Metropolitan regions: New challenges for an urbanizing China

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Introduction

At some point during the 1970s, China passed the US to become the country with the largest number of urban residents in the world. Despite a long political and cultural bias against urbanization, market-oriented reforms since then have created conditions that will transform China into a predominantly urban nation early in the next decade (fig. 1). Experience in the last 15 years suggests that the bulk of this urbanization will continue to occur in and around over 50 expanding metropolitan regions, most of which now spill over municipal boundaries that no longer capture urban markets.

This paper has three objectives:

- The first is to report on interim findings of research that my firm has conducted over the last few years on metropolitan regions in China to inform policy advice to municipal, provincial and central government agencies, largely under the aegis of World Bank

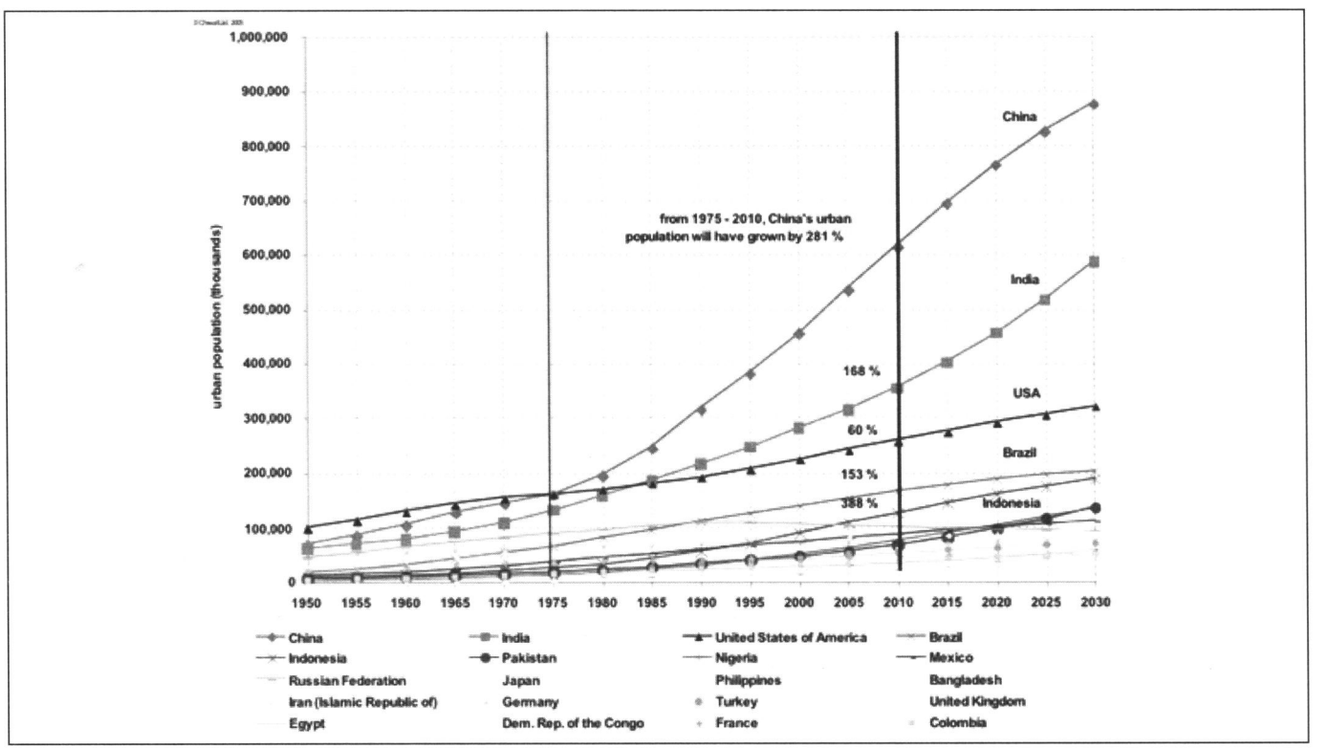


Fig. 1: Urban populations of selected countries (1960-2030). (*Source*: UN World Urbanization Prospects – The 2003 Revision).

and ADB technical assistance. Most recently, this included two "City Development Strategy" (CDS) consulting assignments for the Cities Alliance[1] in nine urban and metropolitan regions in China, targeted specifically to improving the social, economic, and institutional linkages between the traditional "city proper" (comprised of districts of the statutory cities) and surrounding small and intermediate cities, towns and villages that together comprise the "city-region."

- The second objective of this paper is to propose an agenda for focused, comparative research that could help governments in China to better manage the development of metropolitan regions through better public policy.
- The third is to encourage urban and regional researchers from around the world to become far more actively engaged with China in defining more effective ways for managing the country's transition to an urban and largely metropolitan nation.

There are two key findings from the CDS work that we have conducted in China and in a similar vein on 15 other city regions over the last four years[2]:

- The first is that the agglomeration benefits experienced in many city regions in more advanced economies are accruing haltingly and only in limited ways in China.
- The second is that un-managed metropolitan regional growth is having negative impacts both in suburban and central areas, including pollution, congestion, and distortion of land and labor markets.

While most city-regions in China are not yet enjoying the net benefits that agglomeration in metropolitan regions can induce in productivity improvements, trade, innovation, employment generation, and hence poverty alleviation, they are incurring mounting costs (including opportunity costs) of incomplete, inefficient, and ineffective agglomeration. These costs are being borne by all major stakeholders – governments, enterprises, and households – but particularly by more vulnerable suburban town and township governments, small and medium size enterprises (especially in suburban areas), migrants, and suburban landless farmers.

Defining metropolitan regions in China

Defining the boundaries and structure of a "functional metropolitan region" requires current and reliable data on the type, volume, and direction of economic and social flows. As in other countries, because of data limitations[3] proxies must be used to identify the majority of periodic social and economic interactions occurring in urban and metropolitan regions within a reasonable travel-time from the center of China's cities. Research in other countries suggests that a one-hour travel time is generally the limit that households are willing to spend for most journeys to work, and that most suppliers to enterprises can effectively travel for daily deliveries. Assuming motorized vehicles as the dominant mode of movement, this equates roughly to a maximum radius of 50 km from the urban core when accounting for lower travel speeds in more congested central areas.

China's urban regions differ significantly from North American and European cases in the distribution of places of residence and places of work. Private vehicular ownership is low, regional commuter transit (such as in Tokyo, Paris and New York) do not yet exist, and distances to work are generally much smaller in China. This is partly due to

- the development after liberation of large, self-contained State Owned Enterprise (SOE) complexes that included factories, residences, and public facilities in one location; and,
- the TVE industrialization model in which places of work and residence are scattered in suburban towns.

Therefore, in China more so than in Europe and North America, there is a much stronger correlation between population density and employment density, and hence of production. Constraints to physical mobility mean that the 50 km radius is probably a maximum catchment area. A one-hour drive time is possible by enterprises, most of which have access to motorized transport. But the majority of urban residents rely on inner-city public buses, bicycles and walking to get to work: their one-hour travel time distance is considerably more circumscribed. While regulatory impediments were, until recently, the greatest constraints to labor mobility in urban markets, physical accessibility is emerging as the most significant impediment to labor flows within China's emerging metropolitan regions, particularly from suburban areas.

Method no. 1: Analysis of towns, townships and street committees

Given these conditions, two approaches have been followed in identifying and describing the spatial extent and structure of metropolitan regions in China. The first is detailed analysis of population distribution conducted at the town/township and Street Committee scale, and is therefore data-intensive. Small-scale, accurate data on population became available in China in 2002 in analog form using information collected during the 2000 National Census. For the first time, government enumerated individuals where they were living when the census was taken, including migrant populations resident for longer than six months. This provided relatively accurate information on actual populations that accounted for in- and out-migration. The data are available at the statutory Town, Township, and Street Committees; this approximates the scale of census tracts in Canada and the US, and Nomenclature of Territorial Statistical Units[4] (NUTS) 5 units in Europe. Assuming a strong correlation between employment and population density, it appears that the 2000 Census data on population, when analyzed spatially, could provide a reasonable proxy for delineating not only the spatial structure of interactions (location and size), but also an indication of the intensity of these interactions through population densities.

The first method for defining urban and metropolitan regions was developed on recent projects in the Pearl River Delta and Shanghai, and therefore was initially calibrated in large and dynamic metropolitan regions.

It consists of eight principal steps:

- digitizing on GIS the small-scale population data from the 2000 Census;
- calculating, using spatial analysis techniques on the GIS, population densities in a 4 km radius from every Town, Township and Street Committee point[5];
- defining geographic constraints to urban development by calculating slopes over 8°,[6] waterbodies and floodplains;
- overlaying current digitized spatial data on National Trunk Highway System (NTHS) and national and provincial highway networks; and
- overlaying digitized traffic volumes.[7]

Population density grids were then re-classified into

- "zones" of density increments (step no. 6) with the lowest gradient being 500 inh/sq.km (in line with approaches followed in the EU by Eurostat[8]); and
- one-hour drive times from city centers were calculated using average incremental road speeds on NTHS and national highways in which design speeds were lowered to account for increasing congestion in central areas (step no. 7).
- The results of all of these calculations were then overlaid to provide for:

– the definition of Metropolitan or Urban Region (maximum) boundaries as the limits of generally contiguous population densities over 500 inh/sq.km following existing road networks (and

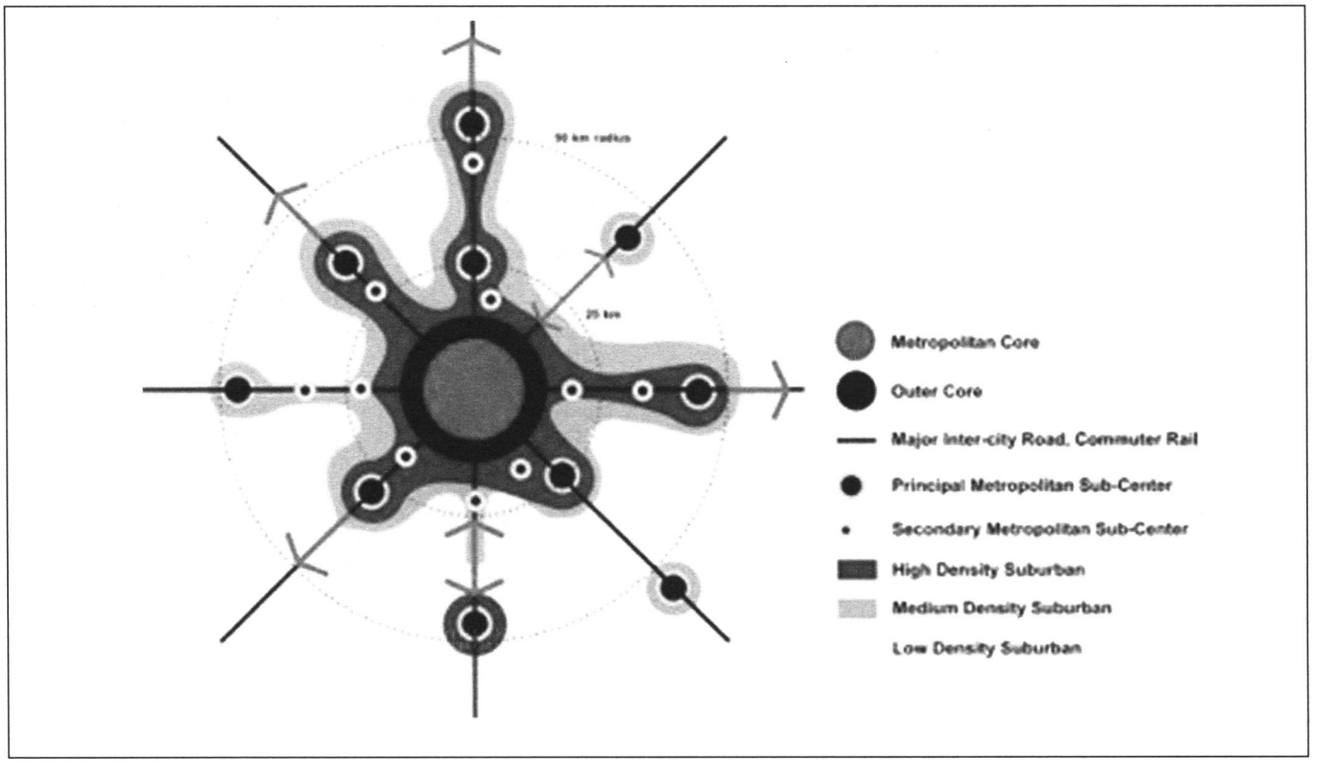


Fig. 2: Schematic structure of metropolitan regions.

checked against traffic volumes from 1996); and
– the identification of key elements of the spatial structure of the region in the form of settlement nodes (density 'zones') and links (principally road networks).

The result is a generalized descriptive spatial model of Metropolitan Regions shown on figure 2. The Chinese metropolitan region generally covers a territory within a 50 km radius from the center of the core city which ranges in drive time from one hour on expressways to two hours on local roads. This is broadly consistent with findings on European metropolitan regions, and with recent research by others on Southeast Asian metropolitan regions.[9] The spatial structure of the Chinese metropolitan region generally appears to be comprised of a metropolitan core, a concentric outer core, principal metropolitan sub-centers (large towns and small cities), smaller metropolitan sub-centers, high and medium density suburban areas adjacent to the outer core and in clusters and corridors farther out from the core, and low density suburban areas (500–1,000 inh/sq.km) in clusters and corridors (table 1). This generalized descriptive model is a working hypothesis: patterns vary among regions depending on geography, human and social capital endowments, production patterns and transportation infrastructure. A similar but less atten-

Table 1
Characteristics of metropolitan region zones

	METROPOLITAN REGION ZONES		LOCATION	DENSITY	FORM	
MR Core	Metropolitan Core (high density)	MC	central in region	> 15,000 inh/km2	principal regional node	
	Metropolitan Core (low density)	MC	central in region	7,500 - 10,000 inh/km2	principal regional node (principally in North America)	
	Outer Core	OC	surrounding Metropolitan Core	5,000 - 15,000	concentric ring	
Suburban Areas	Principal Metropolitan Sub Centers	PMSC	dispersed, mostly within 50 km radius	3,500 - 15,000	concentrated, large sub-regional node	generally structured as corridors and settlement clusters
	Secondary Metropolitan Sub Centers	SMSC	dispersed, mostly within 50 km radius	3,500 - 5,000	smaller concentrated node	
	High Density Suburban	HDS	surrounding OC, PMSC, MSC	2,000 - 5,000	concentric around OC; corridors, clusters	
	Medium Density Suburban	MDS	connecting OC to PMSC, MSC	1,000 - 2000	clearly-defined, often contiguous corridors and clusters	
	Low Density Suburban	LDS	dispersed throughout Metropolitan Region	500 - 1,000	dispersed	
	Very Low Density Suburban	VLDS	dispersed throughout Metropolitan Region	250 - 500	dispersed	

Table 2
Urban and metropolitan regions analyzed to date using Method no. 1 (Census Tract equivalent)

			population (2000)	
CHINA	Metropolitan Regions	Shanghai MR	17,266,863	
		Beijing MR	14,538,227	
		Guangzhou MR	13,745,326	
		Chengdu MR	11,207,318	CDS2
		Xian MR	9,406,327	
		Tianjin MR	9,176,949	
		Chongqing MR	8,656,887	
		Shijiazhuang MR	7,660,495	
		Shenzhen MR	7,014,490	
		Handan MR	6,767,526	
		Zhengzhou MR	6,486,078	CDS2
		Tangshan MR	5,623,742	
		Luoyang MR	5,019,310	
		Lanzhou MR	2,474,777	CDS2
		Baotou MR	1,967,308	
	Urban Regions	Xinxiang UR	2,177,637	CDS2
		Qinghuangdao UR	1,361,286	
		Zhangjiakou UR	1,240,460	
		Chengde UR	602,466	
		Erdos UR	320,576	CDS2
		sub-total: China	**132,714,048**	20 cases
INTERNATIONAL	Metropolitan Regions	Tokyo MR	33,568,477	
		Seoul MR	22,729,502	
		London MR	13,749,443	
		Paris MR	10,371,566	
		New York MR	16,196,635	
		Toronto MR	5,403,051	
		Atlanta MR	3,209,011	
		sub-total: int.	**105,227,685**	7 cases
		TOTAL:	**237,941,733**	

uated structure applies to "urban regions", defined as those anchored on cities with core populations less than 1 million, stretching out generally no further than 25 km from the city center.

