 1955 which are still retained today.

Next, focusing on manufacturing industries, we can see from Figure 2.1.7 that the manufacturing sector in the J-Core had a relatively high labor productively already in 1955, whereas the opposite holds for the J-Periphery. Furthermore, the rapid growth of the M-GDP share in the J-Core indicates that the rapid growth of the J-Core in the initial period (since 1955) was led by the concentration of manufacturing industries there, which suppressed the growth of the J-Periphery (in relative terms). However, since the mid 1960s, both the M-GDP share and M-EMP share of the J-Core have been declining steadily until recently, while the GDP share of the J-Core remains high since the mid 1960s (although there was a slight decline in the mid 1970s). This means that in the J-Core, while the 'hollowing-out' of manufacturing continued since the mid 1960s, its growth since then has been led mainly by the growth of service industries having high labor productivity. In must be noted, however, that the labor productivity of manufacturing in the J-Core has continued to increase (relative to the national average) even after the mid 1960s because its shares of M-GDP and M-EMP have been declining in parallel while the former is always higher.

In contrast, in the J-Semi-Core, both the shares of M-GDP and M-EMP have been steadily increasing since the mid 1960s. That the two share curves are almost the same means that the labor productivity of manufacturing in this area coincides with the average of Japan. We can also see from Figure 2.1.4 that since the mid 1960s, the J-Semi-Core has been (slightly more) specialized in manufacturing (than in services). Finally, in the J-Periphery, both the share of M-GDP and M-EMP has been steadily increasing since the late 1960s. That the two curves are parallel while the M-GDP share is always much higher than the M-EMP share means that the labor productivity of manufacturing in the J-Periphery has been always much lower than the national average.

Summarizing the observations above, we can conclude that a sort of 'flying geese pattern' of interregional manufacturing relocation occurred also within Japan.[8] That is, the manufacturing first grew rapidly in the J-Core, then a little later it grew fast in the J-Semi-Core, and then a bit later in the J-Periphery. However, the labor productivity in manufacturing has been always the highest (the lowest) in the J-Core (in the J Periphery).

2.2. Urban Agglomeration and City Size

2.2.1. Productivity and city size: statistical tendencies

Productivity tends to be higher in larger cities because of agglomeration economies. This is in fact necessary to compensate for higher living costs in larger cities due to higher commuting and housing costs. Figure 2.2.1 depicts the relationship between production per worker and city size (in natural logarithm) for MEA's in 1995.[9] Although the two variables have positive correlation, there are wide variations in labor productivity among smaller MEA's. One reason for this is difference in capital stock. Figure 2.2.2 shows that private capital per worker varies widely among cities of similar sizes. It also shows that correlation between private capital per worker and city size is very small. The social overhead capital also has wide variations but it has fairly strong negative correlation with city size, as shown in Figure 2.2.3. This reflects a strong tendency to use public investment for income redistribution between regions: more public investment has been allocated to regions with lower income levels. Figures 2.2.4 and 2.2.5 show that private capital and social overhead capital have completely opposite relationships with production per worker.

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[8] We discuss in further detail the 'flying geese pattern' of manufacturing relocation in East Asia, in Section 4.
[9] In this diagram, both variables are in natural logarithms. The city size is represented by the number of workers who work in the MEA.

Figure 2.2.1 Production per worker and city size in natural logarithm

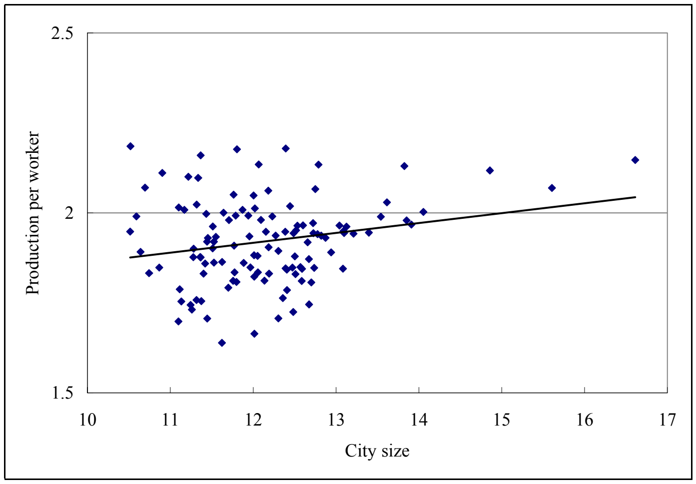


Figure 2.2.2 Private capital per worker and city size in natural logarithm

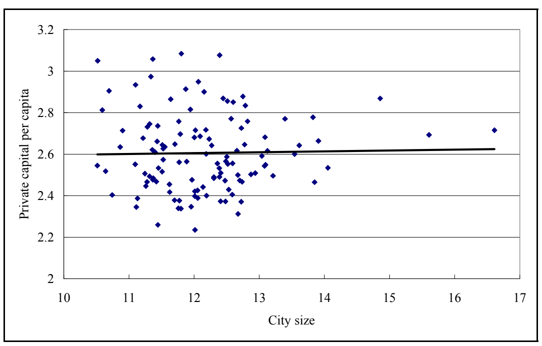


Figure 2.2.3 Social overhead capital per worker and city size in natural logarithm

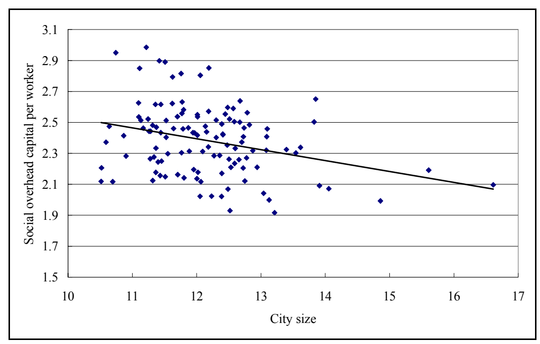


Figure 2.2.4 Production and private capital per worker in natural logarithm

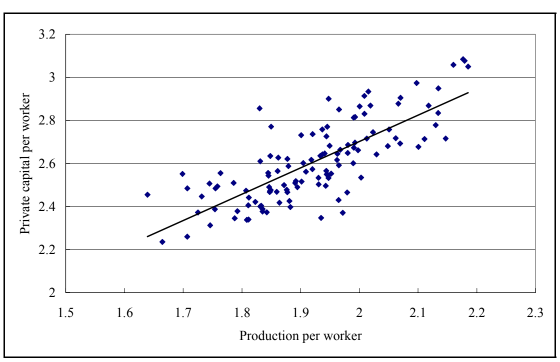
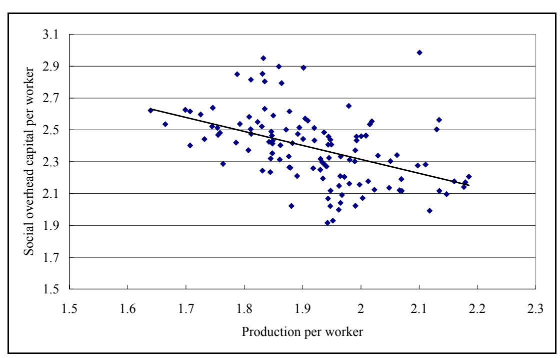


Figure 2.2.5 Production and social overhead capital per worker in natural logarithm



2.2.2. The Tokyo Problem

An obvious policy question to ask concerning urban agglomeration is whether or not the actual city size is close to the optimum and, if not, what can be done. In Japan, many people argue that the concentration of economic activities in Tokyo is excessive. The population of the Tokyo metropolitan area exceeds 30 million and congestion in commuter railways is almost unbearable. However, it is also true that Tokyo is very convenient for business interactions because almost everyone a businessperson wants to talk to is located in downtown Tokyo. In order to check whether Tokyo is too large or not, we have to compare the agglomeration economies with a variety of deglomeration economies such as longer commuting time and congestion externalities.

The relocation of capital has been a hot policy issue in Japan. The House of Representatives adopted the resolution on the Relocation of the Diet and Other Organizations in 2000 and the selection process of the new city has been under way since then. At the moment however there is no sign that actual relocation will occur in the new future. In order to evaluate the impacts of relocation of capital, we need to have a good understanding on the magnitude of inefficiencies that are caused by the current city size distribution.

The Henry George Theorem and a Test for Optimal City Size

Any policy discussions in economics must start with the identification of the sources of market failure. The optimal city size balances urban agglomeration economies with deglomeration forces, and the first task is to check if these two forces involve significant market failure. On the agglomeration economy side, a variety of micro-foundations are possible for agglomeration economies, including simple-minded Marshallian externality models (e.g., in Chapter 2 of Kanemoto, 1980) and new economic geography (NEG) models, as reviewed in Duranton and Puga (2004) in this volume. Although the NEG type models do not have any technological externalities, agglomeration economies that they produce involve market failure similar to them. That is, urban agglomeration economies are external to each individual or firm and a Pigouvian subsidy to increase agglomeration may improve resource allocation. This suggests that agglomeration economies are almost always accompanied by significant market failure.

Kanemoto (1990) illustrates this point by reinterpreting the non-monocentric city model developed by Imai (1982) and Fujita and Ogawa (1982). Imai (1982) and Fujita and Ogawa (1982) interpret spatial interactions among firms as technological externalities, but they can be reinterpreted as the market transactions of intermediate inputs. The reinterpreted model does not have any technological externalities, but they yield locational externalities. These locational externalities do not arise if there are no scale economies in production, since without them all commodities can be produced in the backyard of each house. When scale economies exist, the locational decision of a firm changes transportation and communication costs of its trading partners, resulting in locational externalities. Although NEG models do not have explicit spatial structure within a CBD, they yield the same type of externalities.

On the deglomeration economy side, technological externalities such as traffic congestion certainly exist. Commuting costs per se however do not produce market failure and the magnitude of market failure appears to be smaller on the deglomeration side although we do not yet have quantitative estimates.

In addition to these problems, the determination of city size involves market failure due to lumpiness: a city must be large enough to enjoy benefits of agglomeration, but it is almost impossible to create a new city of some size. If we have too few cities, individual cities tend to be too big. In order to make individual cities closer to the optimum, a new city must be added. It is however difficult to create a new city of large enough size that can compete with the existing cities. The decentralized market mechanism therefore fails to yield the optimum number of cities.

These two types of market failure are concerned with two different 'margins'. The first type represents divergence between the social and private benefits of adding one person to a city, whereas the second type involves the benefits of adding another city to the economy. In order to test the first aspect, we have to estimate the sizes of external benefits and costs. We have not seen any serious empirical work in this direction. The second aspect can be tested by invoking the so called Henry George Theorem. In the simplest case where the only agglomeration forces are externalities among firms in a city and the only deglomeration forces are commuting costs of workers who work at the center of the city, then the optimal city size is achieved when the total Pigouvian subsidy for the agglomeration externalities equals the total differential urban rent.

An implication of the Henry George Theorem is that the per-capita income is not likely to be maximized at the optimal city size. The total urban differential rent is very large in a large city, which implies that agglomeration economies are not exhausted at the optimal city size, i.e., the Pigouvian subsidy is positive and the aggregate production function for a city exhibits increasing returns to scale.

Empirical Tests

Kanemoto, Ohkawara and Suzuki (1996) and Kanemoto and Saito (1998) attempt to test the Henry George Theorem. A direct test of the Henry George Theorem is very difficult because good land rent data are not available and we have to rely on land price data instead. The conversion of land prices into land rents is bound to be inaccurate in Japan where the price/rent ratio is extremely high and has fluctuated enormously. Roughly speaking the relationship between land price and land rent is

land price = land rent / (interest rate - rate of increase of land rent).

In a rapidly growing economy, the denominator tends to be very small and its small change results in a big change in land price. The total real land value of Japan tripled from about 600 trillion yen in 1980 to about 1,800 trillion yen in 1990, and then fell to about 1,000 trillion yen in 2000.

Instead of testing the Henry George Theorem directly, they compute the ratio between the total land value and the total Pigouvian subsidy for each metropolitan area and see if there is a significant difference between different levels of hierarchy of cities. Their hypothesis is that cities form a hierarchical structure where Tokyo is the only city at the top. Equilibrium city sizes tend to be too large at each level of hierarchy. Divergence from the optimal size cannot differ much between cities at the same hierarchical level because otherwise utility levels would differ significantly across cities and intercity migration would result. The divergence from the optimum could, however, be significantly different between different levels of hierarchy. At a low level of hierarchy the divergence tends to be small because it is relatively easy to add a new city when existing cities are too large. For example, moving a headquarter or a factory of a large corporation can easily result in a city of 20 thousand people. In fact, the Tsukuba science city that was created by moving national research laboratories and a university to a middle of nowhere now has a population of more than 500 thousand. At a higher level it becomes more difficult to create a new city because larger agglomerations are more difficult to form. For example, the population size difference between Osaka and Tokyo is close to 20 million and making Osaka into another center of Japan would be almost impossible. Kanemoto, Ohkawara and Suzuki (1996) therefore test whether the divergence from the optimum is larger for larger cities, in particular if the ratio between the total land value and the total Pigouvian subsidy is significantly larger for Tokyo than for other cities.

The total Pigouvian subsidy is computed by estimating an aggregate production function for the Integrated Metropolitan Areas[10]. The estimated equation has a simple Cobb-Douglas form:

$$\ln(Y/N) = A_0 + a_1 \ln(K/N) + a_2 \ln N + a_3 \ln(G/N),$$

where Y, K, N, and G are the total production, the private capital stock, the labor force, and the social overhead capital in a metropolitan area. The estimates of coefficient a_3 for the social overhead capital turn out to be negative in both studies although they are not statistically significant for larger metropolitan areas. As discussed later, this result reflects the tendency that infrastructure investment is more heavily allocated to low-income regions.

The coefficient a_2 indicates the degree of increasing returns to scale in urban production. Under the assumption that without urban agglomeration economies the production function is homogeneous of degree one with respect to capital and labor, this coefficient represents the elasticity of urban agglomeration, i.e., the percentage increase in urban production due to 1% increase in labor force in an urban area. The estimates of a_2 range between 0.01 and 0.07, where it tends to be higher for larger urban areas.

The total Pigouvian subsidy in a city is computed as $PS = a_2 Y$, and this is compared with the total land value. A number of heroic assumptions are necessary for this formulation. Most important among them are the following two. First, production requires only labor and private capital so that in the absence of agglomeration economies $a_2 = 0$. Second, no agglomeration economies exist on the consumption side.

Kanemoto, Ohkawara and Suzuki (1996) find that the total land values are very high compared with the total Pigouvian subsidies in all cities, but the ratio for Tokyo is slightly below the average for 17 largest cities in Japan. Kanemoto and Saito (1998) changed the metropolitan area definition to SMEA and used a different land price data to obtain the opposite result. The ratio between the aggregate land price and the total Pigouvian subsidy for the Tokyo metropolitan area is 68.9, which is much higher than the average of largest twenty metropolitan areas, 40.9.

Directions for future research

These two studies are very preliminary and many more elaborations are necessary for reliable estimates. First, the estimation of the aggregate urban production function is rather crude in a number of respects. For example, they use simple OLS estimates that might involve simultaneous equation biases, and they do not estimate the magnitudes of agglomeration economies on the consumption side. A significant number of articles have estimated urban agglomeration economies in Japan, using different sets of data and estimation techniques. These studies indicate directions for future research.

First, Tabuchi (1996) and Tabuchi and Yoshida (2000) explicitly deal with simultaneous equation bias, either by adding a supply side equation or by using instrument variables. Dekle and Eaton (1999) introduce jurisdictional (prefecture) dummies in a panel data estimation to reduce simultaneous equation bias. Nakamura (1985) augments a translog production function with a cost-share equation, which might have contributed in reducing simultaneous equation bias. These studies suggest that the uses of instrument variables, panel data estimation techniques, and cost share equations should be considered in the next step.

Second, Kawashima (1975), Nakamura (1985), and Tabuchi (1986) use two-digit manufacturing industry data and explore differences among the industries. Dekle and Eaton (1999) examine manufacturing and financial services industries and find considerable difference between them. The use of industry-level data might improve the reliability of estimates.

Third, Dekle and Eaton (1999) and Tabuchi and Yoshida (2000) estimate dual forms such as cost functions and indirect utility functions, and Tabuchi (1986) estimates a labor productivity equation derived from a CES production function. Estimating a dual function instead of a primal production function is another direction.

Fourth, Tabuchi and Yoshida (2000) estimate agglomeration economies on the consumption side, using a dual approach. They find that urban agglomeration economies are significant on the consumption side as well as on the production side. Production-side agglomeration economies are about 10% and those on the consumption side are about 7 to 12%. Both of these estimates are high compared with those of other studies. This may be caused by their choice of land price variables. They use average land

[10] See footnote ?? in Section 2.1 for various definitions of metropolitan areas in Japan.

prices in commercial areas for land prices for both office and housing use. Commercial land prices tend to be extremely high in large metropolitan areas, which may have caused their high estimates of agglomeration economies. It is of interest to know how sensitive the estimates are to the choice of land price data.

Fifth, following the pioneering work of Mera (1973), many studies try to estimate the productivity of social overhead capital. Examples are Asako, et al. (1984), Yoshino and Nakano (1994), (1996), Mitsui, et al. (1995), Kanemoto, Ohkawara and Suzuki (1996), Iwamoto, et al. (1996), Kanemoto and Saito (1998), Doi (1998), Yoshino and Nakajima (1999), and Shioji (2001a). Most of these studies (exceptions are Kanemoto, Ohkawara and Suzuki (1996), Kanemoto and Saito (1998), Yoshino and Nakano (1996), and Yoshino and Nakajima (1999)) ignore urban agglomeration economies. Introducing both social overhead capital and agglomeration economies is obviously necessary. As noted above, however, a simple OLS tends to produce negative coefficients for social overhead capital, reflecting the fact that public investment is used for income redistribution among regions[11].