This method for identifying and defining the spatial characteristics of metropolitan regions has been calibrated from analysis of the five city-regions in the second CDS project in China (CDS2) and recently to fifteen other urban and metropolitan regions in various parts of the country (table 2). In addition, to compare China's regions with metropolitan regions internationally, two MRs in Asia, two in Europe, and three in North America were also analyzed using the same approach (same variables, same size of smallest spatial unit for population data, and the same data year, 2000). Therefore, the research is not only based on analysis of the five CDS2 client cities: 27 urban and metropolitan regions, with a total population of over 200 million residents, have comprised the empirical base for our interim findings.

Research on the spatial structure and characteristics of additional metropolitan regions in China and other countries is continuing as resources permit. Once a consistent sample of suitable size has been constructed, statistical analysis will be conducted to identify possible correlations between spatial characteristics and locational, demographic, economic, and transport variables.

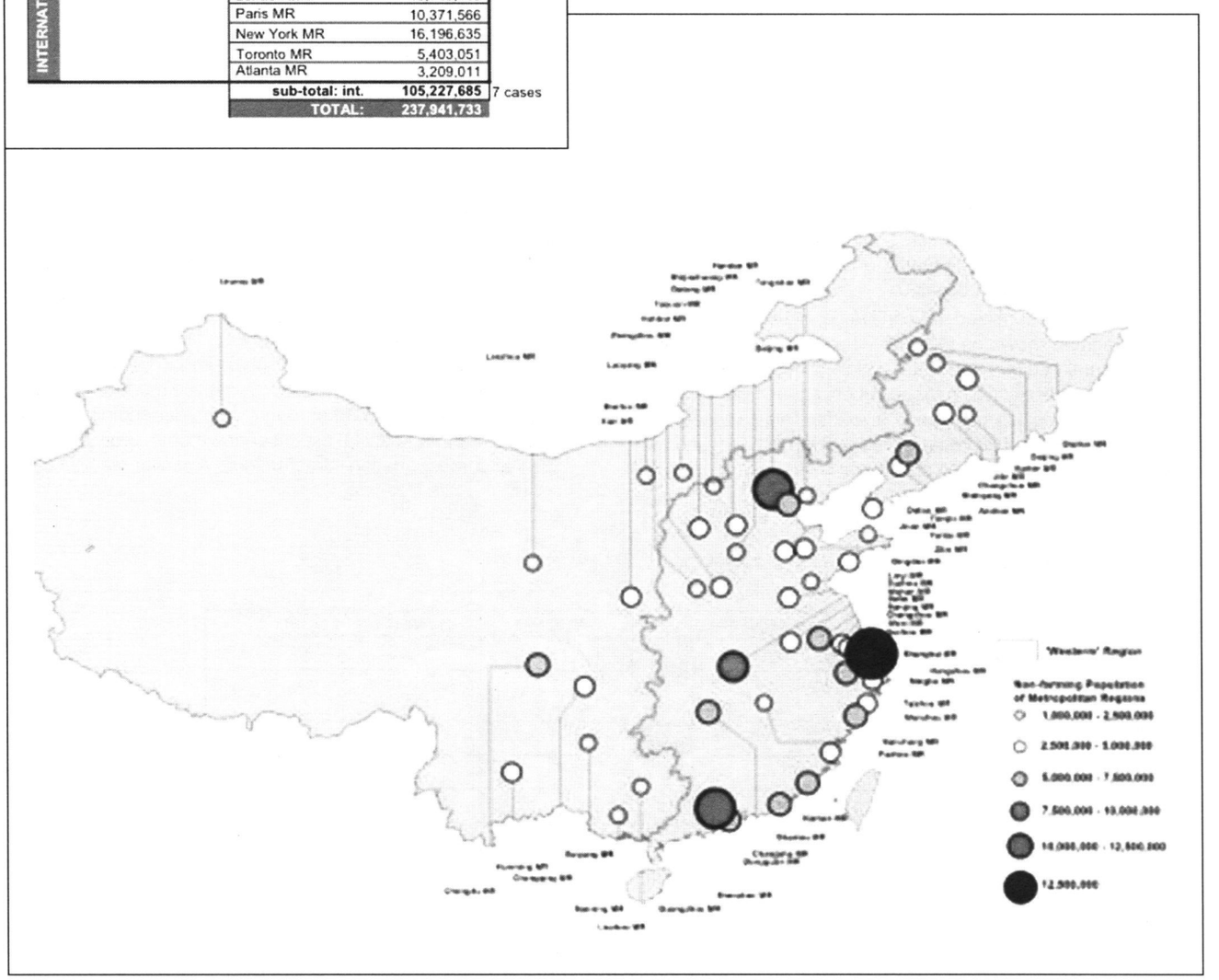


Fig. 3: China's 53 metropolitan regions by size of non-farming population, 2000. (*Source*: Chreod Ltd calculations from *2000 National Census* and *2001 Provincial Statistical Yearbooks*).

Method no. 2: County/city-based analysis of all potential metropolitan regions in China

The results of the analysis of 27 urban and metropolitan regions – 20 of which are in China – provided a working hypothesis for identifying and analyzing the likely remaining metropolitan regions in China using more readily available but much coarser data at the county and city level. The basic hypothesis is that, when viewed as aggregates of counties and cities, metropolitan regions in China:

- are anchored on the urban districts of statutory cities with over 1 million non-farming residents[10];
- spill over to capture non-farming populations and enterprises in towns and cities in adjacent counties and county-level cities (CLCs) that are connected by good quality roads (either NTHS or national highway segments with road quality above Class); and,
- are comprised of the core city and adjacent counties or CLCs generally within a 50 km radius of the center of the core city, representing a notional 1-2 hour travel time.

Analysis of traffic volumes along the national highway network suggests that a few MRs likely spill over to capture selected counties beyond those immediately adjacent to the core city, i.e. that the reach of some MRs is wider than 50 km. While this hypothesis requires testing using the more detailed approach in Method no. 1, resources for such analysis on all remaining MRs in China (38) have been well beyond the scope of our recent consulting assignments.

China's 53 metropolitan regions

According to the county-based Method no. 2, there are 53 metropolitan regions in China anchored on cities with over 1 million non-farming residents and encompassing selected adjacent counties (fig. 3). These appear to be China's main economic engines. They hold almost 370 million people, or 29 percent of the country's population, but produce 53 percent of China's GDP and 62.3 percent of all non-farming GDP from manufacturing, construction and services (fig. 4). The biggest metropolitan region in China is Shanghai with an urban population of over 17 million followed by Beijing (14.5 million) and Guangzhou (13.7 million). A second tier of 11 metropolitan regions has urban populations ranging from 5 million to 10 million. A third tier with populations ranging from 2 to 5 million includes 20 regions. There are 19 small metropolitan regions with populations ranging from 1 to 2.5 million. While first and second tier metropolitan regions are concentrated along the coast, many of China's medium and small

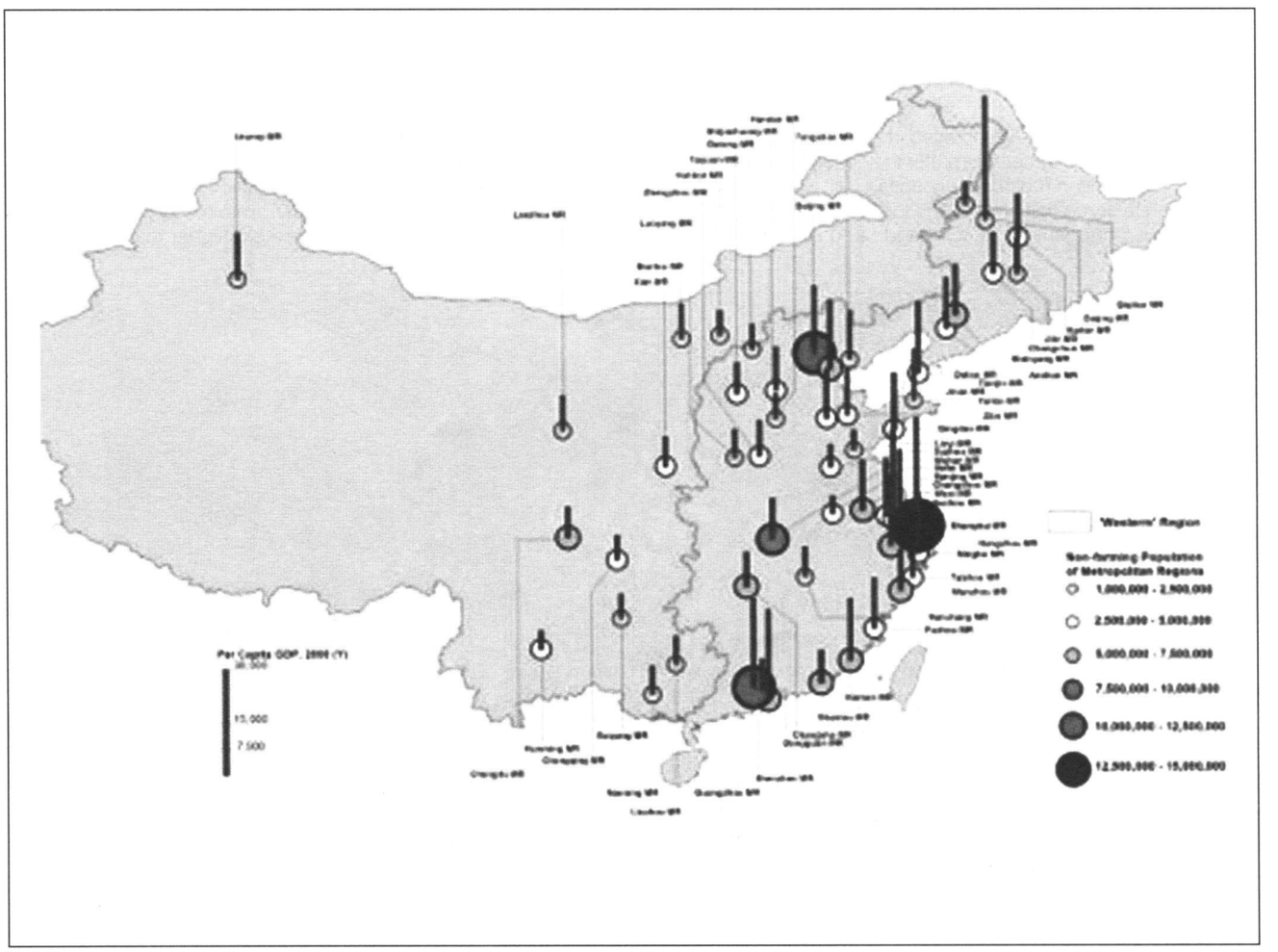


Fig. 4: Per capita GDP in China's 53 metropolitan regions, 2000. . (*Source*: Chreod Ltd calculations from *2000 National Census* and *2001 Provincial Statistical Yearbooks*).

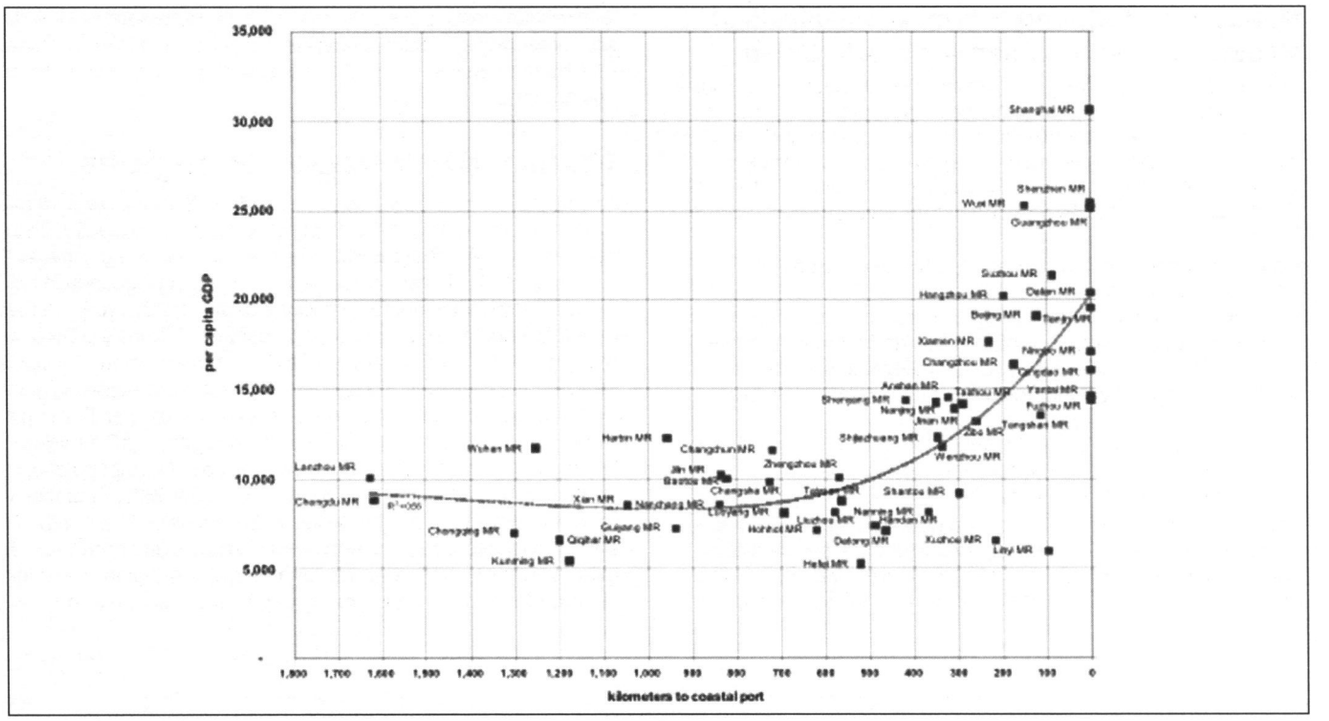


Fig. 5: Distance to coastal ports and per capita GDP. (*Source:* Chreod Ltd calculations).

size metropolitan regions are located inland. Although distance to coastal ports does appear to matter to economic development in these metropolitan regions, per capita GDP is at the medium range even in some selected inland locations, such as Harbin, Zhengzhou, Changsha, Xian, Chengdu and Lanzhou (fig. 5). Conversely, there are few cities within 500 km of coastal ports that are seriously lagging.

Metropolitan regions are China's major centers of productivity and wealth (fig. 6). Per capita GDP within 50 km of the centers of metropolitan regions is 160 percent higher than the national

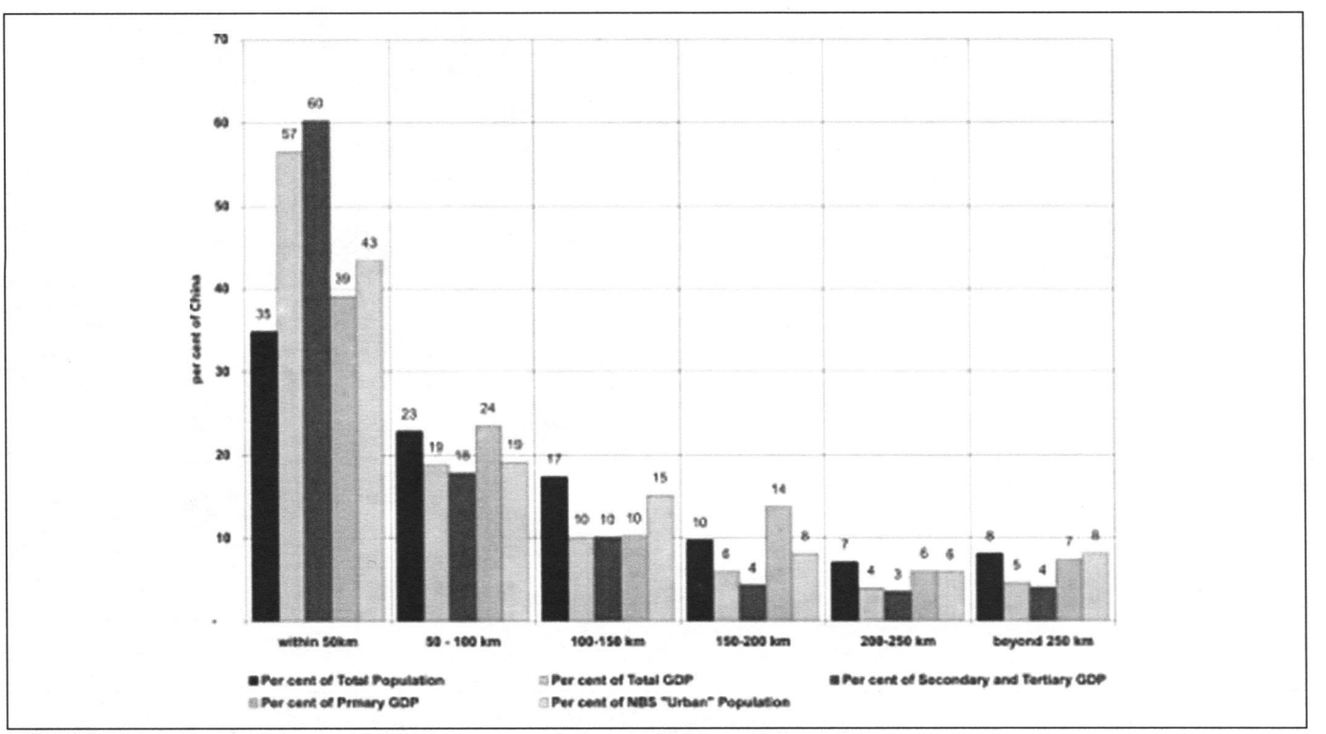


Fig. 6: Metropolitan regions' share of China's population and output (from city center).

average. This rate falls dramatically at a distance of 50-100 km from the metropolitan core, drops again beyond 100 km, and remains relatively stable beyond 100 km, no matter how far out from the center.

Five key challenges facing China's metropolitan regions

While China has consistently enjoyed high economic growth rates over the last 15 years, policy makers are becoming increasingly concerned that:

- growth has largely been generated from investment;
- much of that investment has been to prop up unprofitable SOEs and from foreign enterprises into narrowly defined sectors in a very limited number of largely coastal locations to facilitate exports (i.e. external consumption);
- only a handful of cities are progressing up global supply chains by adding higher values to manufacturing and services; and,
- the potentials for metropolitan regions to generate wider and sustained employment growth are not being effectively realized.

But the challenges are not only economic: in our report to central government agencies on national implications of CDS2, we outline ten issues that need to be quickly addressed in China's metropolitan regions.[11] Five of these, related more closely to "Urbanization, Land Policy, and Urban Form" are reviewed in this paper.

Realizing urbanization economies

Most of China's metropolitan regions have low levels of urbanization,[12] and hence unrealized agglomeration benefits that generally accord to highly urbanized regions. Only 15 of 53 MRs have urbanization levels over 70 percent. Of these, 11 MRs have per capita GDP in the top half of the range of all metropolitan regions (fig. 7). The four MRs with urbanization levels over 70 percent but with per capita GDP in the bottom half are producers of low value-added manufactures (Dongguan, Wenzhou and Taizhou) or are very isolated in the west (Urumqi). Except for Urumqi, all the MRs in central and western China have urbanization levels under 70 percent, with the majority in the 40-60 percent range; all of these have per capita GDP in the bottom half of the range of all 53 MRs. However, there are also 14 coastal MRs with low or moderate levels of urbanization. Of these, five are in Shandong Province, three in Liaoning, three in Hebei, two in Jiangsu, and one in Fujian. While just over half of China's metropolitan regions are in coastal provinces (28 of 53), half of these have urbanization levels under 70 percent. There is, therefore, considerable scope for additional urbanization in both coastal and interior metropolitan regions.

Significant correlation appears to exist between the degree of

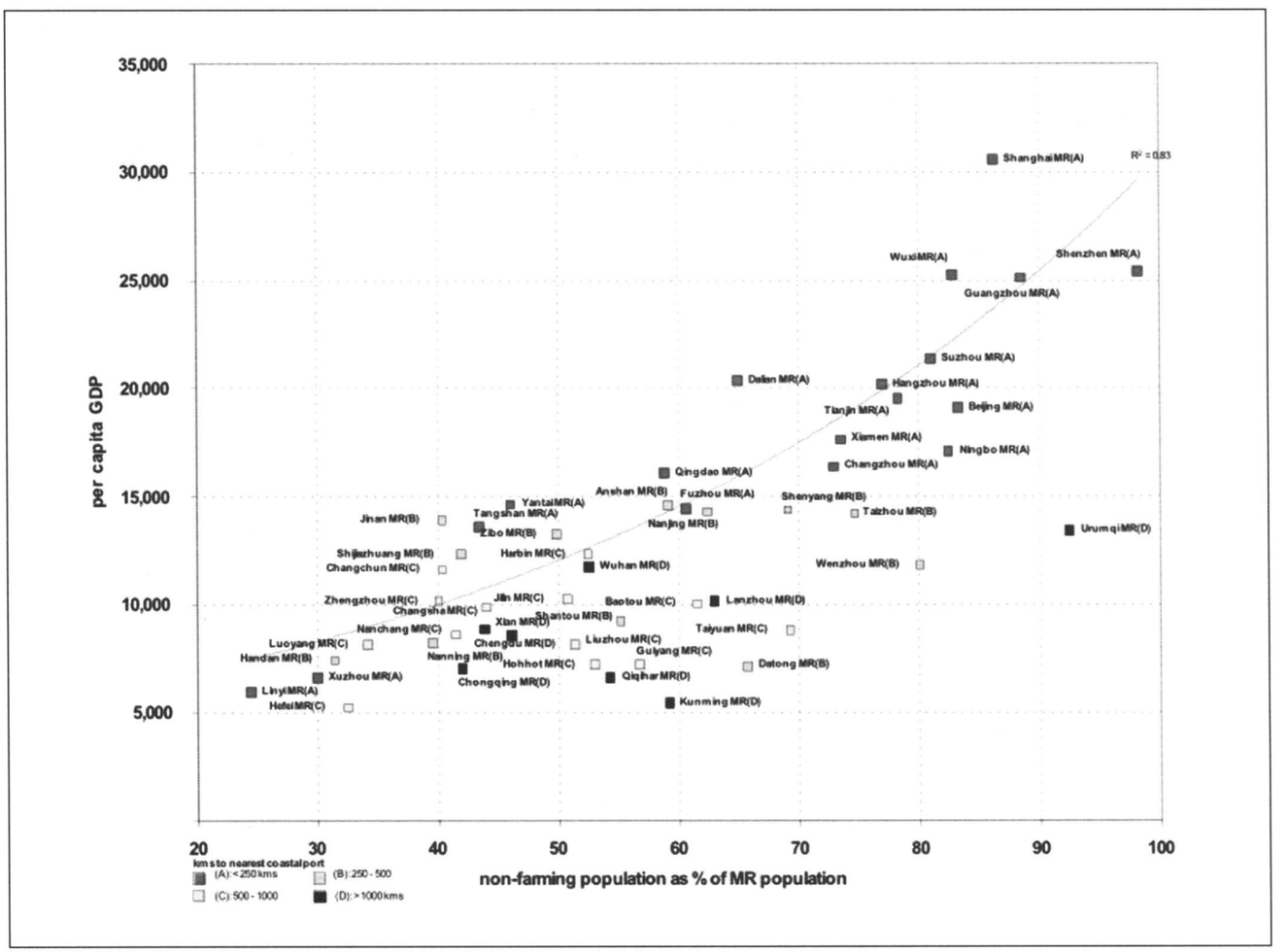


Fig. 7: Urbanization and per capita GDP in China's 53 metropolitan regions, 2000.

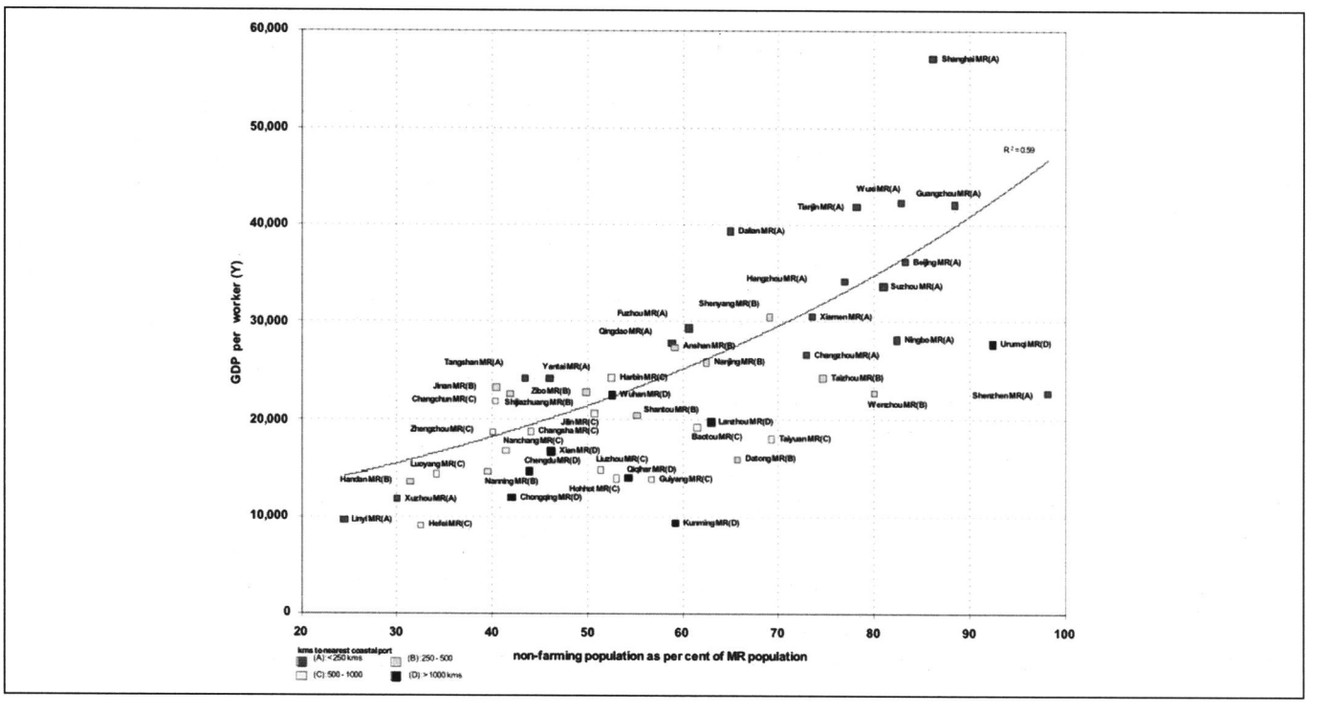


Fig. 8: Urbanization and labor productivity in China's 53 metropolitan regions, 2000

urbanization and economic prosperity of metropolitan regions. Not surprisingly, labor and spatial productivity are higher in metropolitan regions that are more urbanized (figs. 8 and 9).

However, the population size of metropolitan regions also appears to matter (fig. 10). Smaller MRs with under 2 million non-farming residents have lower levels of per capita GDP, reflecting

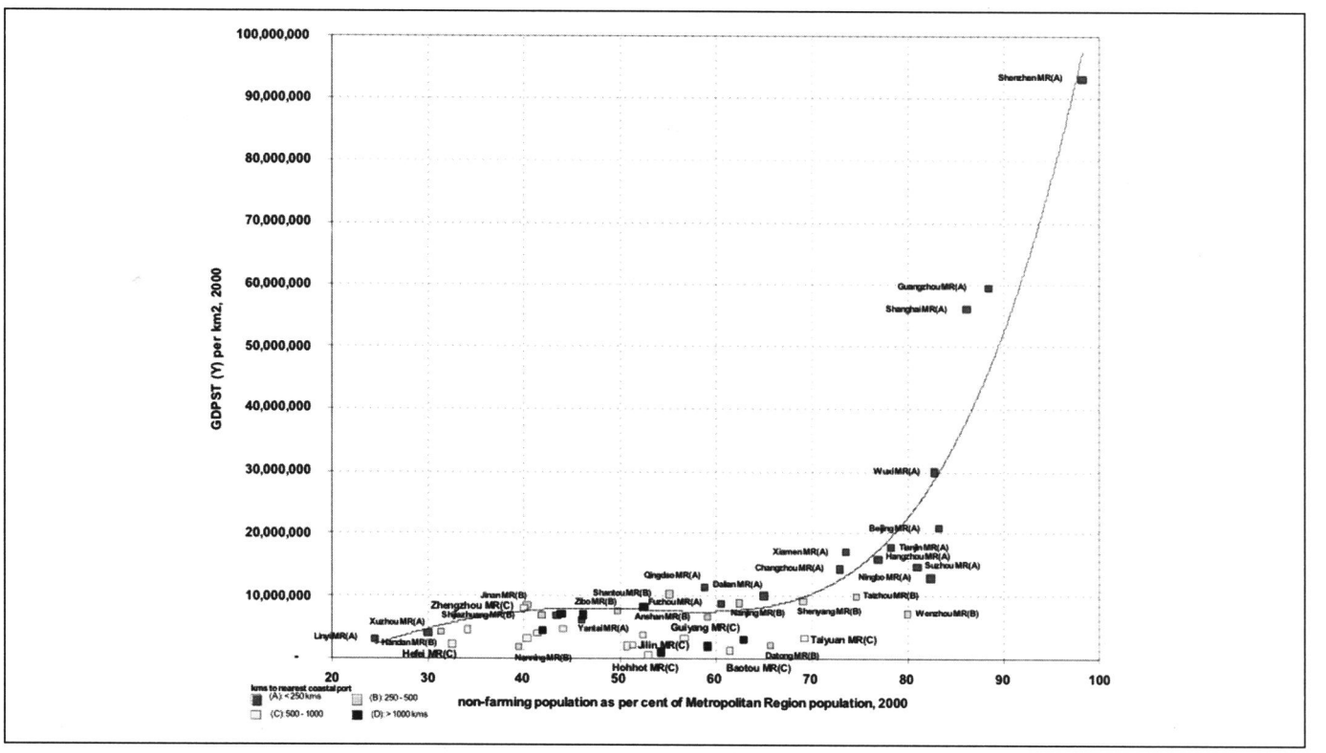


Fig. 9: Urbanization and spatial productivity, 2000.

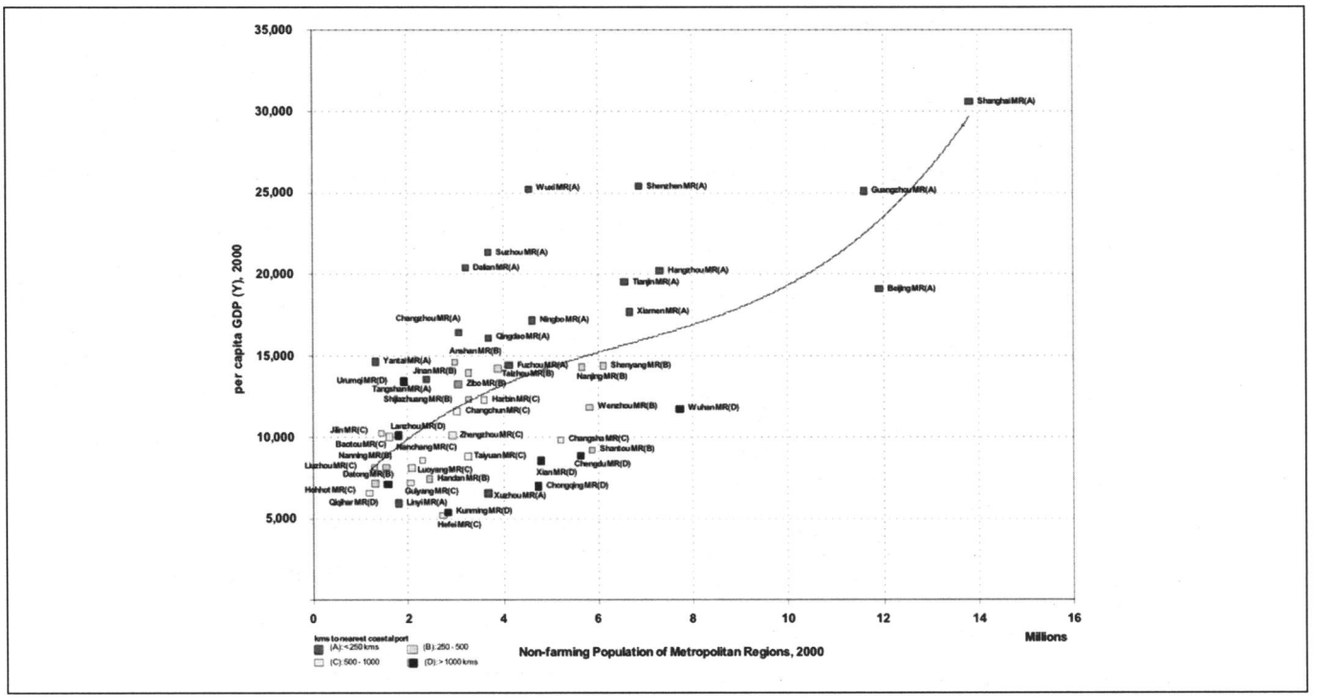


Fig. 10: Per capita GDP and population size of metropolitan regions, 2000.

lower agglomeration economies. All of these, except for Yantai MR, have per capita GDP levels in the bottom third of the range of the 53 metropolitan regions, and all are non-coastal.