Sixth, agglomeration economies can be dynamic and raise productivities in subsequent years. Saito (1998), in a framework similar to that of Glaeser, Kallal, Scheinkman, and Shleifer (1992), estimates dynamic externalities in the Japanese manufacturing sector using 2 digit-level data. Empirical studies on dynamic agglomeration externalities are closely related to those on the convergence hypothesis for regional incomes (Barro and Sala-i-Martin (1991, 1992) and Shioji (2001b)). Shioji (2001a) uses a dynamic model of economic growth to estimate the contribution of overhead capital.

Seventh, Karato (2000) and Hatta and Karato (2001) propose a novel approach that looks at variations in office rents within a single city. Their hypothesis is that higher employment density raises the productivity of firms in central cities, which is reflected in higher land rents. Hatta and Karato compute the percentage increase in total production in the Tokyo CBD caused by a percentage increase in employment in five subareas. According to their estimates, the elasticity is 0.01 for Marunouchi area (which is the center of the Tokyo CBD) and 0.0064 for Shinjuku (which is one of the largest subcenters

[11] This is another simultanesous equation bias problem. Iwamoto, et al. (1996) points out the importance of simultaneous equation bias caused by the government policy of allocating more infrastructure investment to low-income regions. They propose three approaches to avoid the simultaneous equation bias. The first is to use the fixed effect approach in the estimation of panel data. The second approach is to aggregate samples to several groups according to income levels. The third approach disaggregates regional output into primary, secondary and tertiary sectors although input variables other than labor are not disaggregated.

within the CBD). These figures are much lower than those estimated using aggregate data for cities. The relationship between micro-level and macro-level estimates has not been studied yet, and this is one of the fruitful directions for future research.

In addition to the estimation of urban agglomeration economies, there are a number of issues that have to be examined. For example, the magnitudes of congestion externalities such as traffic congestion must be estimated. The land value data are rather crude and improvements are necessary. There is also a theoretical problem that the Henry George Theorem may not hold in a second best situation. This is a serious issue because the main part of urban agglomeration economies arises from locational externalities in an NEG type spatial economy. A market equilibrium in a model of this type is not in general Pareto optimal. As far as we know, Abdel-Rahman and Fujita (1990) is the only one that explicitly examines whether or not the Henry George Theorem holds in an NEG type model. Their result is that, in a model where the Dixit-Stiglitz type structure is assumed for intermediate products, the Henry George Theorem holds even in the second best. We do not expect that this result is general, but it is possible that the Theorem holds approximately in a more general setting.

2.3. Spatial Distribution of Economic Activities

In this section, we look at the location patterns of industries and of population in 1980/1981 and 1999/2000 (where population data is available for 1980 and 2000, while industrial data for 1981 and 1999). Our discussion draws at will from Mori, Nishikimi and Smith (2003).[12]

We begin with the description of data. The geographic unit we consider is the metro area. The definition of a metro area adopted here is the Metropolitan Employment Area (MEA) (refer to Section 2.2.1). We identified 105 MEAs in 1980 and 113 in 2000. Both the definition of counties and the county population data employed are based on the Population Census of Japan in 1980 and 2000.[13] The employment data used are classified according to the three-digit Japanese Standard Industry

[12] While very few attempts have been made to characterize the overall patterns of economic location in Japan, many case studies of location patterns of population and individual industries in Japan have been accumulated by geographers. Kitamura and Yada (1977) reported detailed historical industrial geography of Japan since 19th century, and in particular, concerning the formation of industrial belt along the Pacific coast connecting Tokyo through Fukuoka during the high-growth period in the 1960s. Inoue and Ito (1989) and Yada and Imamura (1991) focus on Kyushu region, while Itakura (1988) puts emphasis on Tohoku region. See also Kosugi and Tsuji (1997), Seki and Fukuda (1998), and Shimohirao (1996) for case studies of the localization of specific industries.

[13] The county here is equivalent to the shi-cho-son in the Japanese Census.

Classification (JSIC) taken from the Establishment and Enterprise Census of Japan in 1981 and 1999, and applied to the respective population data in 1980 and 2000. Since industrial classifications have been disaggregated for most sectors during this 20-year period, we have attempted to reconcile the two classifications by aggregating the 1999 classification. Among the three-digit JSIC-industries, we focus here on three broad sectors, namely, manufacturing, services, wholesale and retail, which together include 264 industries.[14]

To establish the regularities discussed in the introduction of this section, it is essential to identify for each industry the set of MEAs in which that industry operates (i.e., employment is positive), defined as the *industry-choice MEAs* for that industry. Industry-choice MEAs for a given industry can be considered as the viable locations for that industry. Indeed, the literature suggests that there is a persistence of industrial locations: once an industry has successfully located in an area, the size of this industrial presence will tend to grow over time even in the presence of high turnover rates of establishments.[15] This is also supported by our own data which indicates that between 1981 and 1999, the number of industries in operation in more than 90% of MEAs has increased. The number of industry-choice MEAs for a given industry can then be considered as reflecting the *degree of localization* for that industry. For instance, Speaman's rank correlation between the number of industry-choice MEAs and the raw measure of geographic concentration *G* of Ellison and Glaeser (1997) calculated at the county level is greater than 0.9.

2.3.1. Number-Average Size (NAS) Rule

Figure 2.3.1 shows the relationship between the number and average (population) size of industry-choice MEAs for each three-digit industry in 1980/1981 and 1999/2000.[16]

[14] The set of sectors includes 125 manufacturing, 90 services, and 49 wholesale and retail industries, for which data are publicly available. It is also to be noted that industries (such as tobacco) which belong to public sector are excluded. See Mori et al. (2003) for more details.

[15] Henderson et al. (1995) argue that one-standard deviation increase in the proportion of 1970 local employment in a specific industry results in 30% increase in 1987 employment controlling for urban size, current labor market conditions, etc. See also Henderson (1997) for a related discussion. Dumais et al. (2002) report for the case of the US that nearly three-fourths of plants existing in 1972 were closed by 1992, and more than a half of all manufacturing employees in 1992 did not exist in 1972.

[16] The plots by sectors (manufacturing, service, wholesale and retail) are available in Mori et al. (2003). Manufacturing is the most diverse in terms of the number of industry-choice MEAs, while wholesale and retail are the most ubiquitous, locating in more than 78% of MEAs. Note that each plot is independent from the others.

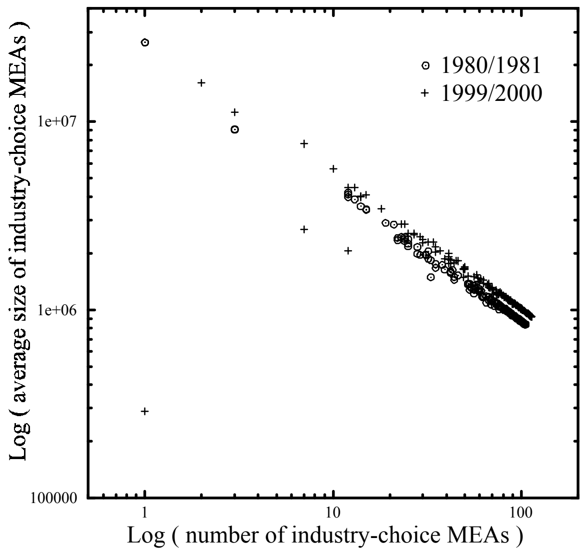


Figure 2.3.1: Size and number of industry-choice MEAs

Except for three outliers in 1999/2000,[17] the relationship is clear: *average size* ($\overline{\text{SIZE}}$) *is strongly log-linearly related to the number of industry-choice MEAs* (#MEA). The OLS estimation gives the following result:

$$1980/1981: \log(\overline{\text{SIZE}}) = \underset{(0.005193)}{7.376}{}^{**} - \underset{(0.002750)}{0.7204}{}^{**}\log(\#\text{MEA}), \quad R^2 = 0.9962, \qquad (2.3.1)$$

$$1999/2000: \log(\overline{\text{SIZE}}) = \underset{(0.004232)}{7.427}{}^{**} - \underset{(0.002750)}{0.7124}{}^{**}\log(\#\text{MEA}), \quad R^2 = 0.9975, \qquad (2.3.2)$$

where the values in parentheses are standard errors, and ** indicates the coefficient to be significant at 1% level. It should be clear by inspection that the actual significance levels are off the chart (with *P*-values virtually zero). Moreover, this relationship is also seen to remain quite stable over time (see Mori et al. (2003) for more details). The results of this analysis show that only the intercepts are significantly different (at 5% level) between the two periods, while the slope, i.e., the elasticity between the number and average size of industry-choice MEAs, has been invariant overtime (with a 1% increase in the number of MEAs chosen by an industry corresponding approximately to an expected decrease of 0.7% in the average sizes of these MEAs).

However the intercept change does reflect a significant effect, namely a differential shift between the

[17] One of the three outliers is coke manufacturing, while the other two are arms-related industries. The latter two outliers may be attributable to the fact that while arms-related industries are technically in the private sector, location decisions in these industries are heavily influenced by government policies in Japan. In addition, it should be mentioned that tobacco manufacturing has been excluded from the analysis, because it was classified in the public sector in 1981. By 1999 tobacco was privatized. Hence it is of interest to note that this industry is also an outlier in 1999, and that this again may be attributable to government policies before privatization.

numbers of industry-choice MEAs and the average size of those MEAs. On the one hand, there has been a dispersion of industries, as reflected by a 12.4% average increase in the numbers of industry-choice MEAs. On the other hand, the average size of industry-choice MEAs has increased by only 10.4%. Given that the number and average population size of MEAs increased by 7.6% and 16.7%, respectively, one would have expected to see a smaller increase in the number of industry-choice MEAs and a larger increase in the average size of industry-choice MEAs. Clealy, there has been *a trickling down of industries from bigger MEAs to a larger number of smaller MEAs*,[18] tending to lessen the effect of population growth.

Despite the similarity of the slopes of these two log-linear regressions, it is worth noting that this trickling down effect is very significant. While both MEA sizes and numbers of industry-choice MEAs have increased, they have done so in a manner which leaves their elasticity invariant. In other words, the percent change in average industry-choice MEA sizes relative to percent change in numbers of industry-choice MEAs has remained essentially constant. Hence this empirical regularity appears to be much stronger, and suggests the presence of a fundamental invariance relation governing the location of industries. As a parallel to the well-known Rank-Size Rule for city size distributions (see the chapter by Gabaix and Ioannides in this Handbook), this new relation is designated as *the Number-Average Size (NAS) Rule* for industrial location patterns.[19]

2.3.2. The Hierarchy Principle

The basic mechanism behind the Hierarchy Principle described in the introduction is related to one of the most distinctive features of industrial location behavior observed in a domestic economy. Since interregional migration is generally less costly (than international one), firms are attracted mainly by the absolute advantage of locations. As a result, certain advantageous location are seen to attract a disproportionately large number of industries, leading to greater variation in industrial diversity among locations. Hence, a smaller city can attract only a subset of industries located in larger cities. Recent

[18] This trickling down effect is reported also by Mano and Otsuka (2000). They conclude that the main factor leading this effect is considered to be the congestion costs.

[19] For different geographic units such as counties and prefectures, the relationship is less clear. See Mori et al. (2003) for more details.

theoretical development for the principle has focused mainly on the production and demand externalities. In the context of new economic geography, such externalities can be shown to lead to the formation of industrial agglomeration consistent with the Hierarchy Principle (Fujita, Krugman and Mori (1999)).

The presence of an industrial hierarchy can be observed for MEAs in Japan has been shown by Mori et. al (2003) as in Figure 2.3.2 below.[20] Here MEAs are ordered on the horizontal axis by their industrial diversities (i.e., numbers of industries they contain), and industries are ordered on the vertical axis by their numbers of industry-choice MEAs. Hence each point "+" in the figure represents the event that the MEA in that column contains the industry in that row.

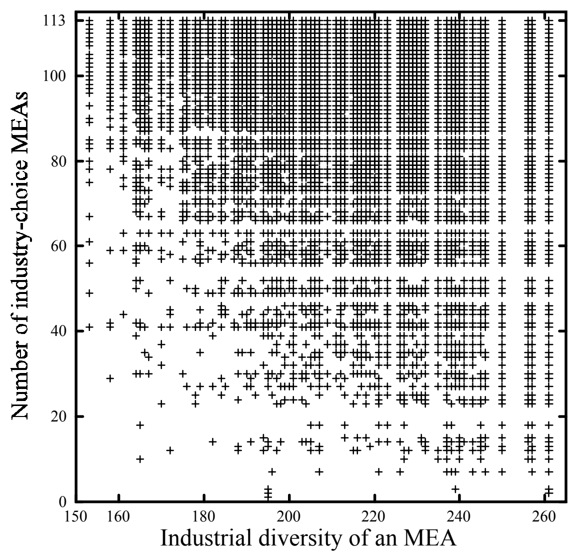


Figure 2.3.3: Hierarchy Principle (1999/2000)

Notice that the points are more sparse near the southwest corner, thus meaning that the industries with a smaller number of locations are found mainly in MEAs with large industrial diversity. On the other hand, MEAs with small industrial diversity tend to have more ubiquitous industries (i.e., those locating in a large number of MEAs). Mori et. al (2003) have shown that the actual location pattern shown in the figure is highly consistent with the Hierarchy Principle (i.e., the actual industrial hierarchy is highly non-random) even after controlling for the relative industrial diversities among MEAs.[21]

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[20] See Takahara (1999) for a related case study for the case of Japanese cities.

[21] It is to be noted that for the testing purpose, Mori et al. (2003) redefined the principle as follows. *An industrial location pattern is said to satisfy the Hierarchy Principle if industries found in a given MEA are also found in all MEAs with diversities at least as large*. The Christaller's definition of the principle (i.e., with respect to the population size of MEAs), any attempt to relocate population along with industries will necessarily change the population distribution, and hence, create certain ambiguities in the interpretation of the principle itself. Moreover, there is close agreement between the rankings of MEAs in terms of diversity (i.e., the number of industries in

Now, let us discuss on the relationship between the Hierarchy Principle and the specialization of MEAs. Though the Hierarchy Principle makes no assertion about the relative employment sizes of industries in each MEA, *under this principle, it is natural to expect that the employment within any given industry should be greater in larger MEAs.* To check this, Mori et al. (2003) calculated Spearman's rank correlations between the employment size of each industry in an MEA and the population size as well as diversity of an MEA. This correlation only fails to be significant (at the 5% level) for population size and/or diversity in 33 [resp., 18] of the 264 industries in 1980/1981 [resp., 1999/2000]. The average rank correlations are 0.61 and 0.50 [resp., 0.62 and 0.61] with population size and diversity, respectively, in 1980/1981 [resp., 1999/2000]. Thus, the above claim does hold approximately, though it is by no means universal.

One possible reason for the imperfect correlation between size/diversity and industry employment in MEAs is that the Hierarchy Principle itself does not hold perfectly in reality (as we have seen). Some medium size MEAs are highly specialized in a few industries that deviate from the Hierarchy Principle, and correspond more closely to Henderson (1988)'s "specialized cities". Henderson emphasizes industry-specific localization economies as a source of city formation. In addition, he notes (Henderson (1997)) that medium/small size cities (with population size smaller than 500,000) tend to exhibit the strongest specialization. In 1999/2000, more than 10% of total employment was concentrated in a single MEA for 48 industries, among which 17 are in small/medium MEAs. Typically, the specialization of these MEAs is based on immobile resources (e.g., wood material and liquor manufacturing), historical background (e.g., explosive assembling), or plant-level scale economies (e.g., steel manufacturing, metal and alloy rolling).

2.3.3. A relationship between industrial location and city size

Given the strong evidence above for both the NAS Rule and the Hierarchy Principle, we now present a possible relationship between these two empirical regularities. As stated in the introduction, it turns out that in the presence of the Hierarchy Principle, the NAS Rule is essentially identical to perhaps the most

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operation) and population size (Speaman's rank correlation is greater than 0.9). See More et. al (2003) for a further discussion.

widely known empirical regularity in all of economic geography, namely the Rank-Size Rule for city size distributions. This rule asserts that if cities in a given country are ranked by (population) size, then the rank and size of cities are log-linearly related:

$$\text{Log } SIZE = \sigma - \theta \log RANK. \qquad (2.3.3)$$

Moreover, the estimate of θ is usually close to one. Although there is no definitive evidence for the Rank-Size Rule, the recent literature suggests that the observed rank-size relationships are too close to this rule to be dismissed as irrelevant.[22] For the Japanese MEAs, we have obtained the estimated values, θ=0.95 (R^2=0.95) for 1980 and θ=1.00 (R^2=0.95) for 2000. Takahashi (1982) reports that θ=0.93 (R^2=0.99) in as early as 1875.

The following relationship among the NAS Rule, the Hierarchy Principle and the Rank-Size Rule is shown to hold by Mori et al. (2003): *under the Hierarchy Principle, the Rank-Size Rule holds with scale parameter $\sigma>0$ and exponent $\theta\in(0,1)$ if and only if the actual industrial locations satisfy the NAS Rule for industries with a sufficiently large number of industry-choice MEAs with scale parameter $\sigma/(1-\theta)$ and exponent θ.*[23] In the sequel, we check whether this result is consistent with data.

For 1999/2000, Figure 2.3.3 shows plots of (a) NAS distribution: average size versus the number of industry-choice MEAs for each industry, (b) upper-average distribution: average size of the largest MEAs up to each rank, and (c) rank-size distribution: size versus rank of MEAs. Notice that plot (b) gives the upper bound for plot (a). The plot indicates that for industries with the number of industry-choice MEAs greater than 10, the average size of the industry-choice MEAs almost coincides with its upper bound. This reflects the fact that during this period, Japanese industries appear to be quite consistent with the Hierarchy Principle. Namely, if this principle holds, then for any given number of industry-choice MEAs, the average size will always be as large as possible within the given city size distribution.

Notice also that plot (b) is almost log linear. It can be shown (Mori et al. (2003)) that the log linearity of plot (b) could very well be a consequence of log linearity for the MEA rank-size distribution in plot (c), even though log linearity in (c) is not nearly as strong as in (b). This discrepancy could be due

[22] See the chapter by Gabaix and Ioannides for the review of literature on the rank-size rule (or closely related Zipf's law) for cities.

to the fact that convergence to log linearity for the upper average (plot (b)) is expected to be faster than for the rank-size distribution (plot (c)).[24] Of course, however, this could also be due to a number of other factors. As one of these, observe that failure of log linearity in plot (c) is most evident for small MEAs with populations less than 300,000.

Note also that there is a clear difference between the slopes of the log-linear regression for plot (b) [▪ 0.7] and plot (c)[▪ 1.0]. Again this discrepancy is heavily influenced by the small MEAs. One possible explanation is provided by Gabaix and Ioannides. They show that if the size distribution of MEAs follows Zipf (1949)'s law, the OLS estimate of θ is upward biased. But, Mori et al. (2003) proposed an alternative explanation provided that the rank-size distribution of MEAs is asymptotically log linear as suggested by the almost log linear upper-average curve (b). Note that while plot (b) and plot (c) must coincide at rank 1, plot (c) should lie strictly below plot (b) for ranks greater than or equal to 2. Thus, fitting a log-linear curve to rank-size distribution (c) would likely produce the estimated slope steeper than that for the upper-average plot (b), i.e., the log-linear part of the rank-size distribution.[25]

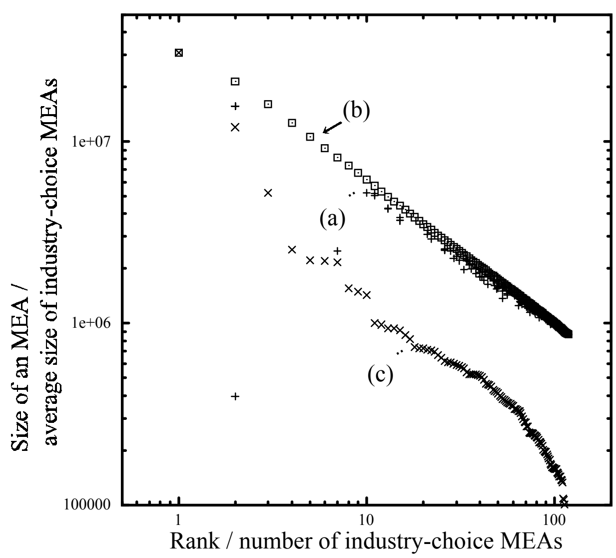


Figure 2.3.3: The Rank-Size Rule and the NAS Rule (1999/2000)

[23] Note that θ is necessarily smaller than 1 for the relation between population size and rank of cities to make sense. See Mori et al. (2003) for more details.

[24] Theorem 2 in Mori et al. (2003) asserts that if the rank-size distribution is asymptotically (i.e., for sufficiently small cities) log linear, then the convergence of the upper-average distribution to log linearity is expected to be faster, which is not surprising given that averaging is a smoothing operator.

[25] In fact, for the rank-size range that appears reasonably log linear (i.e., if the largest three MEAs and those smaller than population size 30,000 are excluded), the estimate of the log-measured slope of the rank-size distribution (plot (c)) is -0.76 (R^2=0.99).

2.3.4. Implications for regional development

The empirical regularity observed in the relationship between industrial and population location presented above appears to have some important implications for regional development policies. A main regional policy objective is to identify those industries that are potentially sustainable in a given region (MEA). The results so far presented suggest that *such sustainability* depends not only on region-specific factors, but *also on the global structure of the regional system*. Such global consideration are often ignored in regional industrial policy decisions. In fact, there may be little freedom in the location pattern of industries, as there is a stable relationship between the number and size of MEAs in which a given industry can successfully locate. In particular, with respect to size, the Hierarchy Principle suggests that there is a *critical MEA size* for each industry, and that only MEAs with sizes greater than this level can provide viable locations for that industry. Hence to attract such high-order industries, it would appear that MEAs should focus first on attracting the lower-order (feasible) industries that will most help to stimulate regional growth. More generally, knowledge of prevailing global industrial location patterns should enhance the efficiency of regional industrial development policies.

2.3.5. Concluding remarks

As a final remark, we would like to comment on the more foundamental issue regarding the geographic scale at which the regularity emerges in the space-economy. As most literatures on the Zipf's law or the Rank-Size Rule, the present analysis has focused on global industrial location patterns at the national level. But, in the same way that "administrative cities" can be questioned as the relevant geographic unit, one may ask whether countries are indeed the relevant geographic collection of units. While there is no question that national boundaries are generally sharp barriers in terms of both population and industrial location, it nevertheless may often be true that certain groups of regions within a given country represent more meaningful spatial economic systems than the entire country itself. For example, in the same way that commuting patterns are used to defined MEAs, one may take the patterns of interregional travel behavior to define relatively coherent subsystems of regions within national economies. (For example, in Japan, it appears that there is a natural nesting of three regional systems based on interregional travel flows: "Tokyo"⊃"Osaka"⊃"Nagoya", as discussed in Mori et al. (2003)). From this viewpoint, it is then natural to ask whether empirical regularities of industrial location patterns are more readily identified at these subsystem levels. In particular, are these regularities the same as those at the national level, or are they qualitatively different? This seems to be an exciting topic for future research.

2.4 Globalization in East Asia

2.4.1. Introduction

Thus far, we have examined the spatial distribution of economic activities in Japan and in the next section we will look at China. In the increasingly borderless world economy, however, it is intuitively obvious that the changes in the spatial distribution of economic activities in one country are closely related with those in the rest of the world, in particular, with those in the neighboring countries. In this section, while still focusing on Japan, we present some empirical data which support the conjecture above. First, in Section 2.4.2, we examine the relationship between the changes in the location of manufacturing industries within Japan and those in the rest of East Asia. Then, in order to supplement the "macro analyses" of industrial location in the previous section, in Section 2.4.3 we focus on the nine largest electronics MNFs of Japan, and study the transformation of their global production system. Section 2.4.2 is based mainly on Fujita and Hisatake (1999), whereas Section 2.4.3 on Fujita and Ishii (1999).

2. 4.2. Regional Structure of manufacturing industries in East Asia and Japan

The rapid growth of many countries in East Asia, or the so-called "Asia's Miracle," during the last few decades demonstrates that the economic growth tends to be highly concentrated also internationally. In particular, the spectacular collapse of financial markets in these countries in the late 1990s, following that of Japan, indicates how strongly the entire economy of East Asia is integrated.

The growth process of East Asia's economy has been likened to the "formation of flying geese." Although there seems to exist no clear definition of the flying geese pattern of economic development, here we loosely interpret it as follows.[1] A group of countries located in geographical proximity (in the present case, East Asia) achieves a rapid economic growth, mainly through market mechanism, by

[1] As is well-known, the term of "flying geese" originates in the "flying geese theory" of economic development proposed by Akamatsu (1937). Here, our interpretation essentially follows that of Hatch and Yamamura (1996, p.27). The flying geese theory is closely related to the "product cycle theory" introduced by Vernon (1966). The former

deepening the international division of labor in industrial production such that the most developed country (Japan), or the "lead goose", becomes more and more specialized in technologically advanced industries by successively shedding industries in which she no longer holds a comparative advantage; these industries, in turn, locate in the nearby, less developed countries (Asian NIEs), or the "following geese": in turn, over time, these developing countries upgrade their own industrial structures by themselves shedding outdated industries to the neighboring, less developed countries (ASEAN and China), and so on.

To explain "Asia's Miracle," a variety of hypotheses have been proposed, ranging from cultural explanations to statism approach. Not denying the valuable insights offered by these hypotheses, we provide below empirical data which suggest that linkage-based agglomeration economies have been at work in such a process of economic development in East Asia.

We focus on Japan, and nine other countries in Asia (Asia-9): NIES 4 (Republic of Korea, Taiwan, Hong Kong and Singapore), ASEAN 4 (Philippines, Thailand, Malaysia and Indonesia), and China. We call Japan and Asia-9 countries together East Asia, of which total population in 2000 is approximately 1.6 billion. Given that the distance between Tokyo and Singapore is about the same as that between New York and San Francisco, East Asia has roughly the same geographical extent as that of the U.S.

The first column of Table 2.4.1 shows the extent of Japan's economic dominance in this region. That is, in 1990, Japan, having only a 3.5% area and 7.9% population of East Asia, accounted for the 72% GDP, and 67% manufacturing GDP.[2] The second column, in turn, shows the extent of the dominance of Japanese economy itself by its core region (J-Core). Here the J-Core, defined in Section 2.1.2, represents the five prefectures that contain the core parts of the three major metropolitan areas of Japan. As shown in the table, the J-Core with just a 5.2% area accounted for the 33% population, 40% GDP and 44% M-GDP of Japan in 1990. This leads to the third column, indicating that for the entire East Asia, the J-Core with a mere 0.18% of total area accounted for 29% of both GDP and M-GDP.

	Japan share in East Asia	J-Core share within Japan	J-Core share in East Asia

observes the same phenomena from the view point of a developing country, while the latter from the view point of a developed country.

[2] International GDP-related figures in Table 2.4.1 and Figure 2.4.1 are based on exchange rates of corresponding years reported in the *International Financial Statistics Yearbook* (IMF).

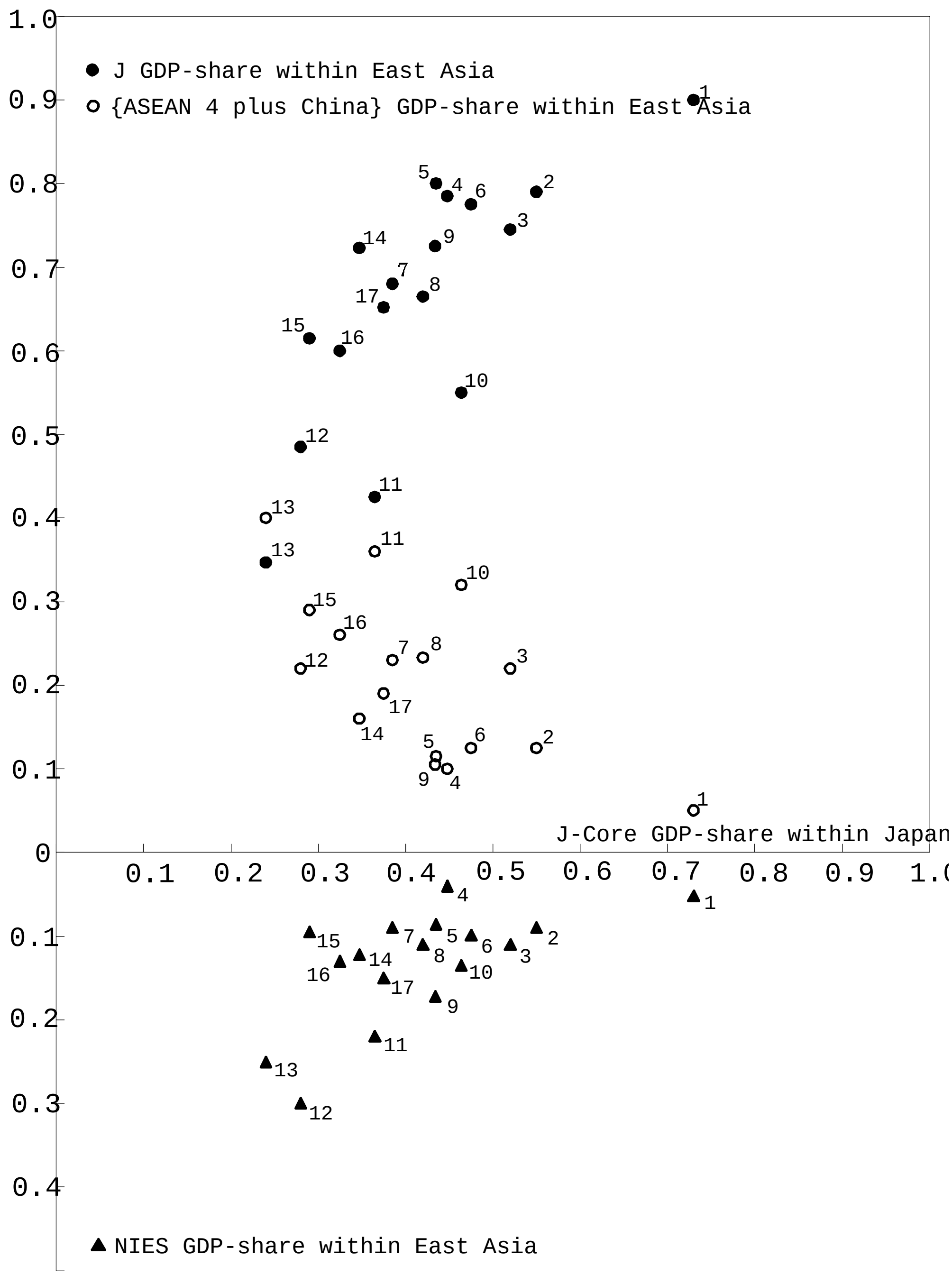
Area	3.5%	5.2%	0.18%
Population	7.9	33	2.5
GDP	72	40	29
M-GDP	67	44	29

Table 2.4.1 Concentration of economic activity within Japan and East Asia in 1990.

Source: National Economic Statistics (Japanese E.P.A.) and *Key Indicators of Developing Asian Pacific Countries* (Asian Development Bank).

Given that the (financial) capital became rather freely movable internationally by the early 1980s and that both labor and capital are almost perfectly mobile within Japan, these astonishing concentrations of economic activity in both Japan and the J-Core would be hard to explain without taking account of some kind of agglomeration economies.

To investigate the nature of such agglomeration economies, here we focus on manufacturing, and present in Figure 2.4.1 the regional structure of manufacturing industries in Japan and East Asia in 1985.



1. Publishing and printing, 2. Transport equipment, 3. Machinery (non-electrical), 4. Electrical machinery, 5. Precision instruments, 6. Fabricated metal products, 7. Basic metal, 8. Chemical and chemical products, 9. Plastic products, 10. Rubber products, 11. Textile, 12. Wearing apparel, 13. Petroleum and coal products, 14. Paper and paper products, 15. Non-metallic mineral products, 16. Food, beverage and Tobacco, 17. Others

Figure 2.4.1 Regional structure of manufacturing industries in Japan and East Asia in 1985.

Source: Census of Manufactures (Japan) and *Industrial Statistics Yearbook* (United Nations).

The entire manufacturing is divided into 17 industries as denoted in the bottom of the figure. The horizontal axis in the figure represents for each industry the GDP share of the J-Core region within Japan. The vertical axis for black dots shows for each industry the GDP share of Japan within East Asia; the vertical axis for white circles shows (for each industry) the GDP share of {ASEAN 4 plus China} within East Asia.

We can see an apparent positive-correlation between the two indices for Japan, indicating that *the more highly Japanese industries concentrate in the J-Core, the more strongly they dominate in East Asia*. In contrast, the set of white circles for the {ASEAN 4 plus China} looks almost the mirror image of the set of black dots for Japan, implying that *these countries are stronger in those industries which are less agglomerated in the J-Core.*[3]

In particular, two groups of industries in the figure present interesting and contrasting cases for Japan. One is the machinery-metal group, consisting of industries 2, 3, 4, 5, 6 and 7, which locate together in the upper-middle (next to industry 1) of the figure. The position of this group of Japanese industries in the figure suggests another strong case of linkage-based agglomeration economies at work. In fact, Michael Porter (1990) discusses extensively how such linkage-based agglomeration economies have been realized by this group of industries in Japan.

The contrasting case is presented by the textile-apparel group (industries 11 and 12). Until the late 1950s, this textile-apparel group constituted a major part of manufacturing activity in both Japan and J-Core. In 1955, for example, this group accounted for the 15% of the total manufacturing GDP in Japan, of which 45% was concentrated in the J-Core. As shown in the figure, however, in 1985 Japan was among the weakest in these industries (within East Asia), and they are among the least agglomerated in the J-Core.

Although Figure 2.4.1 is about 1985, let us also consider 1990 and 1993, and examine statistically how the relationship changed over time. To do so, let

[3] Given that Asian NIES 4 are relatively specialized in industries 9, 10, 11, 12 and 13, no clear correlation exists between the two indices for this group of countries. Notice also that industry 10 is rather exceptional in Figure 2.4.1 because this industry includes both synthetic rubber and crude rubber, the former (the latter) is relatively strong in Japan (in ASEAN).

$$X = \frac{GDP_{J-Core}}{GDP_J}, \qquad Y = \frac{GDP_J}{GDP_{A9} + GDP_J}$$

Variable X represents the measure on the horizontal axis in Figure 2.4.1, whereas Y the measure on the vertical axis for Japan (i.e. for black dots). Figure 2.4.1 indicates that X and Y exhibit a concave relationship. Hence, instead of a direct linear-regression of X and Y, let us introduce an intermediate variable,

$$Z = \frac{GDP_J}{GDP_{A9}}$$

representing the ratio of Japanese GDP over A9 GDP, and assume that

$$Z = a + bX \quad □ □□□□□□□□□□□□ \quad (2.4.1)$$

Then, it holds identically that

$$Y = \frac{Z}{1+Z} = \frac{a+bX}{1+a+bX}$$

which proves concavity in X.