Statutory towns are very important elements of China's metropolitan regions. In most MRs, well over 30 percent of the total regional population lives in towns (fig. 11). As a whole, statuto-

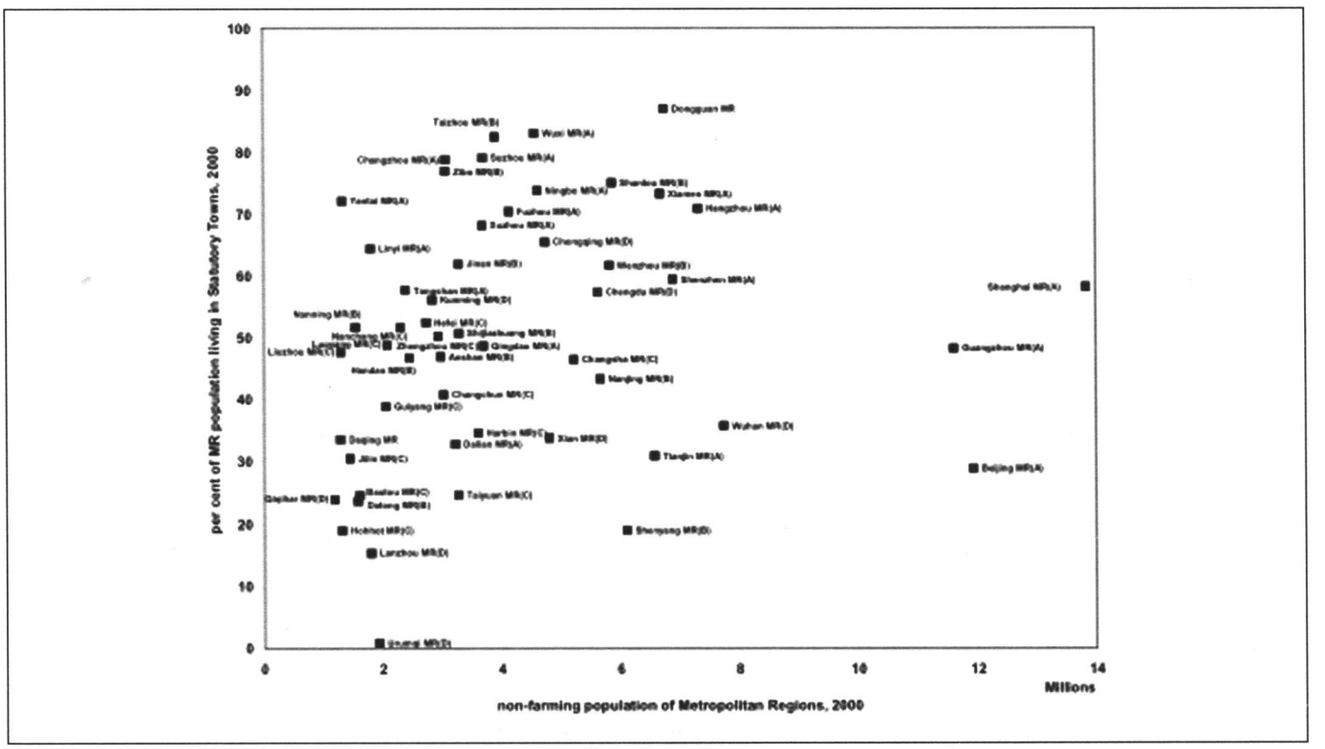


Fig. 11: Towns in China's 53 metropolitan regions, 2000.

ry towns now hold 52 percent of China's metropolitan region population; in 27 of the 53 MRs, towns account for more than half the total number of residents. While there are certainly many exceptions, these towns are generally characterized by: far lower population densities than the central metropolitan areas; low statutory designations of densities through town-administered development controls (e.g. floor-area ratios); comparatively weaker control over conversion of land for urban development; limited and in many cases rudimentary social services; small and scattered, intensive-intensive enterprises; lower levels of human capital in terms of educational and training attainment; limited fiscal capacities (particularly in light of the recent banning by the Ministry of Finance of town-based extra budgetary fees); and governance systems designed to manage farm-based rather than urbanizing economies.

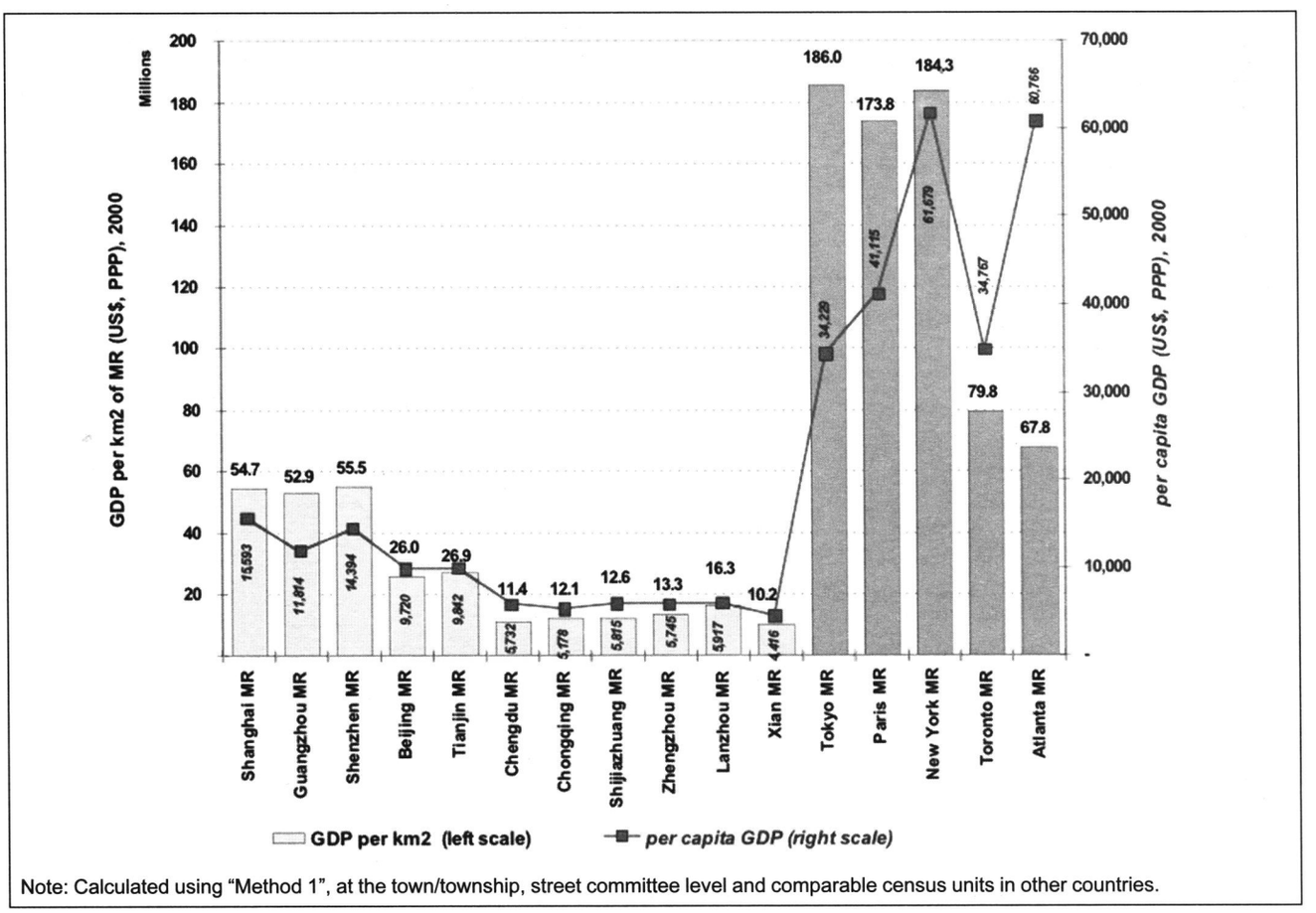
Current public policy in China is to promote urbanization in all towns (especially county seats) and small cities, regardless of their competitiveness and economic sustainability. From the central government's perspective, it cannot be perceived to be picking winners. This is also true at the municipal level, but local governments often go one step further and build new towns as special districts so as not to favor one town over another, thereby adding to spatial dispersion that undermines urbanization economies. This undifferentiated policy avoids difficult decisions and could, over time, actually undermine the urbanization process.

To maximize agglomeration benefits, governments need to promote urbanization in strategic smaller cities and towns within Metropolitan Regions, and not only to their central areas and outer cores. Governments need to set priorities among a few smaller, strategic cities and towns that have the strongest potentials for supporting the formation of new firms, attracting enterprises from outside the region, creating employment, and integrating into regional labor markets and supply chains. This needs to be done on the basis of objective analysis of the metropolitan region's economy as a whole – a particularly difficult challenge given that, for a variety of reasons associated with property rights, municipal government compete fiercely in China for inward investment.

Efficient and effective development of metropolitan regions in China also depends in large part on the removal of constraints to town-based urbanization. The promotion of urbanization in strategic towns and smaller cities in metropolitan regions will require continuing efforts to remove the constraints to migration posed by:

- labor mobility restrictions still pervading from the hukou household registration system;
- shortage of affordable housing for migrants in suburban towns and their often uncertain tenure;
- limited access to and inconsistent availability of affordable social services at acceptable standards, especially education and health;
- lack of access to at least a basic level of social security; and,
- in some areas, formal and informal constraints to migrants entering the town-based labor market.

Constraints to in-situ urbanization also need to be removed, particularly the arbitrary and often inadequate compensation paid



Note: Calculated using "Method 1", at the town/township, street committee level and comparable census units in other countries.

Fig. 12: Productivity of selected metropolitan regions, 2000.

by town governments to farmers for conversion of their land to urban uses (creating the new non zhuan fei population of "landless farmers" who are no longer farming, but are not provided the means for integrating into urban/suburban non-farming labor markets), the absence of training mechanisms to support the transition of these farmers to non-farming occupations, and, in bigger towns and those now within suburban districts, the limited access to affordable public services that are available to more established "urban" neighbors.

Improving production and innovation capacities

All city and town governments in China need to be concerned with increasing their firms' productivity to become and remain competitive. However, given that China's 53 metropolitan regions contribute two-thirds of the country's non-farming GDP, productivity improvements in their urban and suburban areas are essential if national economic growth is to be sustained.

China's metropolitan regions have far lower levels of labor and spatial productivity than those in more advanced economies (fig. 12). Furthermore, there appear to be three distinct levels of MR productivity, the highest being in Shanghai, Guangzhou and Shenzhen, followed by Beijing and Tianjin (at about half the productivity levels), and then what appears to be a consistent third level of remaining MRs, at about half the levels of Beijing and Tianjin.

Few cities, including in China, have sufficient capacities for all forms of production. If market and regulatory conditions allow, firms use a location's comparative advantages to create competitive advantages. Cities and metropolitan regions, therefore, tend to specialize in their production capacities, especially in market economies.

A key issue raised by municipal governments has been defining local productive sectors that could become competitive and, hence, which production capacities need to be improved. Under the central planning model, this was not an issue: central planners decided on the roles of cities in supply chains, and allocated what, in their view, were the resources needed to support production capacities to fulfill these roles. In the transition to a market economy, there is considerable uncertainty at local levels in China over what a city's new roles in supply chains should become. This frequently leads to misallocation of resources in supporting inappropriate capacities, and to rising opportunity costs. For example, almost every city now has a "high-tech area" or zone (many are virtually empty), and most municipal governments declare some form of "high-tech manufacturing" to be a "pillar" industry. However, there are very few cities in China (or, for that matter, in the Americas, Europe or Japan) with sufficient production capacities and competitive advantages in real "high technology."

In fact, capacities to manufacture competitively are also limited: not all cities in China are, should be, or could become significant manufacturing centers. The Yangtze Delta, comprising Shanghai, Jiangsu and Zhejiang Provinces, produced 23.4 percent of China industrial value added in 2000; Guangdong Province (largely the Pearl River Delta) contributed 13 percent, Shandong 9.7 percent, and the Beijing-Tianjin corridor 5 percent (fig. 13). Together these four regions therefore created 51 percent of China's industrial value added. China's industrial con-

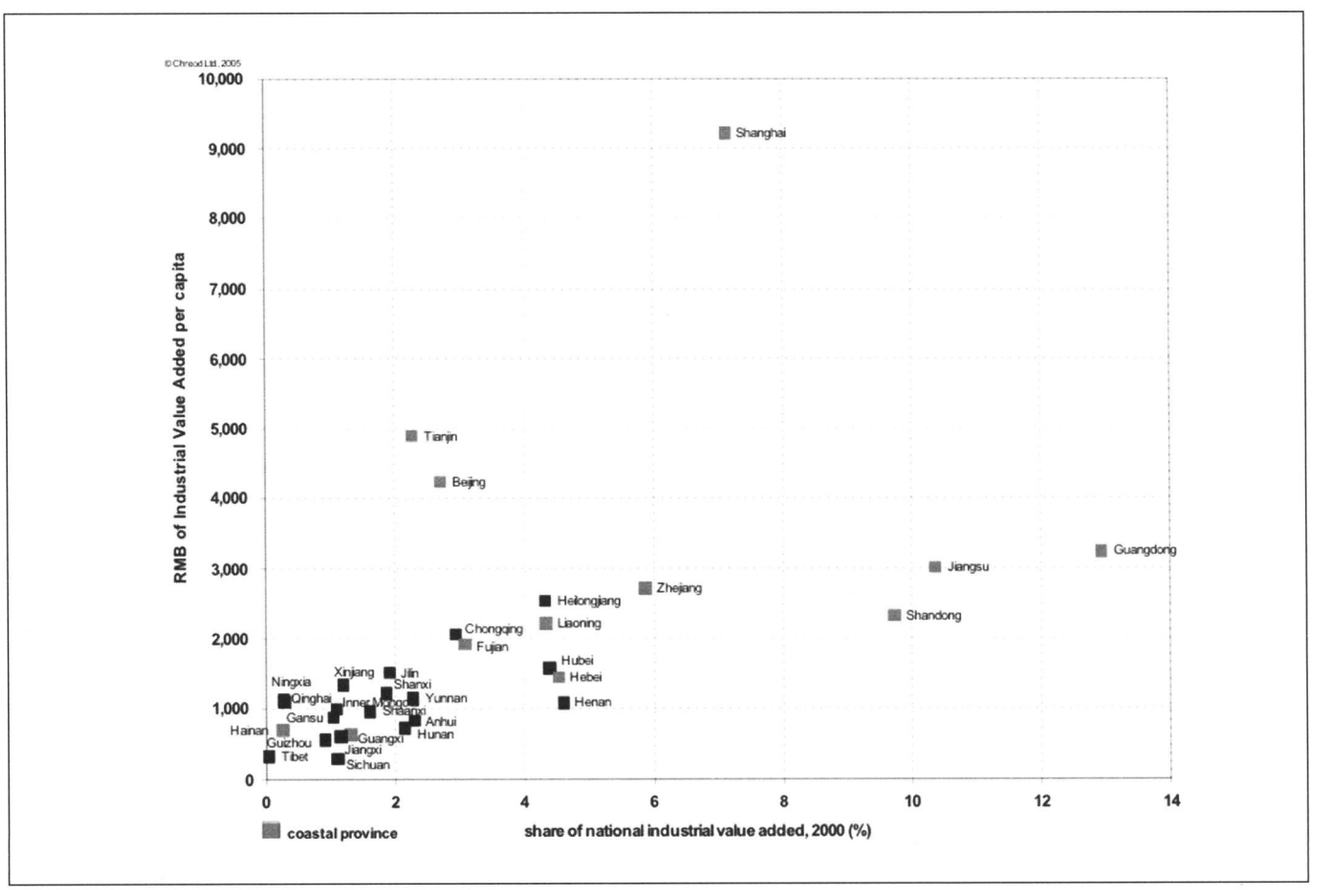


Fig. 13: Industrial productivity of provinces, 2000. (*Source:* Calculated from Jiang (2001), tables 6, 9 and 11).

centration is further illustrated in the map on figure 14 that shows the proportion of county and city workforces employed in manufacturing in 2000. Fully one-quarter of China's manufacturing workforce is located in the Yangtze Delta Region (18.6 percent) and the Pearl River Delta Region (17.0 percent). The Beijing-Tianjin Corridor holds only 3.3 percent. On a per capita basis, there is a 32-fold difference between provinces in industrial value added.

The higher value-added industrial outputs in some provinces reflect a combination of factors including: degree of industrialization and the role that industry plays in provincial economies; history of industrial activity and resulting path dependencies; access to export distribution hubs; current and recent regulatory environments affecting new, primarily foreign investment (such as designation of Special Economic Zones in the 1980s and early 1990s); factor endowments; innovation capacities; and total production costs relative to competing regional locations outside of China. Clearly, there are large differences in each of these factors among China's provinces and its 53 metropolitan regions of which governments need to be very aware. Not every metropolitan region – in any country – can do everything. Local governments need to take the lead in identifying, with other key economic stakeholders, realistic, attainable roles that their metropolitan regions can play in domestic and global supply chains.

The core production capacity of metropolitan regions around the world is their human capital. There are wide variations among China's cities in the levels of skilled workers. China's education system was severely affected during the Cultural Revolution when most schools and universities were shut down, creating a generation with comparatively weak educational attainment. This generation, now 45-60 years old, is absorbing the brunt of unemployment caused by SOE downsizing and closures since workers simply do not have the skills to apply to new jobs. In parallel, the historical disparities between urban and county/township level education continue, and very few rural or semi-rural students progress beyond the mandatory junior school level.

The results are huge differences in educational attainment across China's 658 cities (fig. 15). Two conditions are particularly significant. CLCs (which account for 438 of China's 658 cities) have extremely low rates of vocational attainment, and virtually no graduate-level attainment. This has serious implications for their levels of productivity and innovation, both of which are becoming important determinants of a city's national and global competitiveness. While most Prefecture-level Cities (PLCs) have a significant stock of vocational graduates, there is almost a ten-fold difference in levels between the lowest and highest ranked cities. Again, this suggests significant differences in labor productivity and capacity to assimilate new technologies. Also of concern, however, is the wide range among PLCs in residents with graduate degrees as a proportion of the city population. The human capital to exercise advanced functions in research, marketing and management are in short supply in many areas.

A central theme of recent regional and urban development policy in Europe and North America has been the importance of innovation.[13] Considerable research in many industrialized countries has shown a strong link between innovation and productiv-

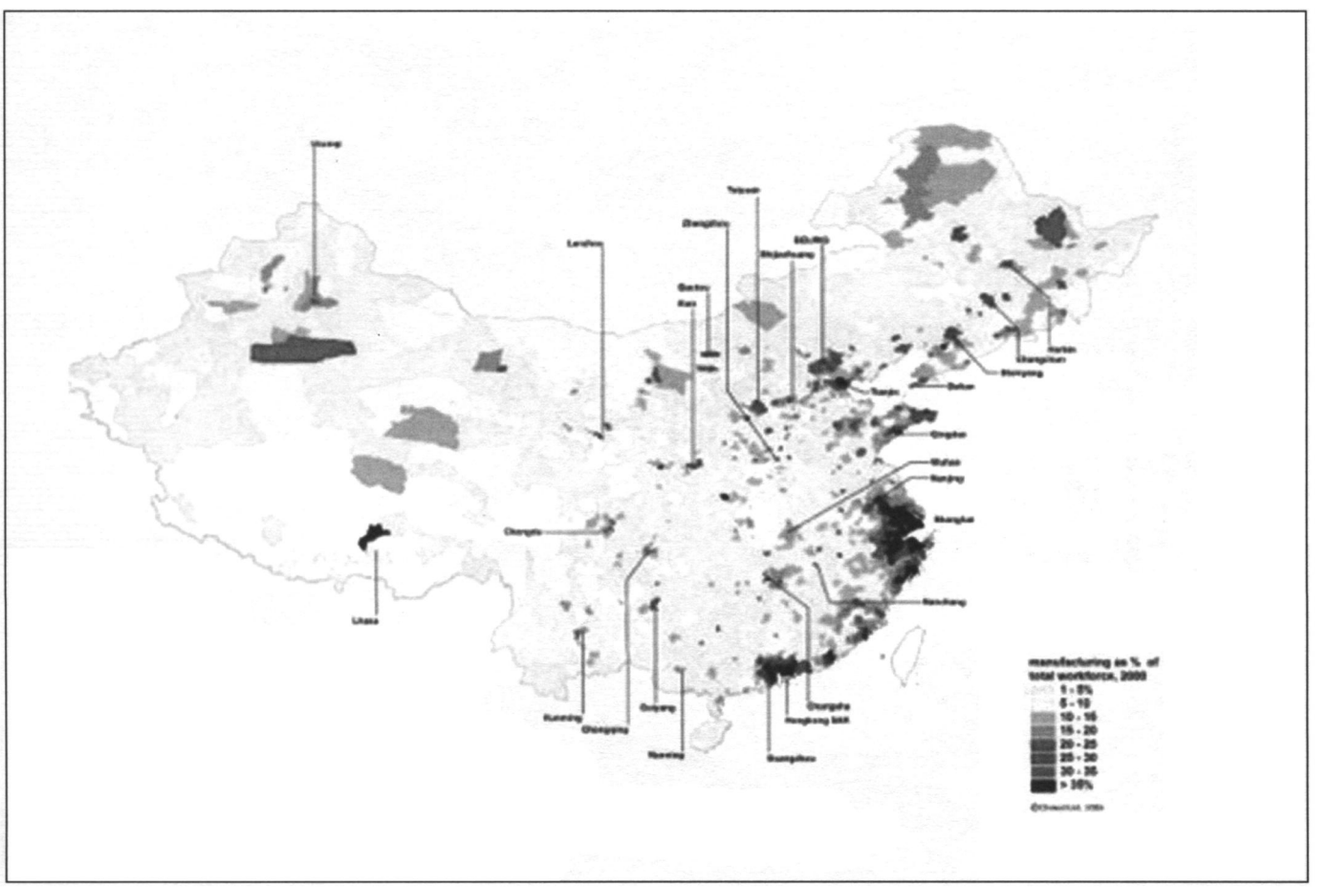


Fig. 14: Distribution of manufacturing workforce in counties and cities, 2000. (*Source:* Chreod Ltd calculation from *2000 National Census*).

ity of firms, and hence the competitiveness of areas in the context of a globalizing economy. Innovation capacities are essential to the continued profitability of firms for the simple reason that someone, somewhere is developing the same or similar products, services or distribution systems that meet customer needs at a lower price, or that respond to future market needs that are not yet obvious to competitors. Those metropolitan regions that foster innovation and its commercialization are likely to become China's leading producers and to be more quickly integrated into higher value-added global supply chains.

Compared to Europe and North America, there has been comparatively little research conducted on innovation capacities in China. There are few comprehensive policies in China specifically targeted towards fostering innovation (beyond some general provisions for "promoting science and technology"). There appear to be three distinct, but incomplete, innovation systems in China:

- The first is lodged vertically in government through research institutes and enterprises that rarely disseminate knowledge, even tacitly, to other organs of government, to universities, or to non-state enterprises.[14]
- The second lies within domestic firms, either quasi-public, State-owned corporations or private companies. While most do not conduct formalized R+D, significant accumulation and distillation of knowledge is acquired informally from other cities in China and overseas through study tours and conferences, and more formally through licensing of advanced technologies and hiring of graduates, including those returning from abroad.[15]
- The third is within foreign-invested enterprises, either joint ventures or wholly foreign-owned firms in a growing number of sectors.

China has explicitly linked direct foreign investment (DFI) to technology upgrading over the last 15 years. The assumption is that foreign firms will transfer improved technologies, and strengthen local innovation capacity through which spin-off technologies will emerge. While parts of China have been successful in attracting foreign firms that have served this policy goal, much of the DFI that is occurring in low value-added manufacturing, real estate, and infrastructure has little technology content, or the technology that is being transferred is third or fourth generation and beginning to degrade, at least for production geared towards more advanced domestic and export markets.[16] While these mature technologies certainly serve the purpose of upgrading many of the antiquated technological processes in China, they do not necessarily provide the springboard for strong and consistent technological upgrading, particularly if improvements to local human capital do not come with the transferred technology.[17]

The spillover effects of direct foreign investment (DFI) in China

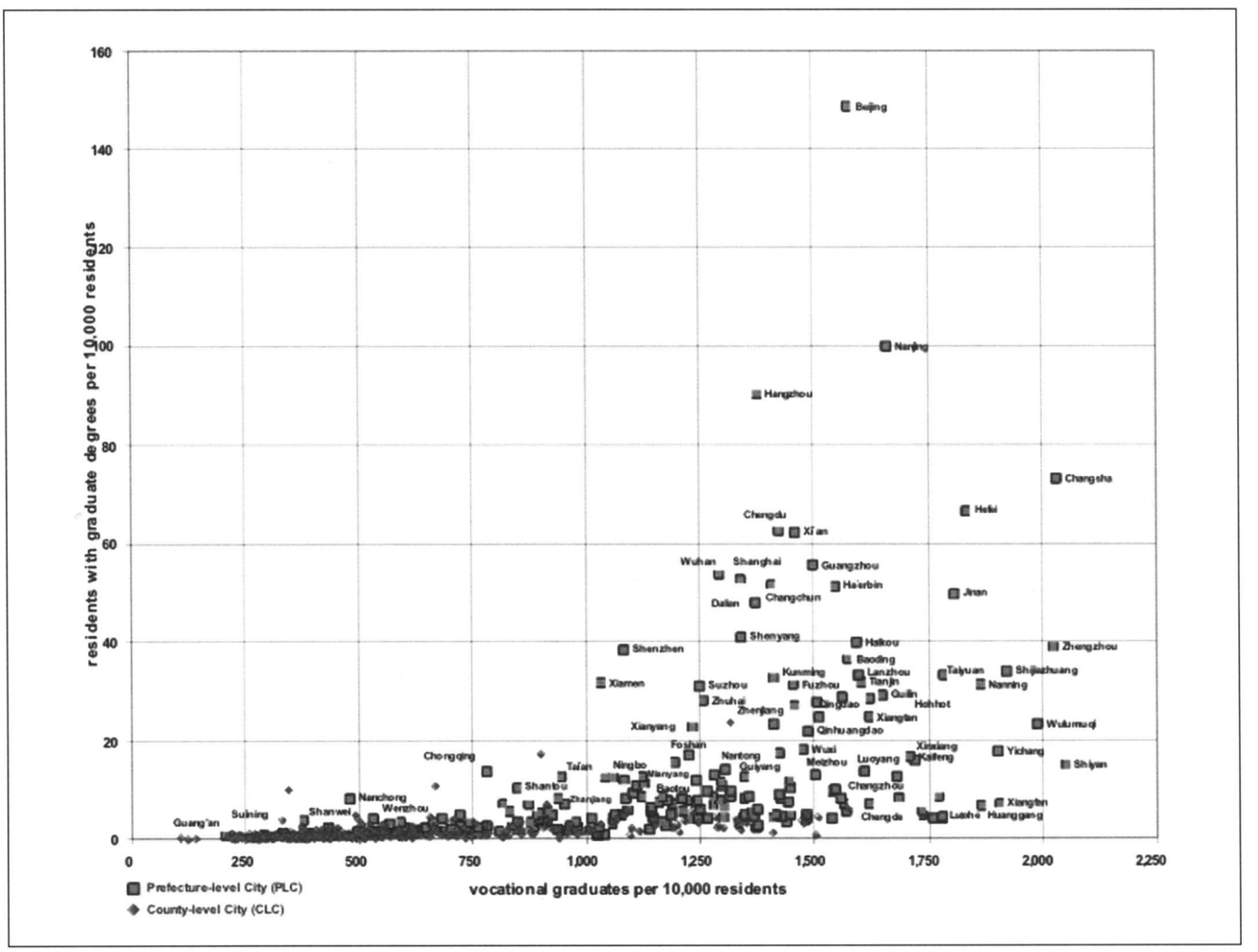


Fig. 15: Wide divergence in educational attainment in China's cities, 2000. (*Source:* Chreod Ltd calculations from *2000 National Census).*

are mixed, depending on the country of origin and the targeted sector for investment. DFI has been concentrated in selected coastal locations for many years to a very few of China's 53 metropolitan regions (fig. 16). The value added to manufacturing of this spatially concentrated DFI varies widely (fig. 17). While DFI has improved productivity in some areas, in many sectors it has not yet become the engine of innovation that government has expected.

While there are likely a host of reasons (including language and intellectual property protection), the reluctance of foreign companies from industrialized countries to transfer advanced technology and management practices is partly due to human capital in most of China's metropolitan regions. Educational attainment is likely to be the single most important constraint to fostering innovation capacities in China's cities over the next generation. The graph on figure 18 shows the difference between university attainment in China's cities (24 top ranked metropolitan regions are shown on the graph) and selected North American metropolitan regions. This could explain, at least in part, why foreign investors have so far generally resisted locating high value-added manufacturing and advanced services in China, preferring instead to keep these in locations where sustained access to highly-educated human capital is more assured. It also explains, in part, China's generally weaker indigenous innovation capacities.

Although university enrolment has increased considerably in the last five years, the delivery cycle for highly-trained technical and professional graduates is 6-10 years, and there is not likely to be a major upsurge in potential employees at least for another five years. But local governments need to recognize that a combination of new graduates and a reported increase in Chinese graduates returning from overseas institutions represent a potentially important addition to the human capital and innovation capacities of their metropolitan regions. Given increased labor mobility in China over the past few years, and growing competition among metropolitan regions to attract highly-qualified graduates, most of this segment of the workforce will be able move to where career opportunities are highest.