The linear regression of equation (4.1) for each of the three years yields the results in Table 2.4.2.

year	a	b	R^2
1985	-3.24	13.9 ** (t=7.87)	0.885
1990	-2.17	12.1 ** (t=7.79)	0.896
1993	-2.09	11.0 ** (t=8.87)	0.917

Table 2.4.2 Regression of equation 4.1 (**: significant in 1%)

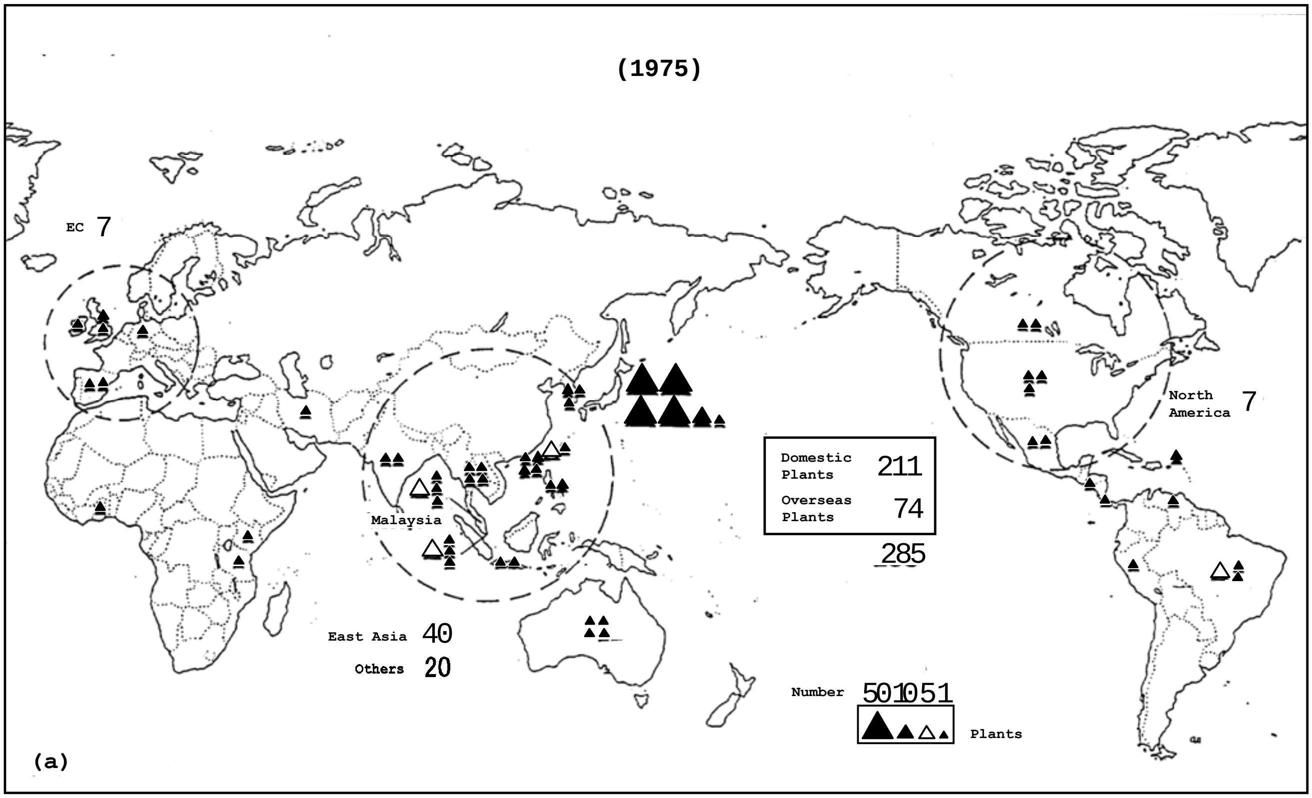
We can see from Table 2.4.2 that there is a strong relationship between the degree of the dominance of each Japanese industry in Asia (measured by its GDP share in Asia) and the degree of the agglomeration of that industry in the J-Core. Furthermore, the coefficient b in Table 2.4.2 in 1985, for example, indicates that if the degree of agglomeration of an industry in the J-Core increases 10%, then the Z-ratio for that industry will becomes 139% larger. However, Table 2.4.2 shows that the value of coefficient b becomes smaller with time, suggesting that the agglomeration economies of the J-Core relative to the rest of Japan and East Asia are weakening over time.

2.4.3 Globalization of Japanese multinational firms

In Section 2.1.2, we discussed briefly about the rapid expansion of the overseas operations of Japanese multinational firms (MNFs) during the second cycle (the mid 1970s to the mid 1990s) of the regional transformation in Japan which led to the Tokyo monopolar system observed today. In order to present additional empirical data supporting previous discussions on MNFs, in this section we focus on the nine largest electronics firms in Japan, and study the transformation of their global production system over the period of 1975 to 1994. In particular, we investigate how their global location behavior affected the transformation of the Japanese regional system. The firms considered are Hitachi, Matsushita Electric, Toshiba, NEC, Mitsubishi Electric, Fujitsu, Sony, Sanyo Electric and Sharp, of which total sales in 1990 were almost 200 billion dollars. As we have seen in Figure 2.1.6, the electronics industry is the largest and most rapidly growing among all manufacturing industries in Japan since the mid 1970s, which is dominated by the nine MNFs above.[4]

In Figure 2.4.2 (resp., Figure 2.4.3), we present the changes in the global distribution of the production plants (resp., R&D facilities) of these nine firms between 1975 and 1994.

[4] Our discussion below includes the activities of the worldwide subsidiaries of these nine firms. Furthermore, throughout this section, the term ‘electronics’ should be understood broadly to include both electric and electronic products.



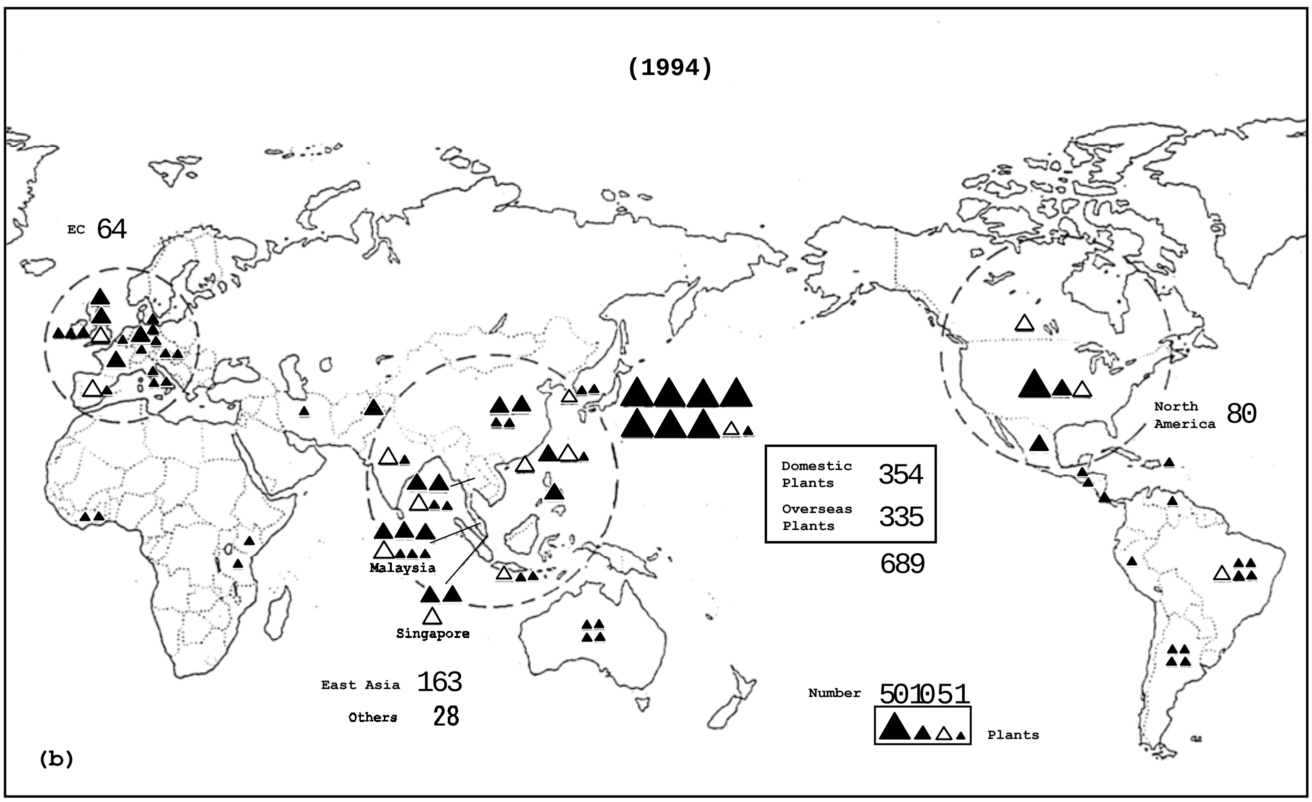
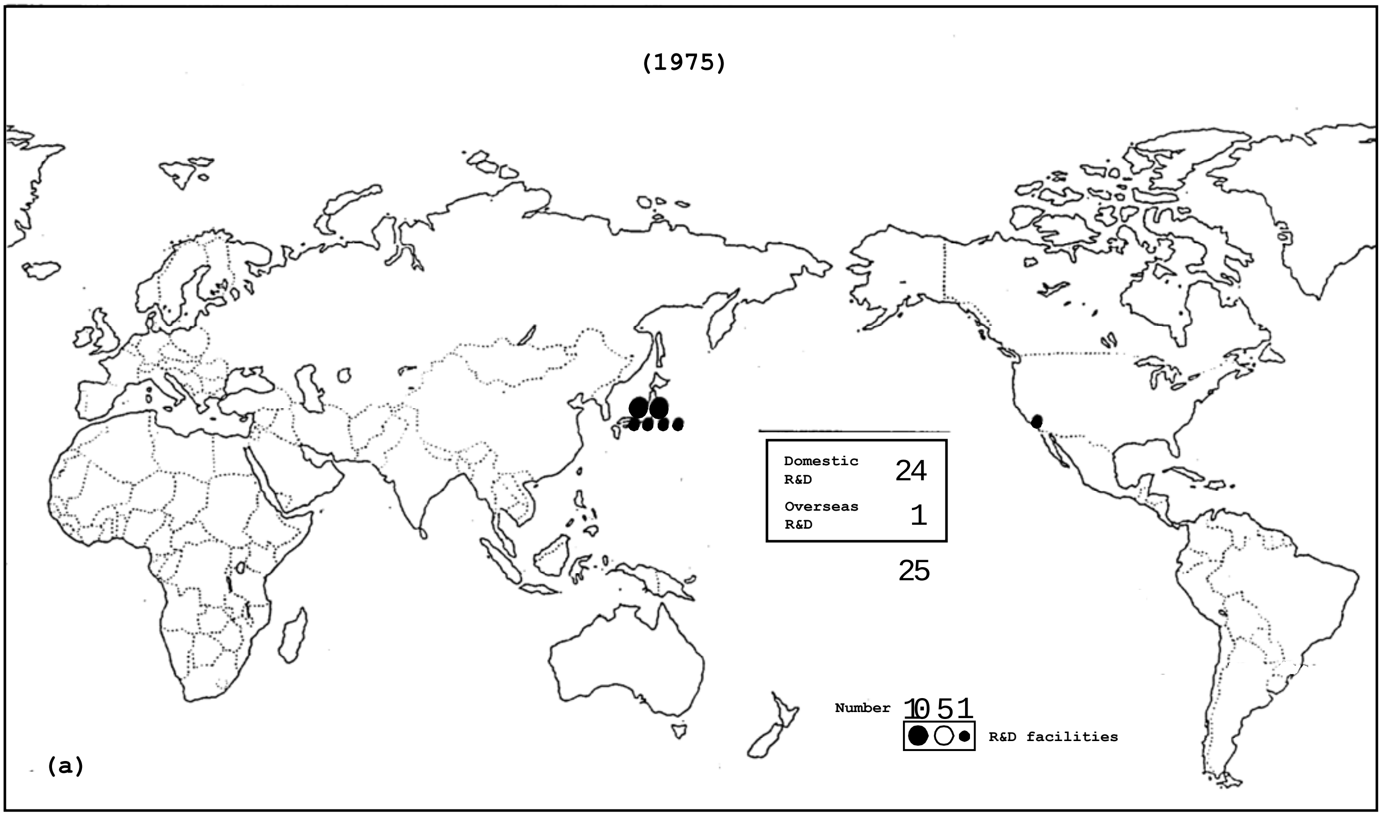


Figure 2.4.2 Location of the production plants of nine Japanese electronics firms in 1975 and 1994;

Source: Fujita and Ishii (1999)



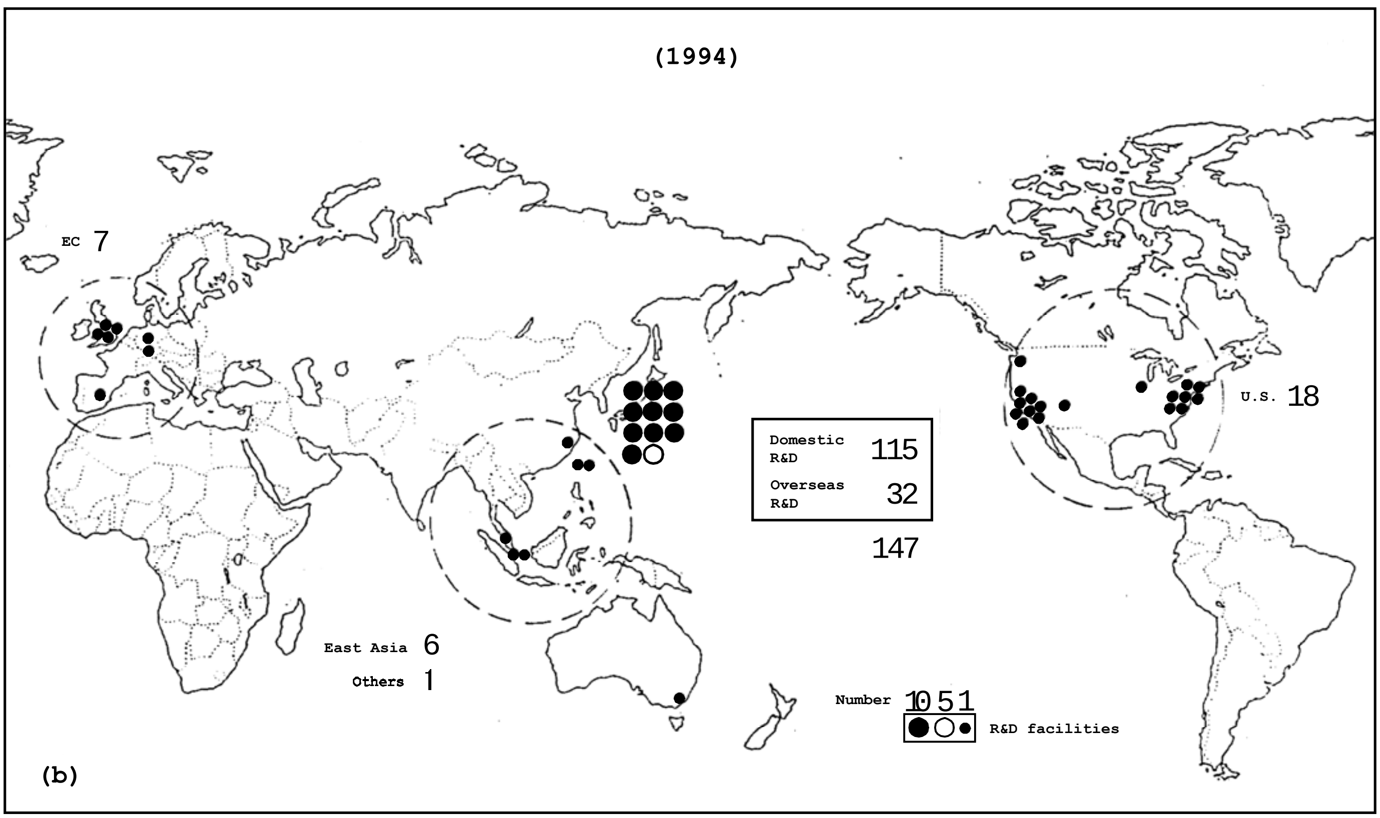


Figure 2.4.3 Location of R&D facilities of nine Japanese electronics firms in 1975 and 1994;

Source: Fujita and Ishii (1999)

As can be seen from Figure 2.4.2, over the 19-year period from 1975 to 1994, the number of worldwide manufacturing plants owned by the nine Japanese firms increased more than twice from 285 to 689. In particular, while the number of domestic plants increased about 70% (from 211 to 354), that of overseas plants jumped 4.5 times (from 74 to 335). As a consequence, in 1994 the nine firms had roughly the same number of plants in Japan and overseas. Their overseas plants are mostly concentrating in East Asia, North America and the EU. The number of plants in East Asia increased greatly from 40 to 163, most of which have been serving as exporting platforms to the global markets while taking advantage of low wages elsewhere in the region. The number of plants in North America and the EU also increased greatly from 7 to 80 and from 7 to 64 respectively, to serve the big markets in these countries.

Next, Figure 2.4.3 indicates that over the same 19-year period, the nine firms greatly expanded their R&D capacity in Japan (from 24 to 115 laboratories) and in the USA (from 1 to 18, mostly located in California State and the Northeast Coast). Several R&D laboratories were also established in the EU. The number of overseas R&D laboratories (of the nine firms) in East Asia is very small in comparison with that of their manufacturing plants, which indicates the spatial division of labor among global regions being developed by the firms.

By the mid 1990s, each of the nine firms developed a very advanced global network for the integrated operation of its entire value-chain including the management, R&D, production, procurement, distribution, sales operations worldwide. Figure 2.4.4 summarizes the locational tendencies of organizational units of the nine firms in 1994. As can be seen from the figure, each unit has a different locational tendency. (In these figures, MA refers to the Tokyo and Osaka MAs, while Non-MA represents the rest of Japan.)

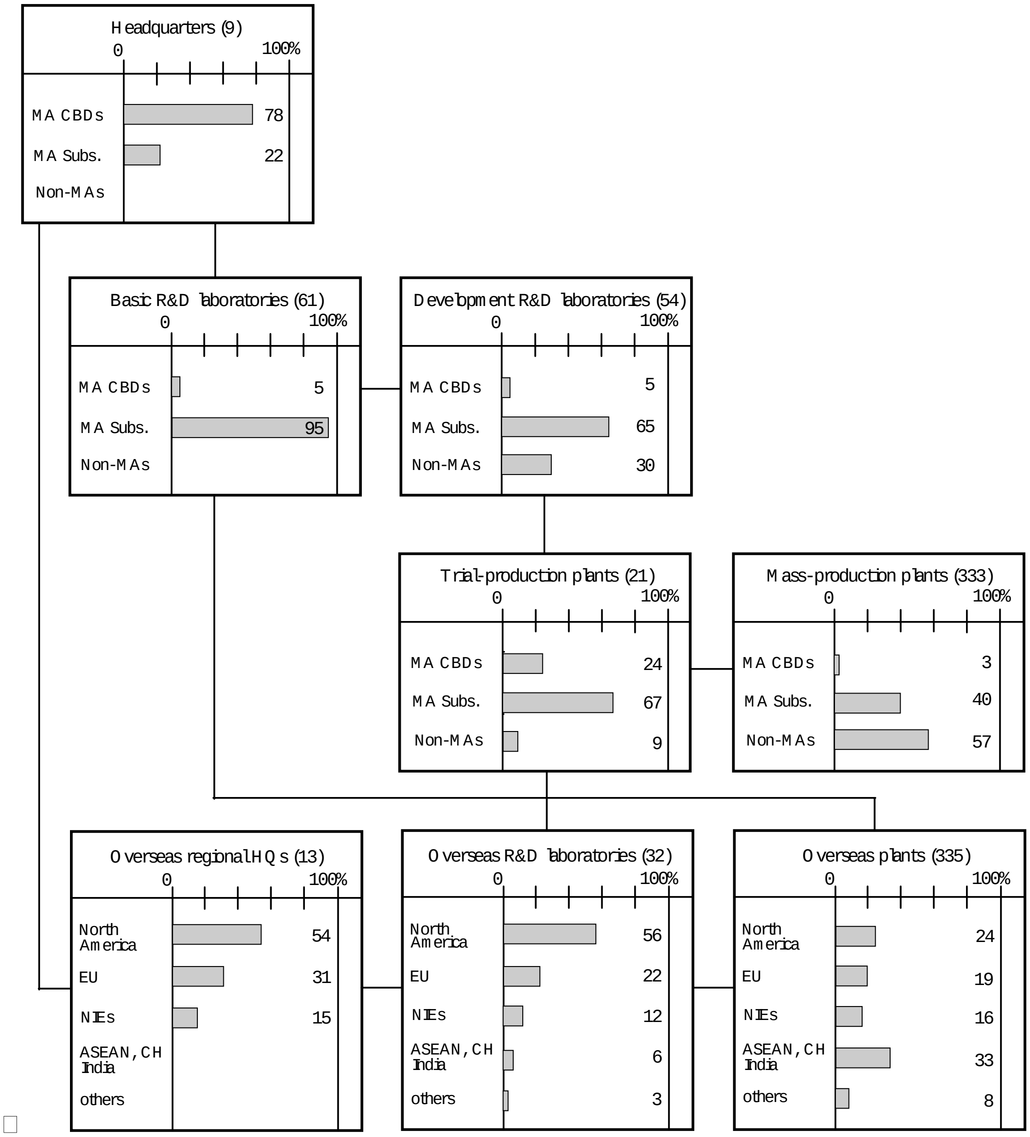


Figure 2.4.4 Locational tendencies of organizational units of the nine Japanese electronics firms in 1994; Source: Fujita and Ishii (1999)

As shown in the top box in Figure 2.4.4, all HQs are located in the two primary MAs in Japan (i.e. six in the Tokyo MA and three in the Osaka MA), and are mostly in the CBDs. The figure also indicates that all their basic R&D laboratories (R&D controlled by HQs) are located in the two MAs, where 95% is situated in their suburbs. Furthermore, 65% of development R&D laboratories are located in the suburbs of the two MAs and 30% of them in nonmetropolitan areas mostly together with mother plants). The middle two boxes in Figure 2.4.4 indicates that trial-production plants, which are closely related to their HQs and R&D laboratories in terms of information exchange, are mostly located in the two MAs (24% of them in the CBDs and 67% in their suburbs). In contrast, domestic mass-production plants are much more dispersed: 40% of them located in the suburbs of the two MAs, while 57% in nonmetropolitan areas of Japan. Next, as indicated in the bottom three boxes of Figure 2.4.4, overseas regional HQs are located either in North America (7 in the USA), the EU (3 in the UK and 1 in Germany), or East Asia (2 in Singapore). Fifty-six per cent of overseas R&D laboratories are located in the USA, while 22% of them are in the EU, and 12% in East Asia. Finally, overseas production plants are dispersed throughout the world: specifically, in North America (24%), the EU (19%), NIEs (16%), ASEAN together with China and India (33%), and the rest of the world (8%).

From Figure 2.4.4, we can conclude that the knowledge-intensive activities (such as HQs, R&D laboratories and trial-production plants) of the nine Japanese electronics firms are mostly concentrated in the Tokyo and Osaka MAs, while their mass-production plants are dispersed throughout Japan and overseas countries. In fact, this phenomenon is common to almost all MNFs based in Japan (regardless of their industrial types). It is interesting to note that this dual spatial trend (i.e. the increasing agglomeration of knowledge-intensive activities into the primary cities and the global dispersion of mass-production plants) emerged from the dual nature of recent developments in communications technologies and transportation networks. That is, as noted previously in Section 2.1.2, the recent development of computer integrated manufacturing (CIM) methods enables the complex production technologies to be embodied in capital, and thus reduces the skill-requirements of workers in standard production operations. In addition, the development of telecommunication technologies is vastly improving the speed, reliability and capacity of communications; furthermore, the costs of such communications are less sensitive to distance. Therefore, by effectively combining CIM methods with modern telecommunication technologies, large firms (which have accumulation of know-how and R&D capability as well as sufficient capital) can rather freely choose the location of their mass-production plants. Thus, the location of mass-production plants follows basic local (non-agglomeration) factors such as availability of disciplined workers, basic infrastructure, low wage rates and low land prices.

Therefore, new mass-production plants do not follow the urban hierarchy, but tend to disperse themselves to nonmetropolitan areas in Japan and even overseas. In contrast, the technological and managerial knowledge/information has the characteristic of *local public goods* which can be shared/exchanged among agents, most effectively through face-to-face communications. Therefore, these knowledge-intensive or information-oriented activities favor close clustering in the primary cities due partly to the convenience of face-to-face communications and more generally to enjoy the agglomeration economies which are generated by accumulated knowledge and information there.

In particular, the fact that the leading activities of the Japanese economies have recently been changing from material-production to informationoriented or knowledge-intensive activities has been bringing about a major transformation of the traditional Japanese regional system centered around Tokyo, Osaka and Nagoya to a new system dominated by Tokyo, i.e. the *Tokyo-monopolar system*, as has been explained in Section 2.1.2. Furthermore, the dual aspects of the recent spatial reorganization of Japanese MNFs (i.e. the concentration of their knowledge-based activities in the primary cities, and the establishment of most of their new mass-production plants overseas by skipping the peripheral regions of Japan) partly explains the recent renewed trend in the increasing income differential between the core and peripheral regions of Japan, as shown in Figure 2.1.4.

3. Urbanization in China

China with a de facto urban population of about 500 million has the largest urban population and system of cities in the world.[26] In 1996, there were over 650 cities, defined as agglomerations of over 100,000 urban residents. This section will argue that the history of policy in China has resulted in an urbanization process where these cities are significantly undersized and agglomeration economies not fully exploited. Cities tend to be over-capitalized relative to the rural sector and there is nationally a high degree of individual and regional income inequality. Coastal cities and regions have been favored at the expense of the hinterlands. We will explore these and other key features of spatial development in China, the underlying policies, and the dimensions of the costs of particularly restrictive policies.

Before starting, to have some sense of the geography of urban China and vocabulary of the urban sector, we examine key city definitions and maps. Cities have an administrative hierarchy. At the top are cities with the administrative powers of a province: Beijing, Tianjin and Shanghai, with the recent addition of Chongquing (originally part of Sichuan) -- followed by prefecture level cities of which there are about 225. Provincial and prefecture level cities administer large land areas, comprised of urban districts forming the city proper and huge ex-urban areas, or rural counties. The definitions of city proper are updated regularly to roughly comprise the contiguous urbanized area of the prefecture, surrounding the nuclear city -- a good definition of the metropolitan area, by international standards. Below prefecture level cities are county-level cities -- either traditional county cities or townships that have evolved into cities. These county-level cities can also administer large rural areas, but there is generally no breakdown between the urban and ex-urban portions, making it difficult to count de facto urban populations.

In Map 3.1, we show provinces for reference in the text. In Map 3.2, we show by city size category all cities in 1996 based on city proper populations for prefecture level cities and total populations for county-level cities. We name the cities over 3m population for reference. Given prefecture level cities contain large non-urban populations, Map 3.3 shows city size categories by non-agricultural employment and Map 3.4 shows growth categories in terms of non-agricultural employment for 1990-96, for cities present in 1990. As we will detail later in Table 3.1, the number of cities grew by 6% a year from 1990-96 and non-agriculture employment in 1990 cities by

4.3% a year, creating and reflecting enormous urban-economic change in China. Data are from the annual volumes of the Urban Statistical Yearbook of China and Cities China 1949-1998, augmented by discussion in Chan (1994).

The maps reveal particular spatial features of China. There are huge coastal concentrations of population around Shanghai and Guanzhou in Map 3.2, the two southern river delta areas. However there are also huge hinterland populations, with a swath of large cities in the central region and near western region. Sichuan province in the (south-) west has over 100m people (including Chongqing), more than almost all other countries in the world. But the far western minority areas of Tibet, Xinjiang, Qinghai and Gansu contain vast tracks of mostly arid land and low population, and are outside most of the discussion in this paper and cut-off in maps 3.2-3.4.

Besides this basic layout of cities, China has a number of key features to its urban system that we note in section 3.1. Then in section 3.2, we turn to a discussion of urban policy from 1950 on, which has led to these features and the geographic layout in the maps. Finally in section 3.3, we review empirical evidence on some of the key issues facing the urban system in China.

3.1. Some Key Feature of the Urban System

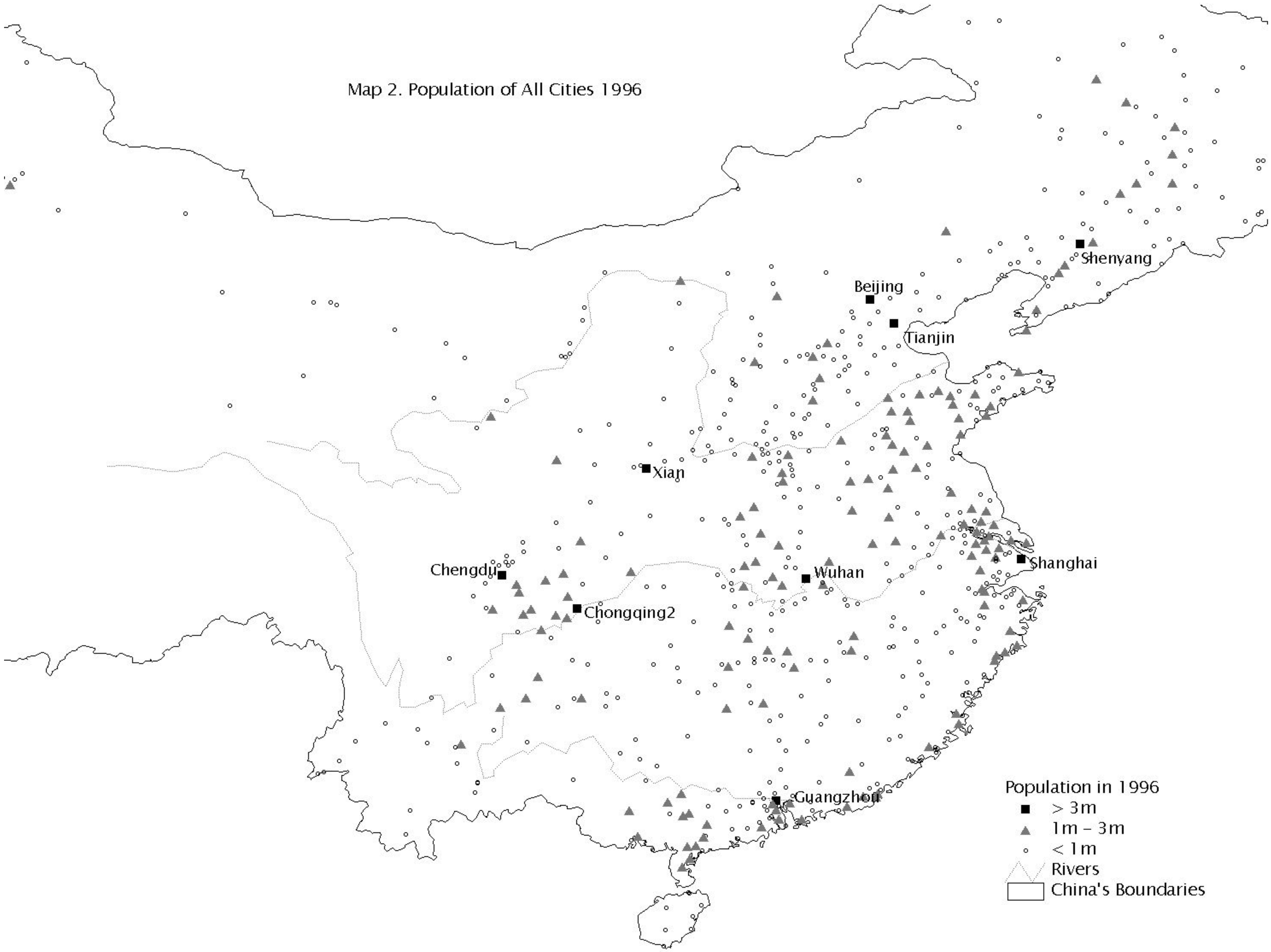
3.1.1 Low Urban Concentration

Chinese cities are relatively small and equal sized, compared to most countries. The UN puts the population of Shanghai metro area, the largest city, at 12.3m in 2000, although its city proper is only listed at 10.7m in 1998 (with little growth). In either case this is well below the populations of the 10 largest metro areas in the world. More critically is that China only has 9 metro areas with populations over 3 million (Map 3.2) while it has another 125 or

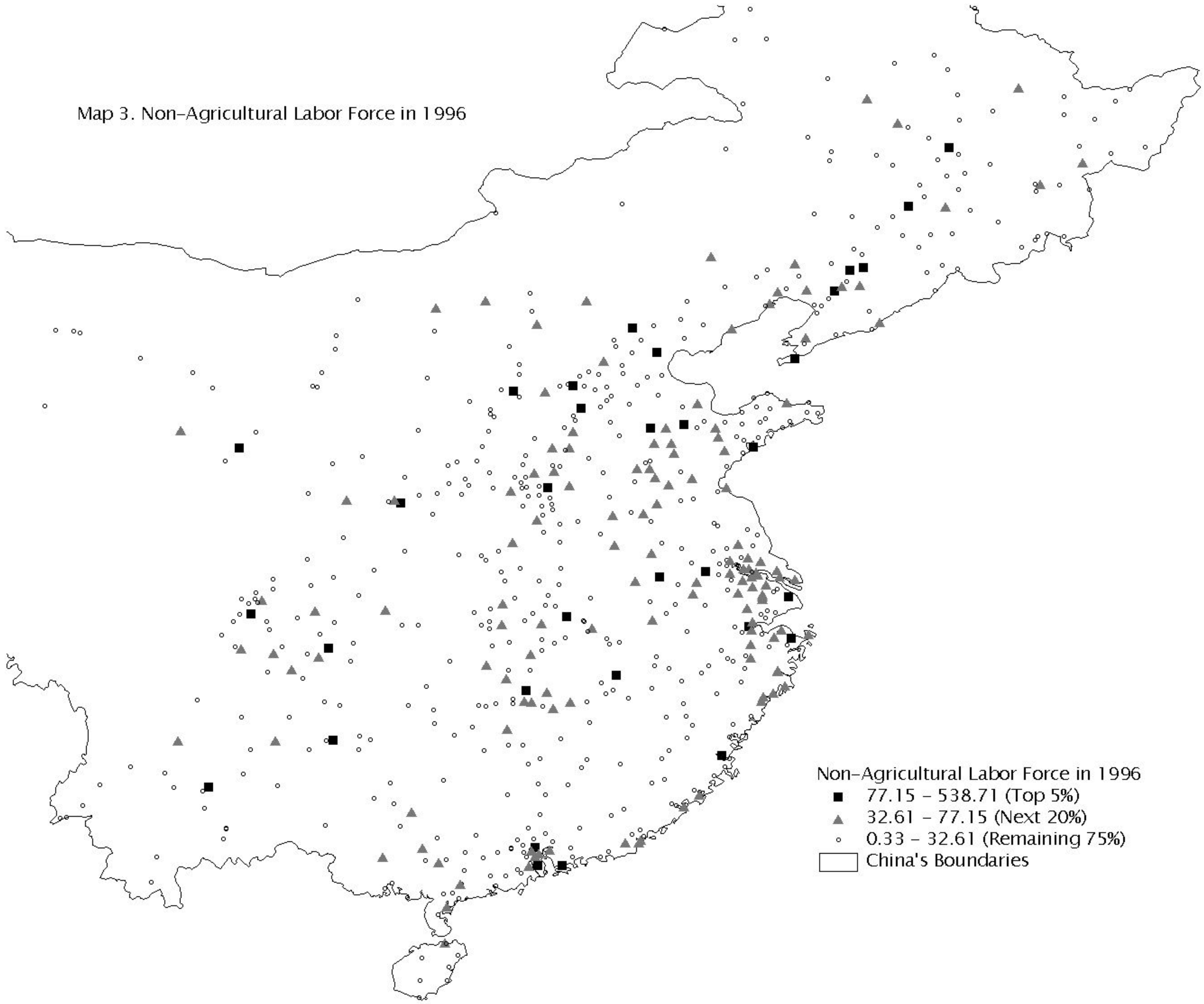
[26] China's definition of urban has varied over the last 10 years with the stated percent urban ranging from about 30% up to 43% (SSB in 1996). Based on international standards, most observers ascribe an urbanization level nearer the 40-45% range. See Ebanks and Cheng (1990) and Chang (1994, 2000).