Broadening agglomeration benefits to vulnerable populations

There appear to be six major groups of vulnerable populations in many of China's metropolitan regions:

- laid-off and unemployed urban workers;
- newly-graduated students looking for work;

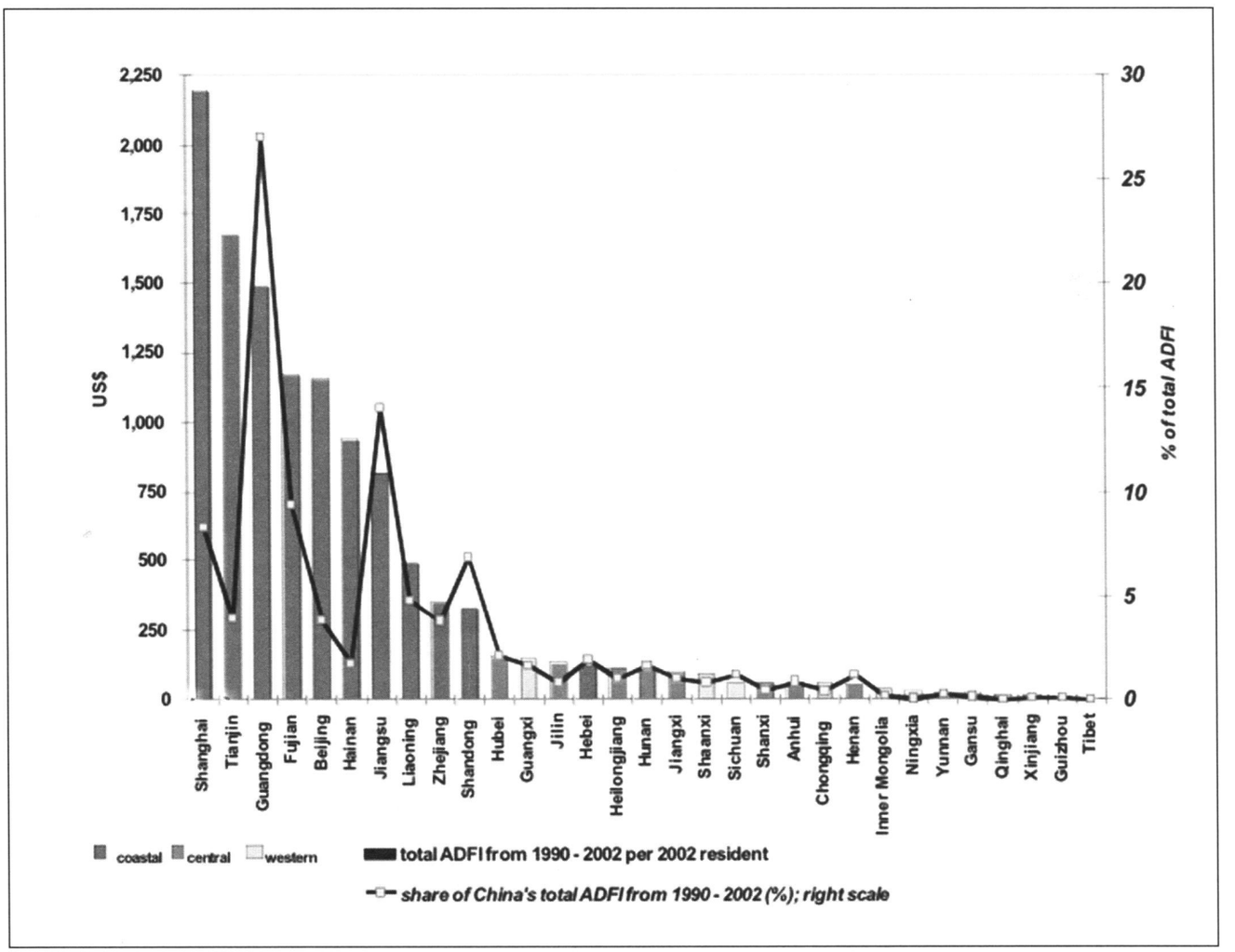


Fig. 16: Provincial performance in attracting foreign investment, 1990-2002. (*Source:* Calculated from 2003, 1996 *China Statistical Yearbooks*).

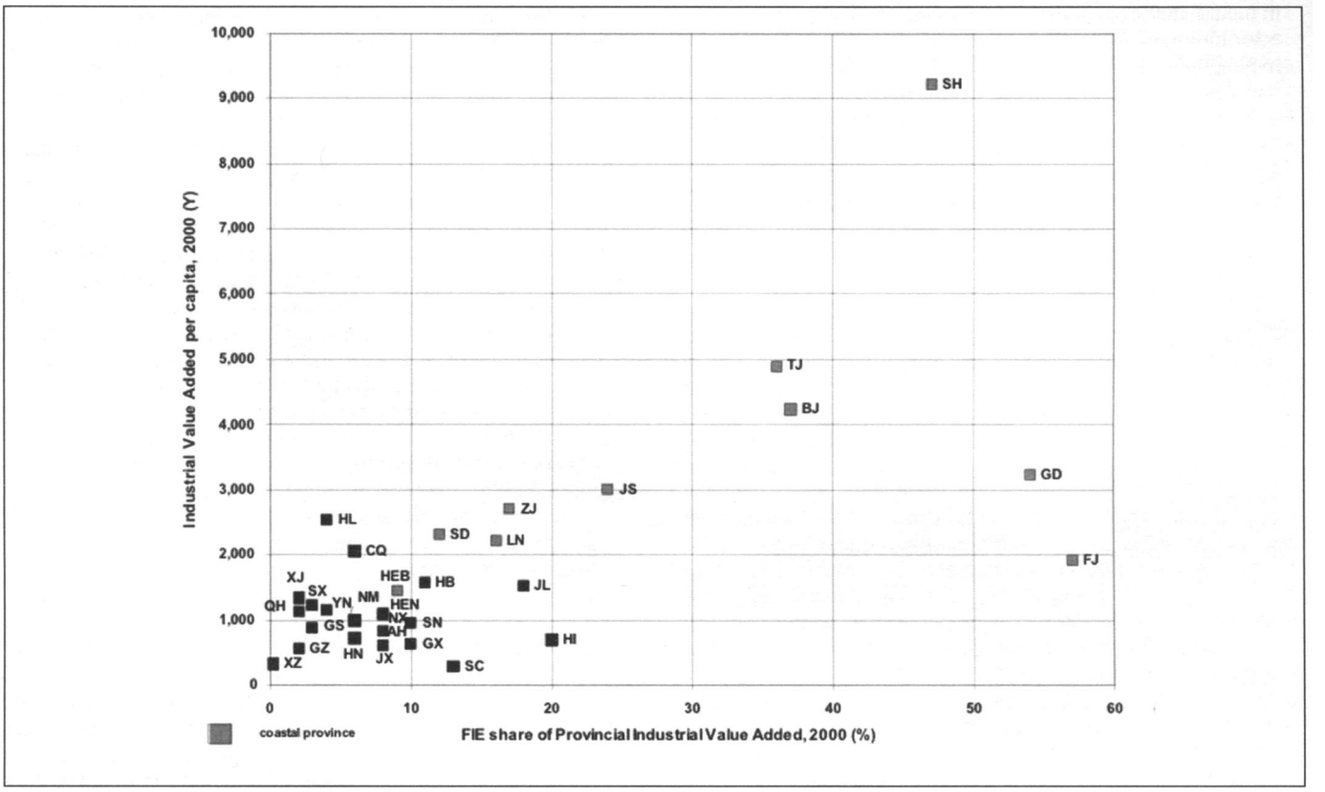


Fig. 17: Influence of foreign investment in adding value to China's manufacturing. (*Source:* Calculated from Jiang, 2001, Tables 6, 9 and 11).

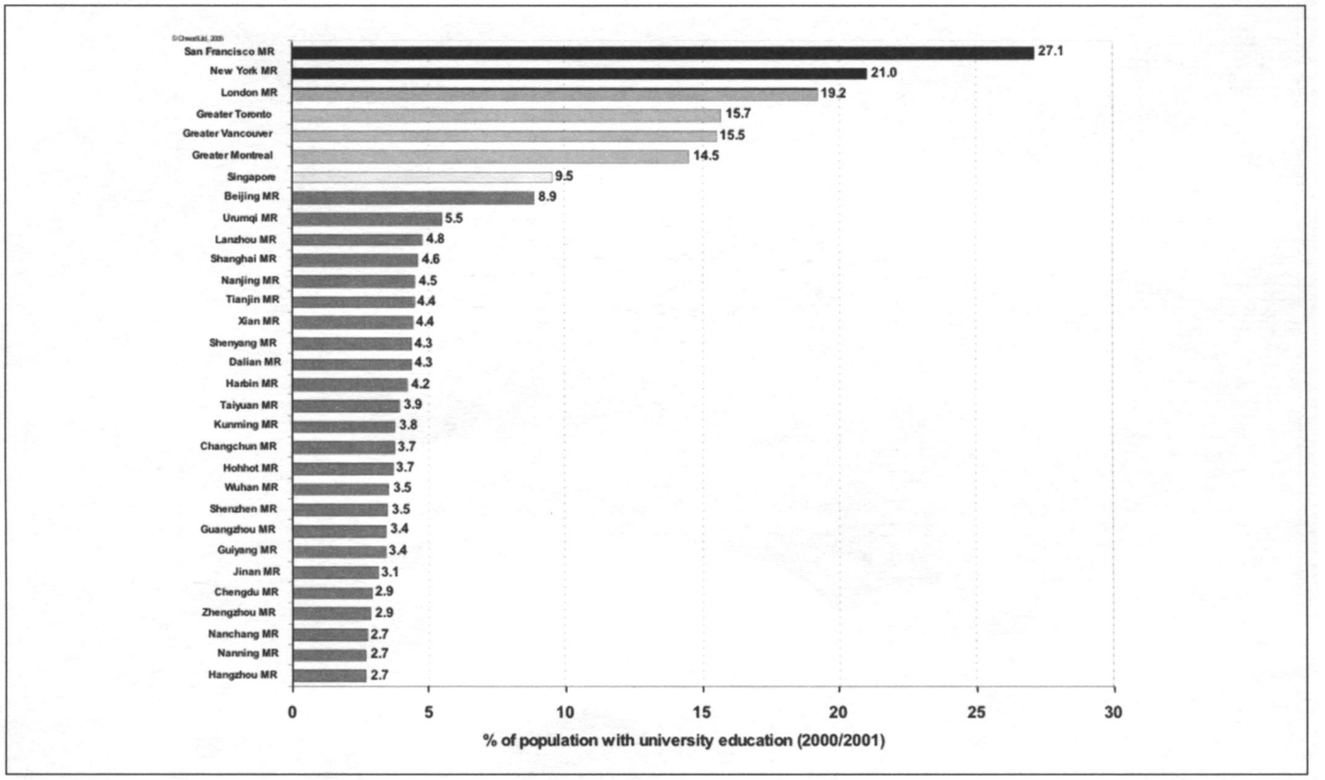


Fig. 18: Percent of metropolitan region population with university education, 2000/2001. (*Source:* For China, *2000 National Census of China* data; for Singapore, *2000 Population Census*; for Canada, *2001 Census*; for USA, *2000 Census*).

- the chronically "old poor" who are under the support of civil affairs bureaux;
- migrant workers and, increasingly, their families;
- "landless farmers" in suburban areas; and,
- over the longer term, a significantly expanded cohort of the elderly.

Local governments are largely coming to terms with their responsibilities for the first three vulnerable groups, but significant attention has yet to be paid to the needs of migrants, "landless farmers," and the aging population, all of whom are distributed far more widely across metropolitan regions.

There is a widespread impression that China's rural migrants are streaming to the coast, looking for work in the Pearl River and Yangtze River Deltas, and in the Beijing-Tianjin Corridor. According to the National Census, there were 75 million migrants in China's 53 metropolitan regions in the year 2000; they accounted for 51 percent of China's total migrants. But the two Deltas and the Beijing-Tianjin Corridor only accounted for 41 million migrants, or 28 percent of China's total of 147 million migrants that year and 54 percent of migrants in the country's 53 metropolitan regions. While there are certainly high concentrations in the two Deltas and in Beijing, rural migration is occurring throughout the country to cities of all sizes – with just over half to China's metropolitan regions (fig. 19). Not surprisingly, a larger proportion of migrants to metropolitan regions are attracted to those cities with higher levels of urbanization (fig. 20). This is significant, since migrants in China generally move on the basis of employment information gathered from family and other informal networks. Migration is a relatively good indicator of real employment opportunities.

Rural migrants lack affordable access to good housing, safe and secure employment, and are rarely included in any formalized social welfare system. Although it is now being gradually addressed, the household registration system has impeded the free flow of labor into the formal employment sector. However, the dynamism inherent in a more flexible labor market has been evidenced by migrant workers making substantial contributions to metropolitan regional economies with unemployment generally at much lower rates than for registered urban residents. In some cities, as much as 80 percent of the retail service sector is occupied by migrant labor. Such success is especially laudable in view of migrants' insecure legal status, and institutional barriers to their employment, schooling and social welfare provisions.

Urban welfare systems and rural land arrangements are the main institutional barriers to labor mobility. High costs of childcare and schooling also hinder rural families migrating to the urban areas. Because of institutionalized discrimination against migrants, they have traditionally borne heavier costs for healthcare and education. Responses by the migrant community to organize "informal" schools (offering reduced tuition rates) for their children has created a two-tiered educational system, excluding migrant children from mainstream educational opportunities. Housing costs in urban areas are also an important barrier. These existing barriers increase the migration cost, and dampen flows to cities and suburban areas.

Migrants are not only becoming an issue in central cities. While the highest numbers and densities of migrants are found in the cores of metropolitan regions, high concentrations are also found in selected suburban towns (fig. 21). Responding to social needs of migrants is, therefore, becoming a growing issue for town governments, not only for the municipal government in the core metropolis.

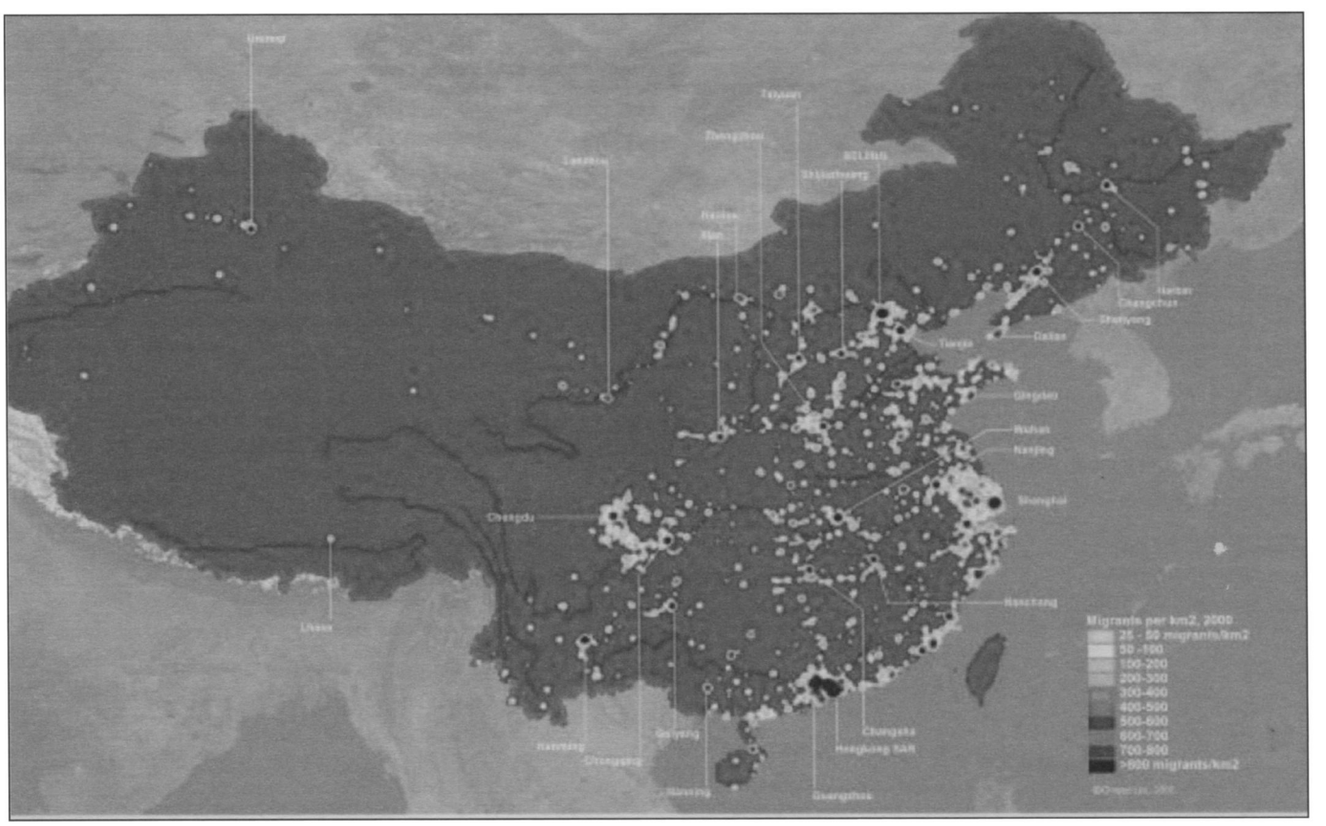


Fig. 19: Distribution of migrants: Migrants per sq.km, 2000. (*Source:* Chreod Ltd calculations from *2000 National Census*).