Map 1. Provinces of China

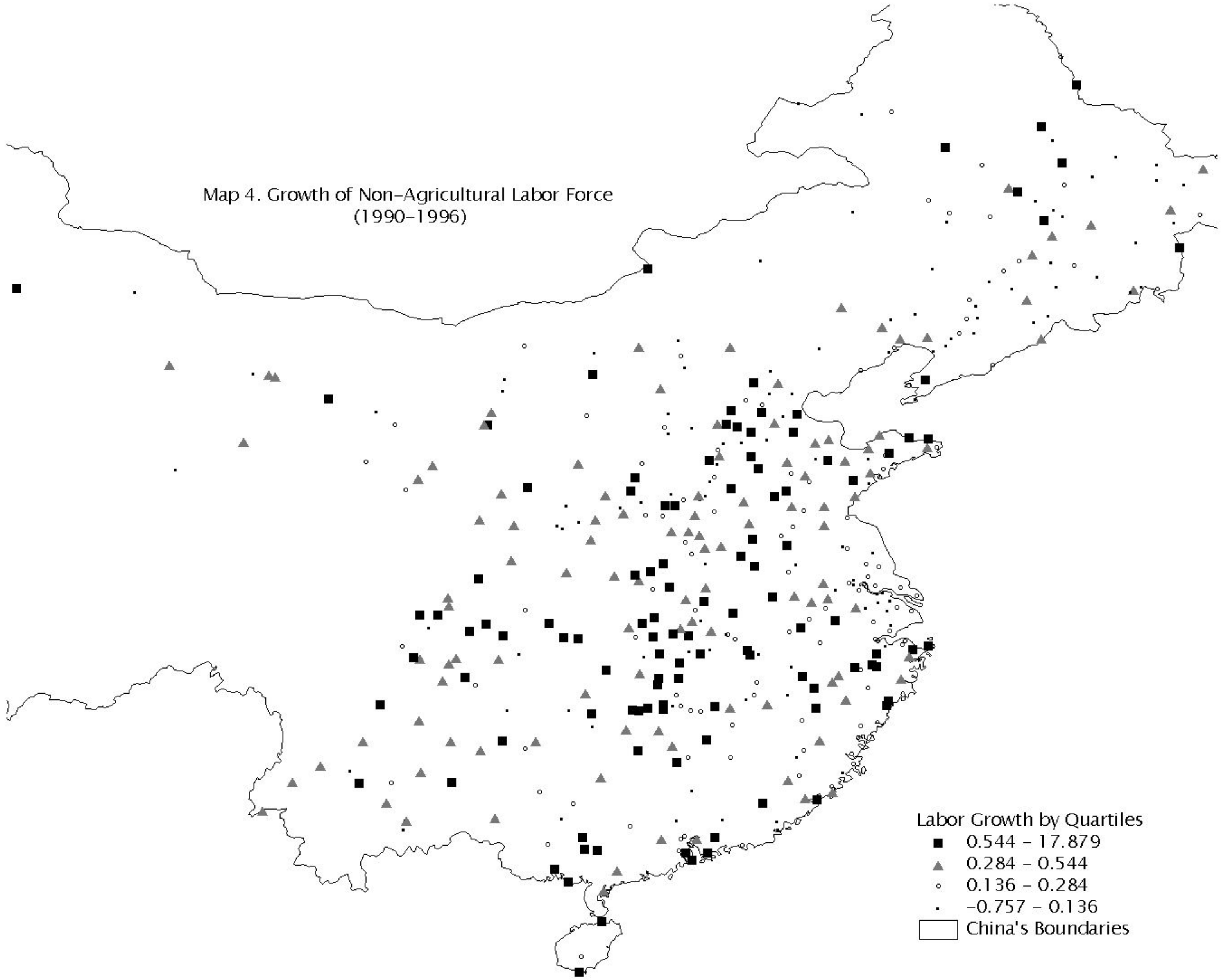
Map 2. Population of All Cities 1996



Map 3. Non-Agricultural Labor Force in 1996



Map 4. Growth of Non-Agricultural Labor Force (1990–1996)



so metro areas with populations from 1-3 million; -- a ratio of .072, compared to worldwide ratio for the same size categories of .27 Henderson and Wang (2003). To give a more common frame of reference for comparisons, we examine spatial Gini's.

For 1657 metro areas with populations over 200,000 in 2000 for the world, the spatial Gini is .564.[27] The Gini is the usual one: rank cities from smallest to largest and plot the Lorenz curve of their accumulated share of total population for the sample (world cities in this case). The Gini is the share of area below the 45° line that lies between the 45° line and the Lorenz curve. China's Gini is .43 in 2000, way below the world, and compares to .65, .65, .61, .60, .60, .60, .59, .58, .56, .54 and .52 for other large countries respectively of Brazil, Japan, Indonesia, UK, Mexico, Nigeria, France, India, Germany, USA and Spain. Only former Soviet bloc countries have similarly low Gini's, Russia with .45 and Ukraine with .40.

In section 3.3, we will argue that Chinese cities in general are too small, leading to significant efficiency losses. In fact we will argue more generally that there is insufficient spatial agglomeration throughout, in both the urban and rural sector.

3.1.2 Regional Income Inequality

Spatial equality in the size distribution of cities does not translate into income equality. Another key feature of China is the high degree of income inequality, deriving traditionally mostly from inequality across geographic units, rather than within units. China's income Gini of .42 in 1995 far exceeds South Asian countries such as India, Bangladesh and Pakistan[28] (with Gini's around .3), not to mention high equality countries of Japan and Korea. Income differences tend to be across geographic units and are increasing. Lin, Cai and Li (1996) calculate the ratio of urban to rural incomes at 2.4 and 2.6 in 1978 and 1994 respectively, with greater consumption gaps: 2.9 and 3.6 in 1978 and 1994 respectively (see also Johnson, (2001)). Regional gaps are also large. For the coast versus the west region (for a three region division: coast (= east), central, west), in 1994 the per capita income ratios were 1.8 overall, 1.4 for urban residents and 2.0 for rural residents, with much higher rural resident ratios between individual richest coastal and poorest western provinces. Fujita and Hu (2001) argue that intra-regional disparities have improved somewhat in recent years but inter-regional inequality is growing and there is no convergence in regional per capita income.

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[27] Calculated from a world city data set prepared by Rupa Ranganathan, Hyoung Wang, and J.V. Henderson, for 1960-2000.

3.1.3. Restricted Migration: The Hukou System.

In China, the geographic-urban dispersion of population and the high spatial inequality is maintained by strong migration restrictions, under the hukou system. Migration restrictions play such a strong role in the society and economy, it is critical to describe them. The hukou system in China is similar to an internal passport system (see Chan (1994) for a detailed description). A person's local "citizenship" and residence is initially defined for a child as a birth right, traditionally by the mother's place of legal residence. The entitlements and details of the system differ for urban and rural residents. Legal residence in a city entitles one to local access to permanent jobs, regular housing, public schooling, and public health care (where almost all health care is public) in that city. Until the early 1990's, it also entitled urban people to "grain rations" -- rations of essentials such as grain and kerosene.

Legal residence in a village or rural township entitles residents to land for farming, township housing, job opportunities in rural industrial enterprises, and access to local health and schooling facilities in their town. Residents also have some degree of "ownership" in local enterprises; although distributed profits all go to the local public budget, which may be used to finance township housing and infrastructure. Again, until recent years, legal residence in a township also entitled a "peasant" to some share in locally produced (or allocated from the outside) grain and other essentials.

How does a person change their local citizenship? There are several common mechanisms. First is education. A smart rural youth may persist through the competitive county system to get a spot in a college. Upon college graduation, the rural youth will be hired into an urban job, with an urban hukou. Second, the state at times can open the gates, permitting factories to hire permanent workers from rural areas, permitting family reunification, or permitting legal migration from rural areas to nearby small cities. However the official changes in residence or hukou status average about 18 million (in under 1.3% of the population) a year over the last 20 years with little annual variation (Chan (2000)).

People can migrate to an areas without local hukou, or an official change of residence/"citizenship", either illegally ("unregistered") or legally as a temporary worker or as a "permanent resident" on a long-term permit. For example, a rural person may be hired as a "contract worker" in industry or services, for a term of three years. Or a rural person may get permission to work temporarily in another local rural area in construction, food services,

[28] From World Development Indicators, 1998, World Bank.

domestic services and the like. People may move illegally, without registering in the new location, and work in the informal sector for low pay, under poor conditions, with risk of deportation. Despite these possibilities and despite some recent relaxations of restrictions in particular provinces, the restrictions in migration remain tight.

Temporary migrants to larger cities typically have no, or very high priced access to health care and schooling facilities and regular, "legal" housing. In fact cities have strict national guidelines on conversion of agriculture to urban land; and institutional difficulties in housing markets in expanding supply makes it particularly difficult for migrants to find decent housing. All this means living and social conditions for migrants and their families are extremely difficult, since children face no or very high priced access to schooling and health care. But there are other restrictions. Legal temporary migration requires getting a permit from the city of in-migration and cities can impose various hurdles to getting a permit -- permission from the home location, proof of a guaranteed job and specific housing, and the like. Cities also publish job lists, citing jobs for which migrants are not eligible; in 2000, Beijing listed over 100 occupants as non-eligible ones. Migrants may still have to pay taxes to their rural home village for services they don't consume and on land left fallow. Finally migrants face direct fees (Cai (2000)). There is a license fee to work outside the home township paid to the township that can be equivalent to several months' wages. At the destination there can be fees for city management, for being a "foreign" worker, for city construction, for crime fighting, for temporary residence, and even for family planning if the migrant is female. All these restrictions sharply reduce the benefits and raise the costs of migration, particularly into large cities. Migration is limited and most migration is short-term, or "return" migration, as we will detail with data below. Overall the hukou system holds 100's of millions of people in locations where they are not exploiting their earning potential, as again we will detail below.

3.1.4 Transformation of the Urban System

The urban system since 1950 has faced repeated system-wide political and economic shocks, inducing enormous transformations. In the next section we will briefly review some of the early episodes; here we focus on the 1990's. Tables 3.1 and 3.2 present some details, starting with the overall urban system in Table 3.1. Columns in Table 3.1 give figures for all cities present in 1990, for prefecture level cities (including provincial cities) present in 1990, for county-level cities after 1990. The first four rows show high overall non-agricultural employment growth from 1990 to 1996, over 4.3% per year for all cities, but much slower population growth, about 1.9% per year. The differential reflects two things. In some cases in 1990, cities contained significant rural-agricultural populations that during the decade moved into non-agricultural employment. This is urbanization from within, although overall local absolute agricultural employment in cities grew modestly from 1990 to 1996. Second and more critically, population numbers may exclude certain types of immigrants while employment figures better reflect them. In particular are shorter-term or longer-term migrants working in the city, who either live in the city but are not counted in population enumeration or who can't obtain housing within the city and reside just beyond the boundaries of urban districts (in often "illegal" rural housing). As a result, it is often better to measure size in terms of non-agricultural employment.

Table 3.1 also shows that real output per worker grew at an incredible rate during the period; for all cities, the average annual rate was about 7.8% a year. Second, over time the manufacturing to service ratio declines. The decline involves some redefinition of manufacturing activity as service activity around 1993-1994. In the data, over the 1990-93 period the ratio declines modestly in total by 4%; between 1993 and 1994 it declines by 24% with redefinitions; and from 1994 on it declines by 4-5% a year, as restrictions on private service sector development are loosened. Later we will note the rapid growth of business services in particular.

Looking across the urban system, prefecture-level and above cities are larger and have much greater human capital. Among county-level cities, there are many new cities, which are larger than traditional county cities, have more industry, and are nearer the coast. These cities reflect rapid urbanization and industrialization of former rural towns and townships.

The period 1990-1996 is one of rapid industrial reforms, removing some of the props under state-owned industry and exposing them to increasing competition. Mostly heavily hit were interior and northern heavy industry cities, especially under the reforms in 1993-94. These reforms moved most planning functions to a market basis and represent a break point in terms of how outputs are evaluated. Along with the rapid growth of business and financial service activity, the result, in this very short period of time, is to dramatically shake up the urban system. To get a sense of the overturning of the old industrial order, we look at transition matrices, as a tool to display mobility. In Table 3.2, Part A is the transition matrix for real output per worker. The first row shows into what 1996 quartile new cities, or entrants from 1990 to 1996, would enter. Interestingly, new cities would enter fairly evenly, across states. The second through fifth rows show transitions for 1900 cities. So of the 116 cities in the lowest quartile in 1990, 58

Table 3.1. The Chinese Urban System

	Prefecture All cities present level in 1990	County- level cities present in 1990	level cities present in 1990	New county level cities
Avg. population 1996 (thousands)	811	1050	589	706
Pop. growth 1990-96	12%	15%	7.9%	n.a.
Avg. non-agri. employ. 1996 (thousands)	327	511	158	183
Non-agri. employ. growth 1990-96	29%	26%	40%	n.a.
% population (over age 6) completing high school in 1990	14.6%	21.7%	12.8%	8.8%
Distance to coast	7.1	6.3	9.4	5.4
Avg. output per worker in 1996 (1990 yuan)	8942	10198	7802	9229
growth in real output per worker 1990-96	57%	53%	62%	n.a.
Avg. manu. service ratio 1996	1.52	1.59	1.47	1.59
Change in manu. serv. ratio	-25%	-32%	-8.2%	n.a.
N	459	220	240	193

Table 3.2. Transition Matrices
(all 669 cities ever present)

A. Output per Worker -- 1996

		not present	first quartile	second quartile	third quartile	fourth quartile
	not present	6	46	47	51	55
1990	**first quartile**	1	**58**	35	10	12
	second quartile	1	46	**33**	28	8
	third quartile	3	13	33	**39**	28
	fourth quartile	0	2	16	37	**61**

B. Employment -- 1996

		not present	first quartile	second quartile	third quartile	fourth quartile
	not present	5	56	65	51	28
1990	**first quartile**	1	**91**	21	4	0
	second quartile	2	17	**65**	24	7
	third quartile	2	0	13	**79**	22
	fourth quartile	0	1	1	7	**107**

remain in the lowest quartile, while 35 move to the second and 12 to the fourth. In addition 1 city in the first quartile in 1990 disappears from the data set by 1996.

What is stunning about Table 3.2 Part A is the incredible mobility. The diagonal measuring the propensity for a city to stay in its original quartile is small, as indicated by the bold numbers. The average probability across states or remaining in the own state is only .41.[29] As noted, 12 of 116 cities jump from the lowest to highest state in just 6 years, while 18 of 116 fall from the highest state to one of the two lowest states. Consistent with the picture of turmoil is the notion of lack of persistence. The correlation between growth in output per worker from 1990 to 1991 and growth between 1995 and 1996 is zero. A city's features that gave it a comparative advantage in 1990 may not do so in 1996.

The transition matrix for total employment in Part B is more "regular". The average probability of staying in the own state is .74; and cities in the top state in 1990 have a very high probability of staying there -- .92. Although there is more motion in terms of relative size changes than in a developed country, cities tend only to move to adjacent states and big cities persist in remaining big, just as one would find in other countries (Eaton and Eckstein (1997), Black and Henderson (2002)).

3.1.5. Urban Specialization and Manufacturing Agglomeration

The urban economics literature suggests that efficiency in urban production particularly for medium size cities involves relative and even absolute local specialization in production. For many standardized manufacturing activities, localized external economies within the own industry are prevalent. Industry-specific agglomeration and hence local specialization are key to industrial efficiency (see Eberts and McMillen (1999) for a review of theory and evidence). For China an issue is whether local scale externalities are not being fully exploited both because local industrial bases are too diffuse and producers within a city are too spatially dispersed, reducing inter-firm information spillovers.

Under the "planning" regime under Mao which remained in force up to 1978, there was no coherent national economic plan, based on national input-output tables (World Bank, 1981). In fact no national input-output table used by Chinese planners existed until the mid-1980's. Planning was done at the provincial level, with provinces tending to autarky, apart from national ministries governing mining, energy, and transportation. As a

[29] For prefecture level cities alone the transition matrices are very similar to those in Table 3.2.

result inter-provincial and even inter-prefecture trade was low. Bigger cities tended to try to produce the entire range of manufactured products. By the mid-1980's, after the economic reforms starting in 1978, Henderson (1988, Chapter 11) presents a picture of bigger cities with extremely diversified industrial bases but some degree of relative specialization, but nothing like the specialization seen in cities in countries like USA,
Brazil, or India. That pattern appears to persist well into the 1990's. For example, Ningbo, a city of only 1.2m people in coastal Zhejiang, based on international 3-digit SIC classifications, still produces in 68 or 70 possible manufacturing categories in textiles, apparel, leather, chemical, plastics, machinery, electronics and instruments sectors, as well as most food, wood, and metals products (from 1998 Ningho Statistical Yearbook). There is some degree of concentration in textiles, apparel, petroleum and electrical equipment (each over 10% of local manufacturing GDP), but that itself is diffuse. Such detailed city data are hard to get on a widespread basis, so it is hard to say how the degree of specialization at the city level has been increasing over time. But more aggregate data suggest increasing specialization.

Fujita and Hu (2001) in examining provincial level data, find strong evidence of increasing agglomeration from 1985-1994 at the provincial level in textiles, apparel, machinery, electrical machinery, electronics, metal products, and rubber and plastic -- key sectors where localized intra-industry scale economies may dominate and where agglomeration is highest. Table 3.3 illustrates showing 1985 and 1994 shares of the top four provinces in gross value of national output for these industries. In general the increased agglomeration reflects relative gains by coastal provinces, with the four dominant provinces (out of 30 provinces) having shares of 50-60% of national gross output value in chemical fibers, rubber and plastics, textiles, garments, electrical machinery and equipment, and electronics by 1994. Note however that in many cases the name of the province with the highest share, which is listed changes from 1985 to 1994. Fujita and Hu interpret this growth in agglomeration as "self-agglomeration" or clustering promoted by FDI and trade policies (see below) that favored industrialization in certain coastal enclaves. Guangdong province around Guangzhou (Canton) with its more freewheeling economics is a big gainer in all of this. By 1994 Guangdong commands market shares in electronic products such as recorders and cameras of over 85%.

Table 3.3 Increased Concentration of Agglomerated Industries

Industry	**Share of National Gross Value of Output by Four Top Provinces**	
	1985 share (dominant province)	**1994 share (dominant province)**
Chemical fibers	62.5% (Shanghai)	64.6% (Jiangsu)
Rubber	39.2% (Jiangsu)	52.3% (Guangdong)
Textiles	48.1% (Jiangsu)	58.3% (Jiangsu)
Garments	37.8% (Shanghai)	60.4% (Guangdong)
Electrical Equipment	46.3% (Shanghai)	53.7% (Guangdong)
Electronics and Telecommunications	52.3% (Jiangsu)	58.9% (Guangdong)

Source: Fujita and Hu (2001), Table 4.

In this evolution, one trend at the city level is the development of services, especially business services in major cities that we will discuss below. Also a strong positive correlation between prefecture city size and the ratio of tertiary to secondary city activity has developed as the service sector has grown.

3.1.6. Governance

The final key aspect of the urban system is governance. In general, especially in economic plans formulated in the 1980's, spatial hierarchy is a strong notion in China. Big (prefecture-level) cities "lead" smaller (county-level cities, and both lead rural counties. Politically large cities have some authority over nearby township and county city governments. High -level units are favored in terms of tax policy, redistribution, and degree of autonomy. Planning of product lines favored higher level units, granting state enterprises monopoly rights over product lines that rural enterprises were starting to encroach on. This hierarchy notion is also played out in other dimensions -- the spatial allocation of revenue and investment of FDI and trade initiatives, and of transport infrastructure investment.

In the next two sections, we focus on key aspects of spatial bias in current economic policy. In section 3.2, we start with an explicit consideration of urban policy in China from 1950 to the present and of the impact of reforms in the post-Mao period since 1978.

3.2. A Brief Review of Urbanization and Urban Policy in China Since 1950

In the period 1950 to 1978, urbanization in China was driven by volatile central government economic and social policy. Table 3.4 shows the annual rate of urban population growth for China under different socio-economic regimes from 1950-1990, based on Chan (1994 Table 2.4). Discussions of official versus de facto urban policy may be found in Kwok (1982), Paine (1982), O (1993), Chan (1994) and Kojima(1996), with further references in Chan. The period 1950-1961 was one of massive capital investment in mostly heavy manufacturing, with an accompanying recruitment of rural labor by urban state-owned enterprises. Although migration restrictions were enacted in 1957, on-going migration to cities up to 1961 was enormous as column 2 of Table 3.4 indicates. While the Great Leap "forward" from 1958-1961 is often associated with backyard rural steel production, in fact the story is one of massive urban emphasis.

Table 3.4. Urbanization in China 1950-1990

Years	Rate nationally of urban population growth (%)	Notes
1950-57	7.2	Russian influence; establish industrial centers
1958-61	9.1	Great Leap Forward "production first; living second"
1961-65	-2.1	famine
1966-77	2.0	Cultural Revolution: % urban declines
1978-90	4.5	Post-Mao: the four modernizations and beyond

Starting in 1961, a combination of weather calamities, chaos in the rural commune sector created by the Great Leap, and poor grain distribution policy led the famines of the early 1960's in which millions died. Migration reversed, as an attempt to deal with food shortage problems and upheaval in the commune sector. 1966-1977 marks the period of the trauma of the Cultural Revolution. Rustification of youth and other social-cleansing policies led to an urban population growth rate below the national population growth rate.

Overall from 1950-1977, China's urban has several consistent features, despite the turmoil and time varying patterns of rural-urban migration. Official policy was distinctly anti-urbanization, with cities viewed as potential centers of Western "spiritual" pollution and counter-revolutionary forces. The rhetoric emphasized rural industrialization and uplifting of the masses. De facto policy differs in key ways. Throughout, capital investment favors heavy urban industries; and rural industrialization is minimal. In 1978 non-farm activity in the rural sector is negligible and even by 1984 in the post-Mao period only 11% of rural labor is engaged in non-farm activity, compared to 20-40% in the rest of the world (Perkins (1994), Henderson (1988)). While official policy post-1960 does emphasize relative rural population growth, at the expense of urban population growth, cities remain the recipients of capital investment and income distribution. As noted earlier, in 1978 urban incomes are 2.4 higher than rural incomes; and China's overall degree of income inequality equals or exceeds India's (World Bank, 1981).

3.2.1. Post-Mao Reforms

The "four modernizations" in 1978 started to introduce market forces into China. Productivity growth in agriculture under Mao was negative and consumer goods, including housing, had been de-emphasized under the "production first … living second" policy. Reforms are discussed in many places and a nice review is in Perkins (1994), as well as Lin et al (1996). Here we note four key elements, before turning to items with specific spatial-urban features. The personal responsibility system was introduced into agriculture, moving agriculture away from a commune system to a quasi-market system where increasingly individual farmers chose their own crops and inputs, and sold increasing portions of output at free market prices. Compared to an annual growth rate of agricultural GDP of 1.4% from 1957-1978 (far less than the rural population growth rate), the annual growth rate for 1978-1984 is 7.3%, which then levels off at 3.7% for 1984-1992 (Perkins (1994)). Further productivity advances in agriculture are limited by two items relevant to the urban sector -- continued restraints on rural-urban migration and continued diversion of capital away from the rural sector, as well as failure to enact full property right reforms in the rural sector.[30]

While urban state-owned industry [SOE] was subject to reforms attempting to introduce incentives for workers and managers, SOE's still faced soft budget constraints, rigid employment, wage, and compensation policies, and constraints on production choices (Jefferson and Singhe (1999)). Industrial reform really came through first the vast expansion of the collective, mostly rural, industrial sector (see below) and then the expansion of private industry in the 1990's, with the state-owned sector increasingly withering away.

Reforms also altered the composition of national output, away from heavy industry towards first lighter, consumer-oriented manufacturing and then services, with both playing a role discussed below in urban policy. Nationally China's service sector accounted for 15-23% of GDP in 1978 (with the percent depending on whether domestic/historic (15%) or international 1990 (23%) prices are used). Today the share has risen past 30%. But it is still far short of the 42^{+}% found in low-income countries or the 52^{+}% found in low-middle income countries.

The final background element we note is that economic reforms were constrained by a lack of political reform. The effective rule of law and transparency in accounting and fiscal rules and procedures have been very slow to develop, with the Party and personal relationships substituting. Later we will note some key urban components that emerge.

3.2.2. Urban Policy Since 1978

There are implicit and explicit urban policies, and our discussion is a mixture of the two. The key implicit policy is that the hukou system remains in place, so free migration with a permanent change of residence is still not a feature of China. The details and implications of this are discussed in the next section. However China's urban population growth rate as seen in Table 3.4 is 4.5% for 1978-1990 versus 2% in the previous 11 years. So migration policy as part of urban policy has changed.

As defined in part by the 1982 Sixth 5-Year Plan, as well as the Seventh 5-Year Plan, the post-Mao period has a set of initially defined urbanization policies that persist today. Good sources on aspects of these policies include Chan (1994), Kojima (1996), O (1993), Lin, Cai and Li (1996), Ebank and Cheng (1990), Fujita and Hu (2001), Wei and Wu (2001), Shixun and Xian (1992), and Henderson (1988). First urban population was to expand,

[30] In particular the maximum lease length in agriculture remains at 15 years inhibiting the incentive of farmers to undertake long

but through the rapid growth of smaller cities relaxing hukou transfers at the level, while containing the sizes of larger cities. Table 3.1 and the spatial Gini's cited earlier show the impact of that policy. The 1990's witnessed the rapid growth in number of cities, as many places were recognized as having passed 100,000 urban population mark. However China's spatial Gini and degree of urban concentration remains very low by world standards and even lower in 2000 than in 1960 (.42 versus .47). General urban population expansion has also been fueled by rapid growth, particularly in coastal towns, of township populations, always pushing these towns towards (or past) the 100,000 mark to be a city (Ma and Fan 1994).

In the Sixth and Seventh 5-year plans there is a sense of hierarchy, played out both in governance structures and in economic policy. Larger cities are to lead smaller ones and rural areas; the coast is to lead the center and west. "Leading" has many dimensions. Larger cities focus on newer production -- initially high tech and light industry and then business service development in recent years. Large cities receive new technologies and hand-down traditional activities to their hinterlands, in particular contracting-out parts and components production to small cities, towns, and rural areas, and relocating heavy, polluting production to their peri- or ex-urban areas. Table 3.5 Parts A and B illustrate aspects of this. This is not to say these changes are the consequence of planning. Rather planning may have been consistent with natural market forces, and helped ignite them. Part A of Table 3.5 shows the move of industry from the urbanized city proper in specific prefecture level cities to the ex-urban rural hinterland areas of these prefectures in the 1990-1997 time period. Note in Part A the already high degree of suburbanization of industry in some cities by 1990. Suburbanization of manufacturing to lower wage cost ex-urban or fringe areas with potentially more readily available land is part of market driven urban spatial development. Mature manufacturing firms in core cities typically suburbanize once their need for core city information spillovers declines and illustrates the existing ex-urbanizational industry achieved by 1990.

Part B of Table 3.5 shows the expansion of the business service sector. The table shows the rapid growth of business services in all regions and shows their relatively high level in the three traditional provincial cities -- roughly a 3-fold higher level than in the rest of the country in terms of share of local GDP. More generally among prefecture level cities, as in other countries, a negative correlation between city size and the ratio of secondary to tertiary sector activity has developed. By 1997 most major cities in China, such as Beijing, Shanghai, Chengdu, and Changsha proudly reported that they had passed the 50% mark -- over 50% of local GDP from the tertiary sector.

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term investments in, for example, irrigation and local transport projects.

Table 3.5. Aspects of Urban Change

A. Ex-Urbanization of Manufacturing

Share of City Proper in Prefecture Secondary Sector Employment

Industry	**1990**	**1997/98**
Beijing	82	69
Tianjin	81	81
Shanghai[31]	70	68
Chengda	59	43
Changsha	54	39
Hangzhou	37	33
Zhuzhou	47	42
Xiangtan	66	51

B. Percent Growth in GDP of Business Services and Trade[32] 1987-1997

	Industry	**Trade**	**Business Services**	**1997 Share of Business Services in local GDP**
Beijing, Tianjin Shanghai	-14.7%	55.9%	70.4%	7.5%
Coast	15.7%	85.0%	48.7%	26%
Center	15.6%	86.2%	94.7%	3.0%
West	9.4%	68.1%	56.4%	2.3%

[31] The figure under 1990 for Shanghai is for 1994. The area of the city proper in Shanghai was tripled in 1993.

[32] Trade is wholesale and retail. Business services here include Chinese sectors labeled as real estate, leasing, public facilities, hotel, tourism, recreation, computer services, and information and consultancy (e.g., advertising).

Again given China's low service production, expansion of this sector in response to market forces is not surprising.

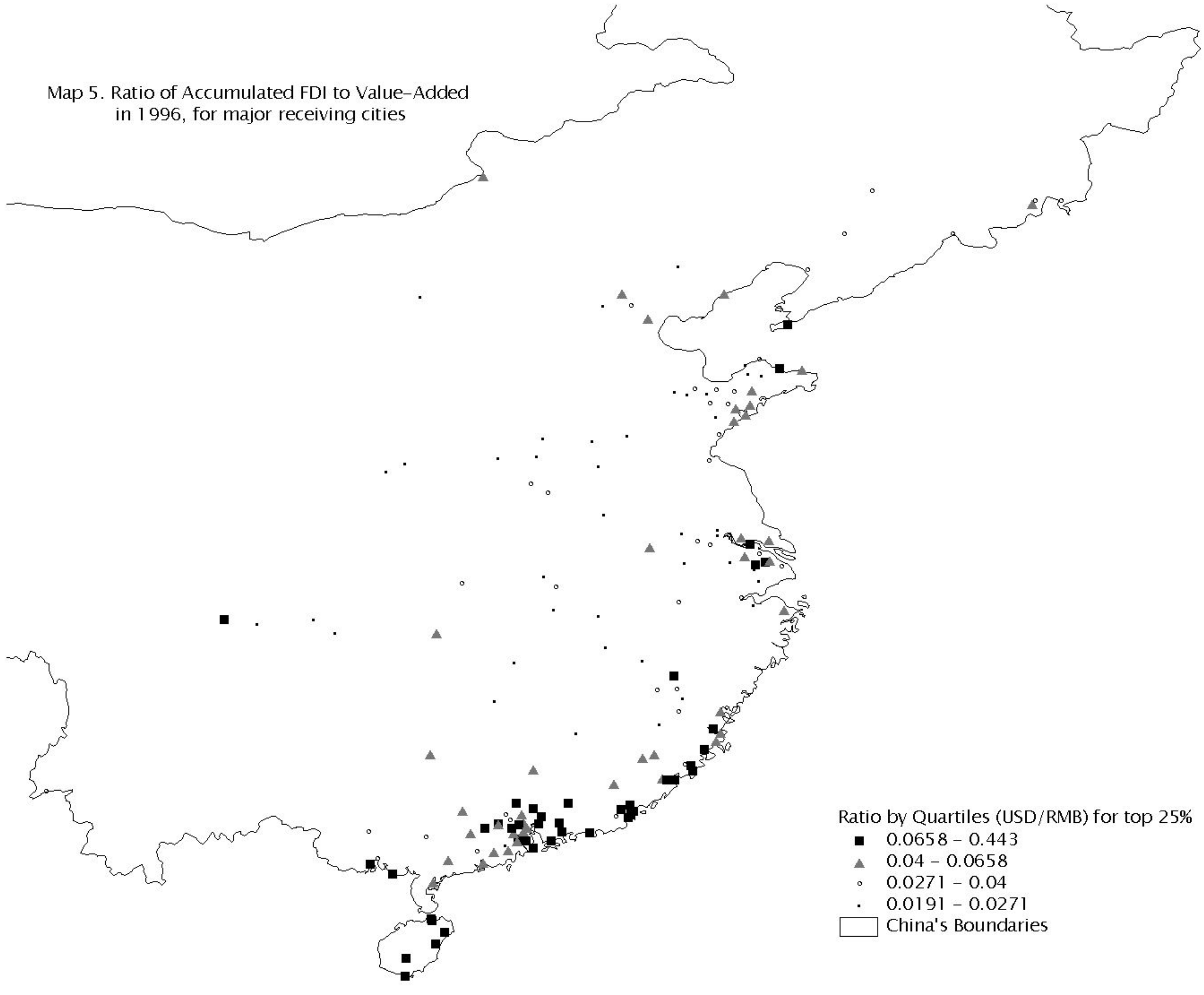
Another aspect of urbanization policy, implicit and as part of big cities leading the rest, is played out in the development of rural industry -- the town and village enterprise sector [TVE's]. The rapid productivity growth in agriculture after 1978, coupled with prior restrained urbanization, meant a vast surplus of labor in agriculture. Given the desire to continue to restrain urbanization (although at a much higher rate after the 15 or so years before 1978), a policy of "leave the land but not the village" was crafted. So the rural sector was to industrialize, but generally not spatially agglomerate. TVE development was constrained by under-capitalization, an inability to spatially agglomerate, and in the 1980's policies restraining its competition with SOE's (followers are not supposed to out-compete leaders!).[33] However, TVE growth by 1997 VA in the TVE sector was twice that in remaining SOE's (independent accounting units). TVE's had hard budget constraints, fewer regulations, and greater ability to respond to input (hiring and promotion, choice of sellers of intermediate inputs) and output (product demand) market conditions. By the early 1990's, Jefferson and Singhe (1999) document how TVE total factor productivity exceeded SOE's, ascribing that to the greater operational freedom and hard budget constraint of TVE's, illustrated by Murakami, Liu, and Otsaka (1996) in terms of buying and contracting-out decisions.

Still TVE sector development was constrained by the under-capitalization of the rural sector that has been a feature of modern China. Based on micro data, Jefferson and Singhe show that the rate of return on capital in the TVE sector in 1997 exceeded that of SOE's by 25%. Similarly Au and Henderson (2002) calculate that, while the social marginal product of labor in prefecture level cities is only 7% higher than in the TVE sector, the marginal product of capital in the TVE sector in 1997 is 40% higher than in prefecture level cities. In calculating social marginal products of labor in the urban versus rural sector another aspect of "leading", or bias in the urban-rural allocation of resources concerns education. The higher wage and compensation returns to labor in the urban sector combined with college education being the key to permanent migration from rural to urban areas, means the more educated population is funneled into cities. An area of investigation is the very high social returns to education in the rural sector, improving township allocation decisions of resources between agricultural, animal husbandry and TVE activities (Yang and Au (1997); also Au and Henderson (2002)).

In addition to these policies governing rural-urban (and big city-small city) allocation of capital and labor there are other much more explicit policies with a spatial bias (Chan (1994), Yang (1997), Naughton (2002), Fujita and Hu (2001)). While they have some big city-small city/town flavor, they also have a coastal versus rest of the country flavor. Arguably the key element is initial policies that directed FDI and trade to certain coastal cities. In the early (1979) reforms, 4 coastal special economic zones, centered on 4 prefecture level cities were created to encourage free market experimentation, an inflow of FDI, and development of international trade. In the mid-1980's, 14 more coastal cities were declared as open cities to foreign investors, with 2 more coastal cities added by 1990. In addition 10 cities (half-overlapping with open status) were given separately listed status -- economic decision making powers equal to the provincial cities of Beijing, Tianjin, and Shanghai.