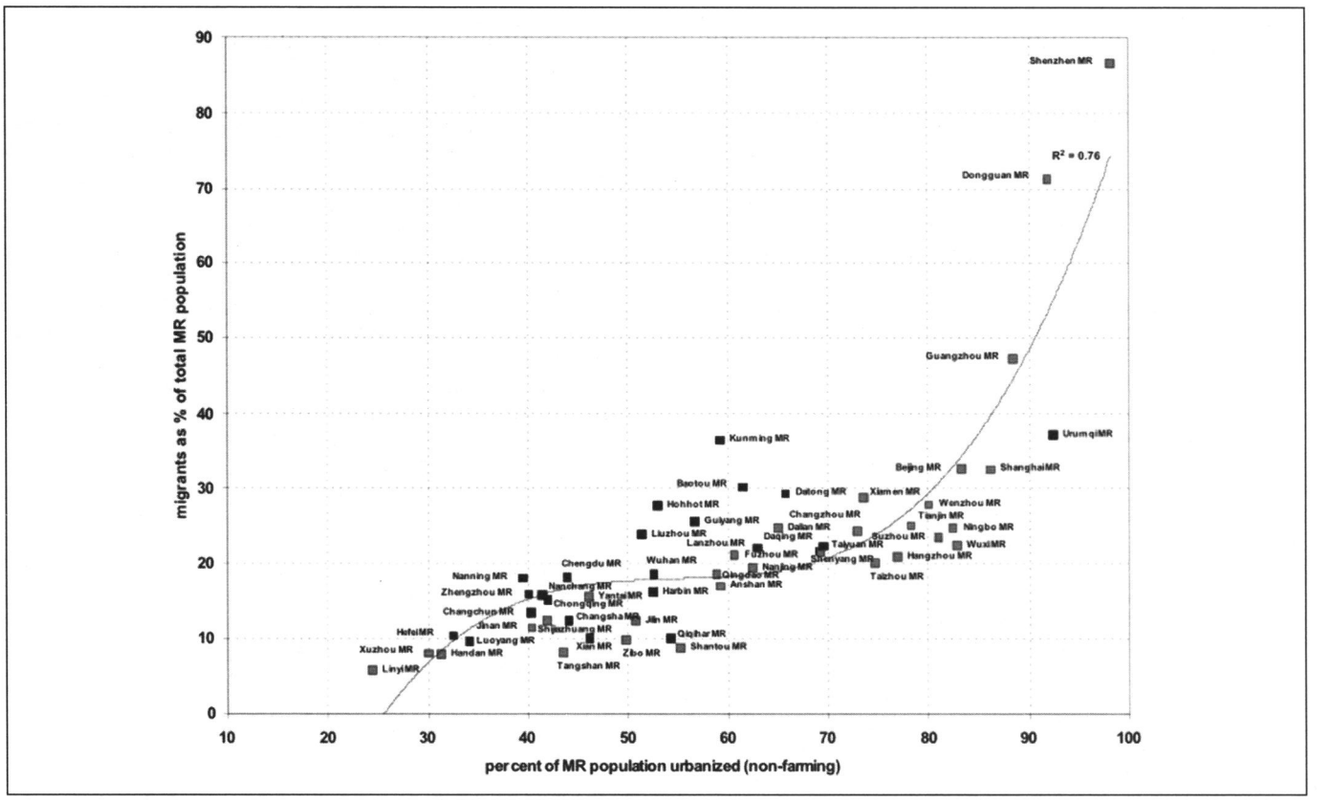


Fig. 20: Migrants are attracted to more urbanized metropolitan regions (2000).

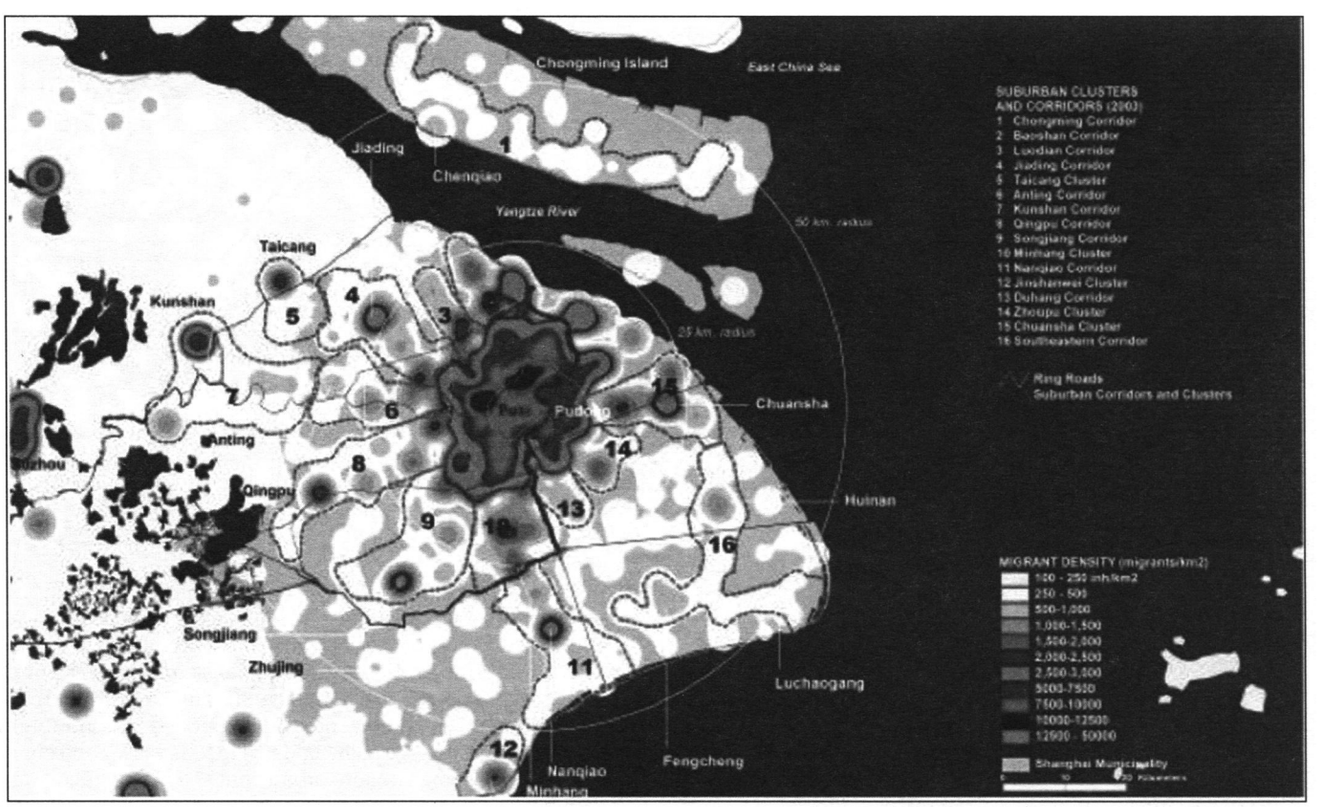


Fig. 21: Density of migrants in Shanghai metropolitan region, 2000 (migrants/sq.km). (*Source:* Chreod Ltd calculations from town, township, and *Street Committee Census 2000* data).

Suburban concentrations are directly related to employment locations: they are more dispersed in larger and more rapidly-expanding metropolitan regions such as Shanghai. Of all types of metropolitan residents, suburban migrants face the greatest constraints to employment choices because of their limited physical access across metropolitan regions, most of which have, at best, very rudimentary forms of regional public transport.

The relatively new social phenomenon of "landless farmers" is also likely to become a growing challenge to town and suburban district governments in metropolitan regions. At the end of 2003, there were reportedly 20 million such households in and around China's cities, representing a population probably approaching 80 million. While the central government's recent crackdown on unauthorized conversions of agricultural land to urban construction will dampen growth of the number of landless farmers in the short term, in the medium and long terms, such conversion will need to continue to accommodate land requirements of expanding metropolitan populations and enterprises.

A recurrent issue raised recently in many cities is the low level of compensation paid to farmers for forsaking their rights to landholdings. Aside from expropriation for infrastructure needs (such as roads), the principal method of land conversion is for town governments to purchase rights from farming households to assemble tracts of land that can then be marketed as industrial parks or sold to commercial developers for new residential and recreational uses. In some cities, there is a 30-fold spread between what is paid to farmers and the selling price of assembled and semi-serviced land. Many local governments are facing considerable pressure from landless farmers to retroactively increase compensation to approach what is perceived to be fair market value.

The challenge of integrating landless farmers into the labor force and social systems of metropolitan regions is similar to the situation with rural migrants. Unlike for migrants, the children of landless farmers already have access to formal education, and households often retain their homes. However, with their minimal incomes, costs of education are reportedly becoming onerous and measures need to be found to ensure that children will continue to have access as parents acquire urban skills and jobs. In addition, the principal needs for landless farmers are training in non-farming employment skills and improved, affordable transport access to employment opportunities.

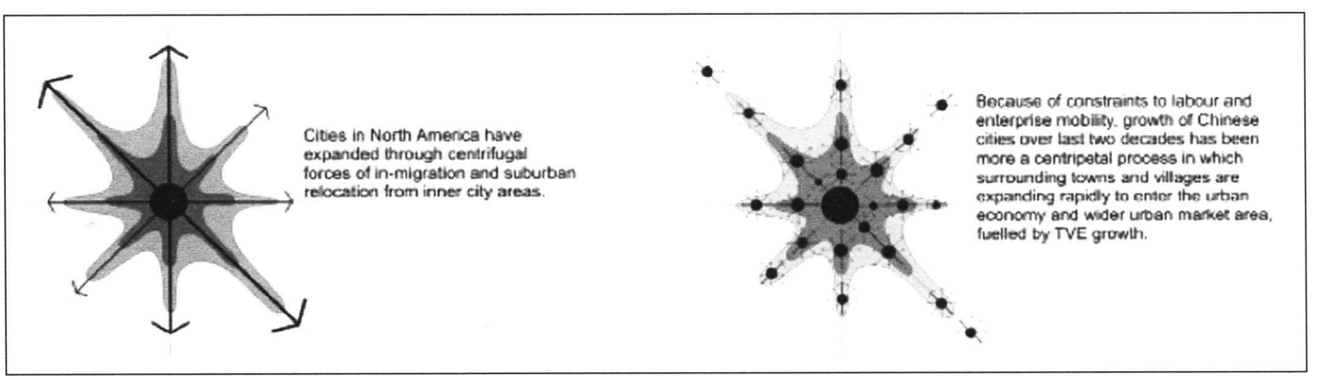


Fig. 22: Contrasting growth dynamics in metropolitan regions.

Directing urban and suburban growth

The spatial structure of metropolitan regional growth in China over the last two decades has differed considerably from the pattern in North American and some European cities over the last century. The latter have traditionally grown outwards in a centrifugal way with large influxes of migrants (from the countryside, from other cities, and from other countries) accompanied by large-scale suburbanization as many sitting residents relocated from inner city areas. In China, households and enterprises face numerous constraints to mobility into (and out of) inner urban areas that severely limit locational choices. Aside from hukou (mandatory registration at birth as either an agricultural or non-agricultural resident), which limits labor mobility, the dominant enterprise structure of vertically-integrated SOEs means that many supply chains are extremely localized within cities. Inner city land and housing tenure also affect mobility. Heavy subsidization of residential units by state-owned and government work units in urban areas has only recently been discontinued, and secondary markets in formerly state-owned residential units are slowly emerging. The decades-old administrative allocation of inner urban land to state-controlled enterprises at no cost means that, up until very recently, there has been no economic incentive for these firms to relocate to lower-cost suburban sites.

In suburban areas where arable land is collectively-owned and far less regulated, informal shifts from farming to small-scale industrial production have been relatively simple, particularly when firms are owned, at least in part, by town/township and village administrations. Similarly, residential and labor mobility among rural residents in suburban areas, including from other towns and townships, are less constrained. Residential growth in many suburban towns and villages is supported by informal rental markets that have evolved over the last 15 years. Therefore, while household mobility and enterprise formation have been tightly constrained within inner urban areas over the last two decades, under market reforms the reverse has been true in suburban towns, townships and their constituent villages.

The growth of metropolitan regions in China, at least over the past 15 years, has largely been centripetal, through locational decisions by households and firms that circumvent administrative constraints to residency, employment, enterprise formation and land tenure in urban districts (fig. 22). Given the population densities in suburban areas, and the relative ease of industrial enterprise formation, it has not taken much for farming areas on the outskirts of urban districts to rapidly transform into semi-formal suburban precincts. While this centripetal pattern of urban growth resembles some aspects of supposed "mega-urban" growth elsewhere in Asia, the underlying reasons for and characteristics of China's recent urban spatial transformation are unique to the administrative constraints imposed on property rights, the mobility of labor and capital, distribution systems, the

land market, and inter-jurisdictional trade. However, while most metropolitan regional growth in China over the last 20 years has been centripetal, centrifugal pressures are now building in many regions due to large influxes of migrants, industrial relocation from the central cores, new non-state investment in suburban industrial parks, and government efforts to reduce inner city residential densities by promoting relocation to suburban areas. Unlike in the past two decades, many metropolitan regions in China will face a complex mix of both centrifugal and centripetal growth pressures over the next 20 years.

The resulting spatial pattern of metropolitan regions in China is therefore a combination of high densities in central areas (generating attendant congestion and environmental costs), and very dispersed suburban areas which together undermine urbanization economies (figs. 23 to 26). There are numerous CLCs and towns in Chinese MRs that are all competing for inward investment and for spillover benefits from metropolitan economies. The capital and recurrent costs to adequately service these multiple sub-centers are often either unaffordable (and services are therefore not provided) or are very high and hence drive up costs to households and firms. In either case, urbanization economies do not accrue across the metropolitan region. This compares with spatial patterns in some highly-productive metropolitan regions outside of China, such as Paris and New York, where there

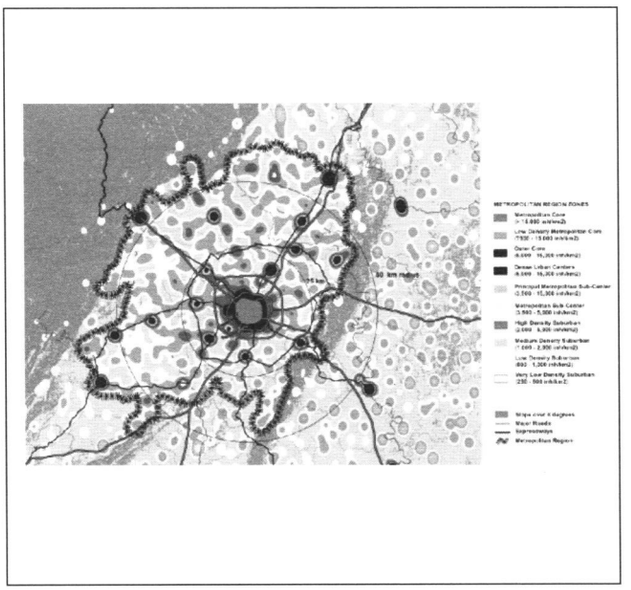


Fig. 23: Chengdu metropolitan region: 11.2 million residents (2000). (*Source:* Chreod Ltd using "Method 1" analysis of georeferenced Town, Township and Street Committee data from 2000 Census).