Fujita and Hu (2001) show that 14 open cities and 4 spatial economic zones accounted for 42% of national FDI from 1984-1994, the 24 "special status" cities (special economic zones, open, and separately listed) plus Beijing accounted for 65% of all FDI in prefecture level cities, while accounting for only 36% of value-added in non-agricultural production of prefecture level cities. This initial advantage persists, despite opening of the entire economy. These 25 cities account for 63% of all FDI accumulated from 1990-1997 in all prefecture (or provincial) level cities. Map 3.5 illustrates. It takes the upper quartile of all cities in terms of their ratio of accumulated FDI from 1990-1996 (in dollars) divided by their 1996 GDP (in RMB), and then divides that upper quartile into four quartiles in terms of ranking of relative accumulated FDI. The cities in the top group (.0568 - .443, for the upper 1/16 overall) are heavily concentrated along the coast, except for a few inland special cities.

[8] Usually shifting restrictions on products that could be produced by TVE's were the competition restraint. Success by a TVE competition could lead to its product line being terminated (Henderson (1988)).


Map 5. Ratio of Accumulated FDI to Value-Added
in 1996, for major receiving cities
Ratio by Quartiles (USD/RMB) for top 25%
0.0658 - 0.443
0.04 - 0.0658
0.0271 - 0.04
0.0191 - 0.0271
China's Boundaries

Fujita and Hu (2001) argue persuasively that the agglomeration of electronics and light manufacturing in coastal areas such as the region around Guangzhou is due to these initial policies promoting FDI and trade in these favored coastal areas. The effect is reflected in the ratio of investment occurring in coastal versus interior regions: in 1984 the ratio is 1.12 while 10 years later it is 1.93 (see also Naughton, 2002). These policies and their impacts are deliberate spatial policies of the Sixth and Seventh 5-year plans, favoring development in a spatial hierarchy of the coastal region. On a more positive note, Wei and Wu (2001) do show the expanding trade within these favored regions, tended to reduce rural-urban income inequality, because trade helped the TVE sector in the urban fringe (rural) areas.

An entirely different aspect of this spatial policy bias involves transportation. On a world scale, China has an anemic road system. Its ratios of national roads to land, roads to population, or paved roads to land or to population in 1995 are very low by international standards. For example, its normalized ratio of roads to population in 1995 is 1.2, to be compared to 2.1 for India, 1.5 for Pakistan, 1.9 for Indonesia, or 2.7 for Mexico. Half of these roads are paved in India but only 15% in China. For a country with far-flung populations, this places hinterlands at great disadvantage in their ability to secure inputs and truck products to coastal and international markets. Only now is a highway being built to link Chengdu, Sichuan's capital, and the 100m. people in the Sichuan region to the coast.

The final aspect of spatial bias involves governance and fiscal relations. Fiscal rules and inter-governmental relations in China are not well defined and transparent. Revenue redistribution contracts send monies coming from the center back to provinces and cities; up to the mid-1990's these appeared to favor bigger and richer cities. But much official public expenditure is extra-budgetary -- local revenues retained within localities (Jin and Zou (2002)). What is retained and the specifics of a city's fiscal allocations from above, whatever the rules, are in part the result of bargaining. And in the hierarchy of big city versus small or coast versus interior, the bigger and the coastal have greater bargaining power. Actual results depend on the personalities and power of local leaders, with an interesting literature on China documenting this (Peter T.Y. Cheung, Jae Ho Chung, and Zhimin Lin, (1998)). Bigger cities have more effective fiscal autonomy and more control over key appointments (e.g., heads of local state-owned banks which become a source of funds and subsidies of local industries). Cities compared to rural areas are favored with the ability to offer lower tax rates on FDI firms. The issue is a difficult one and there has emerged no clear way to quantify the fiscal advantage of one city or set of cities over others. But the spatial bias and lack of transparency is a key feature of China's urban sector.

3.3. Some Evidence on Key Issues

In this section, we focus on agglomeration economies and city sizes in China -- the extent to which cities in China may be too small and the welfare losses from that, the extent of rural-urban migration that is actually occurring, and how one could model the process of city population growth in China. At the end we will turn to the issue of spatial bias and history of pro-coastal policies.

3.3.1 Under-agglomeration in Cities.

Using data for 1996 and 1997, Au and Henderson (2002) estimate city production functions for 212 prefecture level (or above) cities. Output is value-added per worker in the non-agricultural sector of the city proper. Determinants include the capital stock to labor ratio, share of accumulated FDI in capital stock, distance to the coast, education and scale measures. These city level figures on GDP, investment, and other economic data are considered to be reliable and consistent in collection and accounting methods across cities. The city statistical bureaus which collect these data have traditionally been responsible de facto for the national level urban economic data. National figures were simply aggregates of provincial figures, which in turn were aggregates of the city reported numbers. Given this institutional "accident", these are the only reliable GDP numbers at the city level (i.e, at the level of the city proper, or the de facto urbanized area) that we are aware of internationally.

Following traditional systems of cities analysis (Henderson (1974); see also the Puga and Duranton and the Abdel-Rahman and Anas papers in this volume), real output per worker is postulated to be an inverted U-shape function of local scale, as measured by total local non-agricultural employment. At low scale, the marginal benefits in terms of increased productivity of increased local scale from enhanced scale externalities and local backward and forward linkages outweigh the marginal costs from increased congestion and commuting costs and environmental degradation. So at low city scale, real value-added per worker is increasing in scale, then at some city size it peaks, and after that declines with further increases in city scale.

However cities are in an economic "hierarchy" where cities relatively and absolutely specialize in different products. In general, the manufacturing to service ratio of cities declines as city scale rises, or cities move up the hierarchy. For the USA, Kolko (1999) shows a monotonic decline. To capture this, Au and Henderson (2002) postulate that the inverted U-shape shifts right as the manufacturing to service ratio drops. They estimate a relationship for city i where

$$\ln\ (VA_i / L_i) = \beta X_i + \alpha_1 L_i + \alpha_2 L_i^2 + \alpha_3 L_i \cdot MS_i \tag{3.1}$$

In (3.1), X_i are controls on technology, capital-labor ratio, access and the like. VA_i is value-added; L_i is total (non-agricultural) employment, and MS_i is the manufacturing to service VA ratio (secondary to tertiary sector VA). In eq. (1) output per worker peaks where

$$\overset{*}{L_i} = \frac{\alpha_1 + \alpha_3 MS_i}{-2\alpha_2} \tag{3.2}$$

where $\alpha_2 < 0,\ \alpha_1 > 0,\ \alpha_1 + \alpha_3 MS_i\ > 0$ and $\alpha_3 < 0$. The last reflects the economic hierarchy idea: bigger cities are more service oriented, so $\overset{*}{L_i}$ declines as MS_i rises.

Estimation of (3.1) in Au and Henderson (2002) is by instrumental variables using 1990 (planning period) variables as instruments. Estimation produces a tight fit with excellent specification test results. Table 3.6A shows relevant manufacturing to service ratios, the peak points $(\overset{*}{L_i})$ where value-added per workers is maximized and the 95% confidence interval for peak scale. Note scale is in thousands of workers. Most Chinese cities (85%) lie to the left of their peak points and 43% are below the 95% confidence interval on $\overset{*}{L_i}$. That is, 43% of cities are significantly to the left of $\overset{*}{L_i}$, or significantly undersized. Table 3.6B shows the percent gain in VA per worker from moving below the peak to the peak.

For county-level cities, Au and Henderson are unable to quantify an inverted-U, instead finding unbounded scale effects (for these smaller city sizes). Similarly for TVE's across provinces, local scale economies (average township TVE employment by province over three years) are unbounded and very large -- a 10% increase in local scale increases value-added by worker by 3%. This is the same order of magnitude found by Jefferson and Singhe (1999) to TVE scale, using micro data.

Table 3.6. Efficient City Sizes

A. City Employment at Peak of VA per Worker

manufacturing to service ratio

	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0
$\overset{*}{L}$	2730	2380	2030	1670	1320	970	620	270
95% confidence interval								
- lower	1880	1680	1420	1090	670	180		
- upper	3590	3080	2630	2260	1980	1760	1580	1430

B. Gain from moving to $\overset{*}{L}_i$

percent current size is below peak

	50	**40**	**30**	**20**
percent gain in VA per worker	35%	20%	9.5%	4.1%

The conclusion is that throughout China there is under-agglomeration, held in place by the hukou system, and also property right issues in rural areas. For the latter, there is no ability to readily transfer TVE ownership and location, for township residents to sell their "shares" in local TVE's so as to liquidate and relocate, or for township residents to shift location to another town. That makes rural agglomeration difficult. However here we focus more on rural-urban migration. But free migration in China would change the landscape -- some prefecture and county-level cities would experience huge population inflows over a period of years. Some townships would also experience huge inflows and transform into major cities. Conversely, these flows imply some less competitive large cities and towns would experience large population losses.

3.3.2. Extent of Actual Rural-Urban Migration

In the popular press, there is sometimes a sense that there is already enormous migration in China, with the transformation well underway. Certainly a transformation as we saw in Tables 3.1 and 3.2 is underway, and may be more advanced in provinces such as Guangdong; but the issue is the extent of overall population movements. In 1998, the commonly accepted number for the "floating" population -- those currently outside their town of residence for more than 1-3 days -- was about 100m of 1.2b or so people. From Chan (2000), several factors are apparent concerning these 100m. First the number of annual permanent residence changes has been constant at about 18m for the prior 15 years. About 15% of the population relocates every 10 years, including, as we will suggest, a substantial portion of rural-rural and urban-urban moves. Second, in general, most temporary migration in China is return migration -- migrants move for a few months or years and then return home. Third, most of even this temporary migration is short distance.

Table 3.7 covers this short distance aspect, as well as an overview of temporary migration. Of the 100m floating population in 1998, only 62.4m had been out of residence for over 6 months. Of these (based on 1995 survey results), 41% moved just within their home county. So in 1998 only about 37m people had been living outside their official county of residence for more than 6 months. For these, what about rural versus urban destinations?

Based on flows for 1990-1995, for migrants moving for over 6 months, 40% of moves involve urban residents and 60% rural. For these 60% rural, 60% go to cities, as opposed to other rural areas. Finally for all movers with 6^{+} months stay, only 32% move outside of province. If we apply these numbers to 1998 and assume urban and rural movers have equal out of province propensities, in 1998 of the 62.4m temporary migrants, only 12m were rural folks moving out of province (62.4m * 32 * .6).[34] Of the 12m temporary long distance rural migrants only some portion (60% suggested in Table 3.7) go to cities.

Whatever the exact numbers and the fact that we are past 1998, the analysis suggests that the permanent urban populations are only modestly supplemented with rural migrants on a nationwide basis. Table 3.7B suggests of the 62.4 temporary migrants, under 15m (62.4 * .36) involve rural-urban migration, both within and outside provinces. Even if we triple that number to adjust for increased migration and to add in some of the floating population staying less than 6 months, that still means only 10% of the official 450m urban residents are temporary migrants from rural areas. Migration is still terribly constrained.

3.3.3 City Size Determination

Given migration restrictions, city size is not determined in the usual free migration paradigm. Cities limit in-migrants through policies influencing housing availability, the cost and availability of residence permits, access to jobs, and lack of availability of health care and education. Following Rappaport (2000), in any period we could think of the gap between urban and rural welfare for a typical urban versus rural resident as being equalized for the representative migrant to the cost of in-migration, $m(\dot{L}_i)$ where $m^1 > 0$ and $\dot{L}_i$ is the current flow. That is, more entrants imply escalating entry costs in the form of (a) premiums paid by migrants for housing and health care, (b) reduced urban wages through discrimination and (c) greater explicit fees and implicit costs of obtaining residence permits. Inverting such an equation we get a migration response function where

$$L_{it} - L_{it-1} = g(U_{it-1} - R_{it-1}) \tag{3.3}$$

In (3.3) U_{it-1} and R_{it-1} are urban and rural utility for a typical resident in city i and migration decisions (for temporary naïve migrants) are based on $t-1$ realizations. We might expect both U_{it-1} and R_{it-1} to be increasing in local urban scale: for the former that means we are to the left of $\overset{*}{L}_i$ in equation (3.2) and for the latter that means as rural in-migration increases the alternative utility level rises (the city recruits those with better alternatives from further away). Eq. (3.3) is then interpreted as a city population growth equation, where in-migration rates depend on

9 These numbers are consistent with Liu (2000) who finds for 1998, 18m floating population living out of province (where 18m ≈ 100m * .6 * .32).

Table 3.7. Migration in China

A. Stocks of the Population

floating population (outside of township of residence (estimated) for more than 1-3 days) in 1998	100m
temporary migrants (outside of township of residence for more than 6 months) in 1998	62.4 m
percent of temporary migrants living outside home county (1995)	59%

B. Flows of Population 1990-1995

Rural/Urban (origin→destination)	**Percent**
U → U	35.4%
U → R	4.8
R → R	23.8
R → U	36.0
Out-of Province destination	32.1%

Source: Abstracted from Chan (2000)

the rural to urban welfare differential, and $g^1 > 0$. We carried out instrumental variables estimation of this equation for prefecture level cities.

From 1990-1997, prefecture level cities average from Table 3.1 about a 25% increase in employment. As Table 3.8 shows these cities grow as variables which enhance urban worker productivity grow. A one standard deviation increase in the capital to labor ratio, FDI per worker, and education raise city growth points (in percent) by 3.7, 6.1, and 7.2. Special status cities are the 25 cities noted earlier which have special, open, or separately listed status (plus Beijing) in 1990. As results in Table 8.3 show, even after accounting for greater FDI and better educated populations, these cities grow much more quickly than other cities—about 27 percent points, presumably reflecting their greater freedom and ability to recruit contract workers (as temporary migrants). Access to the coast per se has no significant impact, but market potential does. Market potential of a city is the sum of populations in all other prefecture and county-level cities discounted by distance from the city to all others. Market potential represents a source of demand for a city's products. A one standard deviation increase in ln MP raises growth by 5.8. Finely bigger cities grow more slowly. Larger cities are nearer their peak L_i^* and also have smaller urban-rural utility gaps. If a city is larger to begin with, ceteris paribus, it has a smaller urban-rural gap and has significantly lower growth.

3.3.4. Spatial Discrimination and The Coast Versus The Hinterlands

China has subsidized FDI (through tax breaks) in prefecture level cities and encouraged FDI and trade development in certain coastal cities, as part of a general program emphasizing coastal development, over hinterland development. The question is whether the FDI policy is efficient. On the subsidization question, the argument is that FDI brings in technology transfer, as well as creating job opportunities for low cost Chinese labor. The counter-argument is that FDI is not particularly high tech, compared even to more sophisticated domestic production, and FDI may discourage, or divert funds from local R&D. The evidence is not conclusive. For example Au and Henderson (2002) find that, ceteris paribus (same total capital to labor ratio) that cities with a one-standard deviation higher FDI/capital ratio have 8% higher output per worker. In section 3.3.3, FDI also enhances city growth rates. And in Fujita and Hu (2001) as noted earlier, FDI is associated with coastal agglomeration.

Assessing the issue of the efficiency of coastal versus hinterland development is less straightforward. On FDI, in Au and Henderson (2002), there is no evidence that FDI interacts with distance to the coast or city size -- returns to FDI occur in the same degree for all cities regardless of size or location. But there is a more general

Table 3.8 A City Growth Equation
(Change in ln (employment) from 1990 to 1997)

1990 variables	3SLS	OLS
ln (capital/labor)	.104 (.074)	.0676 (.0776)
% pop. (over age 6) with high school	.00832** (.00374)	.00854 (.00593)
FDI/labor	.000592** (.000253)	.000511** (.000260)
ln (market potential)	.244** (.106)	.232** (.104)
manufacturing/ service (VA)	-.0476* (.0267)	-.0400 (.0274)
ln (city employment)	-.219** (.0367)	-.209** (.0408)
favored city dummy variable	.266** (.0829)	.264** (.00759)
distance to coast	.00848* (.00453)	.00759* (.0830)
adj R^2	.171	.175
N	210	213

* significant at 10% level; ** significant at 5% level

The primary effect of instrumenting is to double the coefficients for ln (capital/labor) and % pop. with high school and raise the employment coefficient by 30%. Instruments are: distance to coast, favored city, west region, center region, land area, 1990 FDI or not, 1990 FDI, manufacturing/service ratio, ln (market potential), ln (capital stock), ln (capital stock) * manufacturing/service ratio, ln (SOE VA/city VA), doctors per person, telephones per person, books per person, roads per person.

question of coastal versus hinterland development. The Rappaport and Sachs (2001) story is that hinterlands are inherently inferior locations for economic development, compared to coastal locations. Démurger, Sacks, Woo, et al (2002) amend the story for China to argue that favored provinces tend to be coastal provinces so that the faster growth of coastal provinces is explained by a combination of policy-bias and inherent advantage.

A flaw in the analysis of coastal advantage is the failure to control for market potential of cities, a control fundamental in the analysis of economic geography (Overman, Redding and Venables (2001), Black and Henderson (2001)). Statistically the issue is that in many countries (e.g. USA), historically populations have agglomerated on coasts (including in Rappaport and Sacks for the USA the Great Lakes). So access to the coast captures both greater domestic market potential effects, and pure coast effects. In Au and Henderson (2002), distance to the coast on its own in eq. (1) significantly reduces productivity. However introduction of market potential eliminates the effect of access to the coast, and produces large significant effects for market potential. Similarly in the section 3.3.3 regression, access to the coast is not associated with higher growth per se, once FDI and market potential differentials are accounted for. The Sachs story is also complicated at times by calling coastal anything that is near navigable inland waterways so Switzerland would then be considered coastal (Gallup, Sachs, and Mellinger (1999)). But navigable waterways are an investment like rails or highways and only represent more historical modes of transport. If we consider Sichuan in Western China, its 100m residents have enormous market potential. With proper modern highway links to the coast, it in some sense will become "coast", with easier access to the coast. While coastal provinces still have better access to international markets, Sichuan may be domestically competitive, relatively specializing in domestic products. Its "disadvantage" may reflect policy disadvantage in terms of transport development, FDI, and loosening of planning constraints, more than an inherent disadvantage of hinterland location.

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