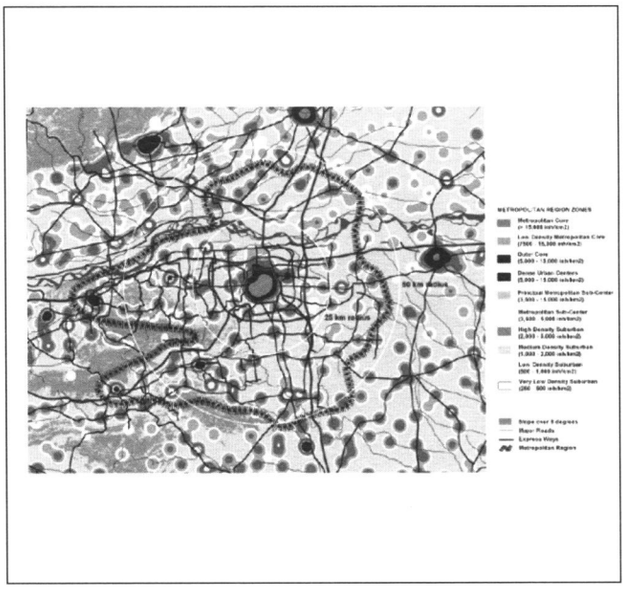


Fig. 25: Zhengzhou metropolitan region: 6.4 million residents (2000). (*Source:* Chreod Ltd using "Method 1" analysis of georeferenced Town, Township and Street Committee data from 2000 Census).

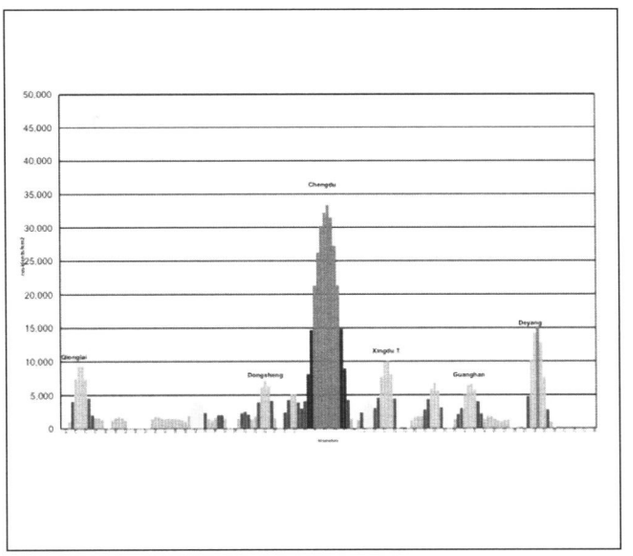


Fig. 24: Cross section of population densities in Chengdu metropolitan region (2000).

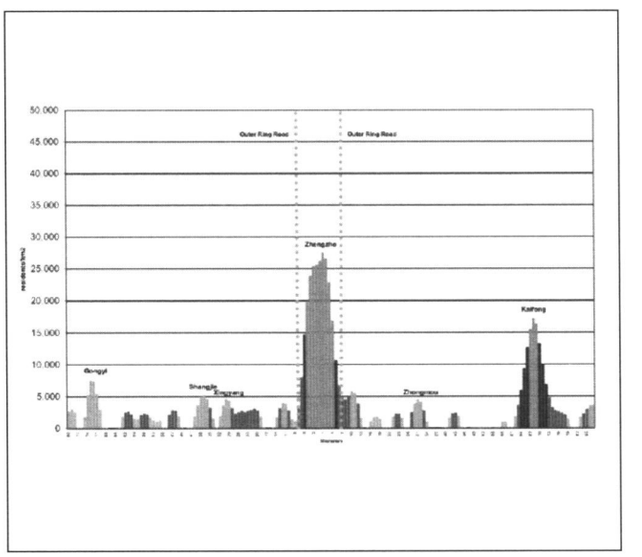


Fig. 26: Cross section of population densities in Zhengzhou metropolitan region (2000).

are lower central core densities and far fewer sub-centers (figs. 27 to 30).[18]

The comparatively high centrality of China's metropolitan regions is a direct result of two legacies: a long tradition in which the country's few cities predominantly played governmental and administrative rather than economic roles; and the central planning tradition favoring the development of rural areas and promotion of targeted industrialization within selected cities through strict controls on the formation and mobility of factor inputs, especially labor. Both traditions are now history, but the path dependencies are still manifested in very high central city densities, the proliferation of suburban towns (former market towns), and the comparatively low population densities within these towns.

However, with the dramatically increased mobility of factor inputs caused by market reforms over the last 20 years, many of China's metropolitan regions are beginning to expand rapidly through un-directed suburbanization. The result is consumption of agricultural land and growing urban sprawl that is causing inefficiencies in land use, land markets, goods transport, and public transport, all of which undermine agglomeration benefits. This is occurring not only in the major coastal metropolitan regions, such as Shanghai (fig. 31) and Guangzhou (fig. 32), but also inland in smaller regions such as Chengdu (fig. 33). Time-series analysis of satellite imagery[19] shows that built-up land areas in large parts of suburban Chengdu grew by 300 percent in a six-year period (1996-2002) and built-up parts of large areas of suburban Shanghai expanded by 350 percent from 1988 to 2002. Concerns over rampant conversion of agricultural land have triggered periodic inspections and local clampdowns by the Ministry of Natural Resources and Lands, but the basic problem for municipal governments continues to be actually knowing what is happening in suburban areas under the administration of outlying, relatively autonomous districts and town governments.

The form of suburban growth in metropolitan regions is calling into question the basic premises under which area urban development plans are being prepared in China's metropolitan regions. Most regions are developing through corridors of suburban development along major roads, and in smaller urban clusters an-

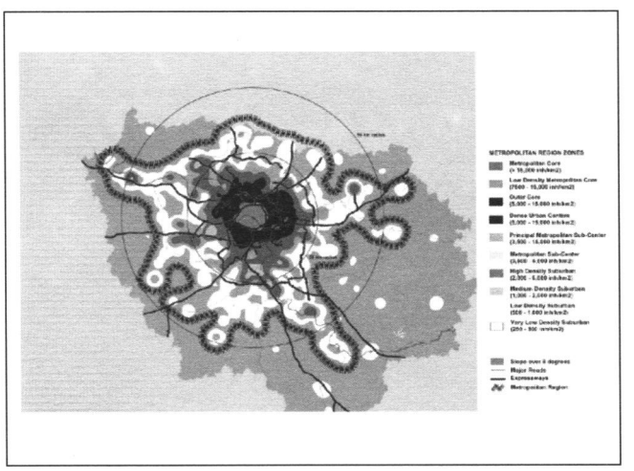


Fig. 27: Paris metropolitan region: 10.4 million residents (1999). (*Source:* Chreod Ltd using "Method 1" analysis of georeferenced data from 1999 Census).

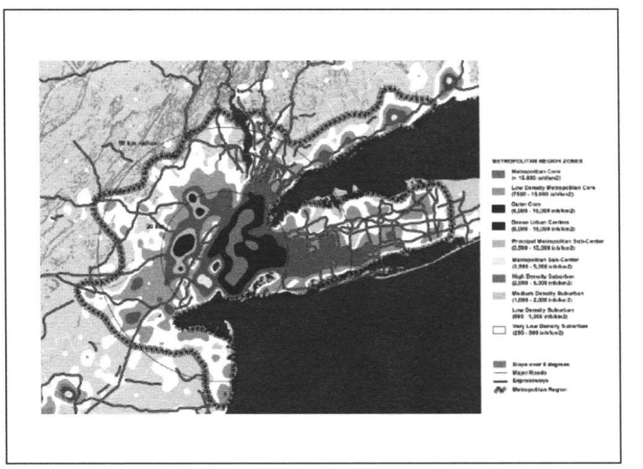


Fig. 29: New York metropolitan region: 16.2 million residents (2000). (*Source:* Chreod Ltd using "Method 1" analysis of georeferenced census tract data from 2000 Census).

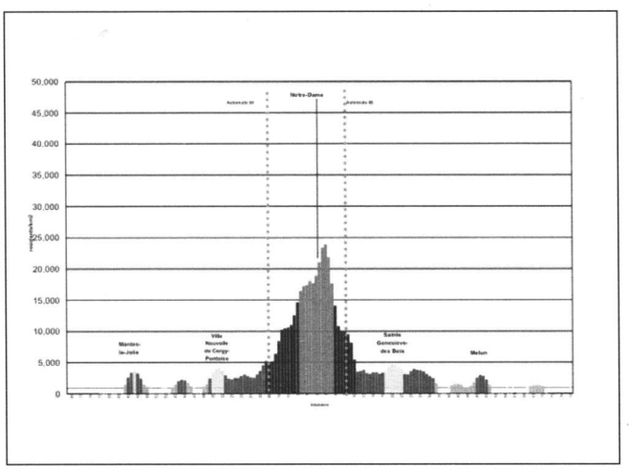


Fig. 28: Cross section of population densities in Paris metropolitan region (1999).

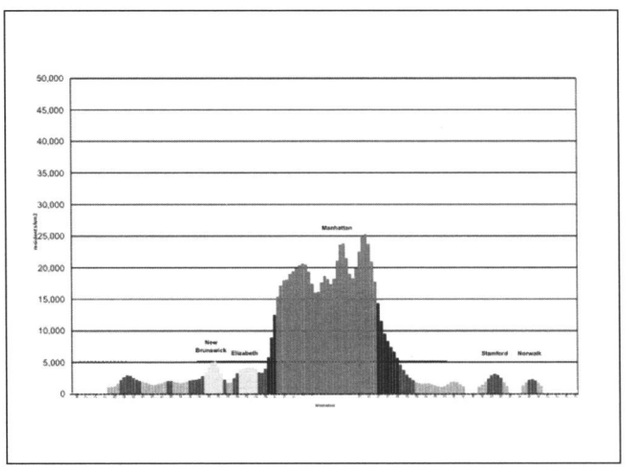


Fig. 30: Cross section of population densities in New York metropolitan region (2000).

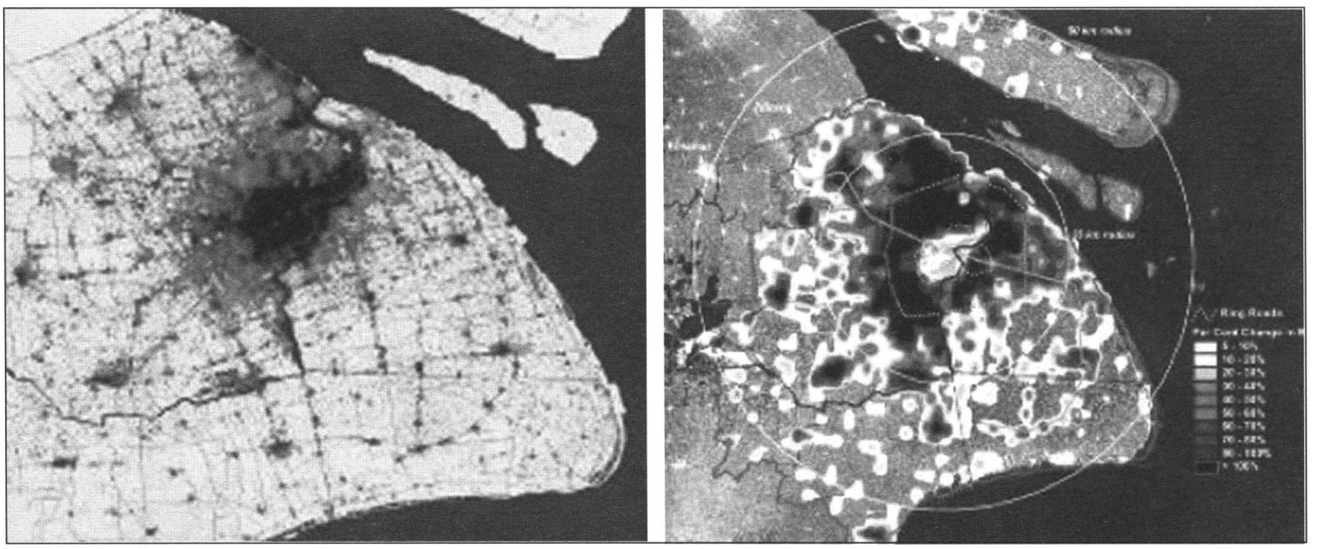


Fig. 31: Urban land use in Shanghai: 1988 and 2002; change intensity (right). (*Source:* Chreod Ltd).

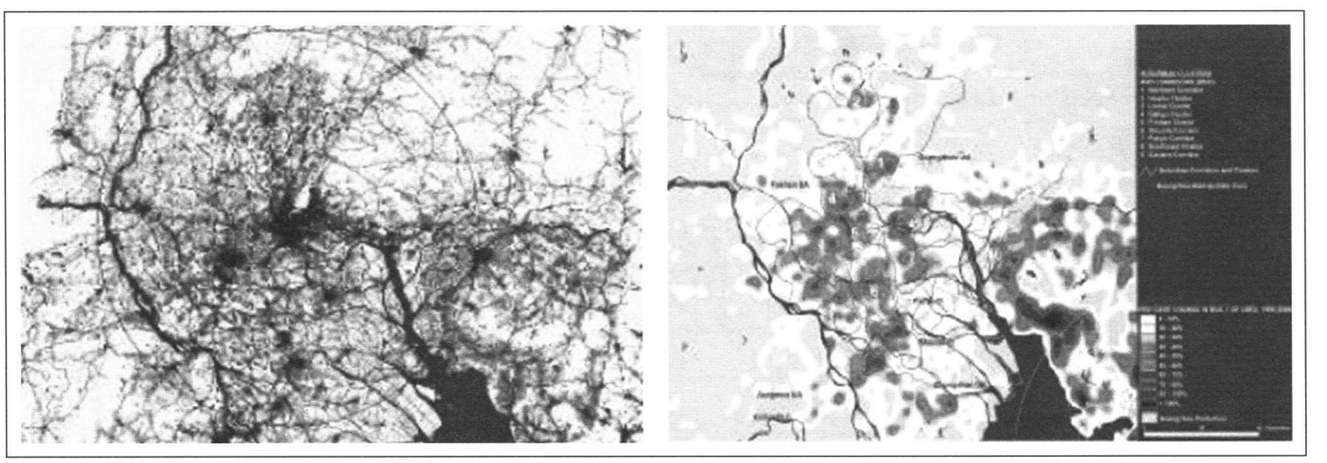


Fig. 32: Urban land use in Pearl River Delta: 1990 and 2000; change intensity (right). (*Source:* Chreod Ltd).

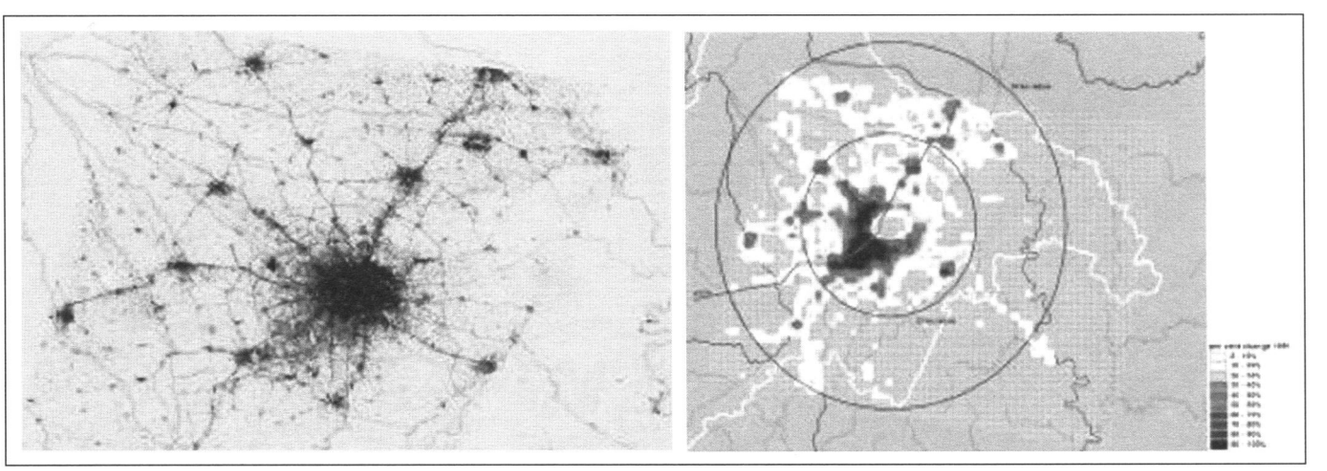


Fig. 33: Urban land use in Chengdu: 1991 and 2002; change intensity (right). (*Source:* Chreod Ltd from satellite data provided by Schneider et al., 2003).[19]

chored on suburban towns. This pattern of growth is occurring in metropolitan regions of all sizes, ranging from the largest (Shanghai and Guangzhou; figs. 34 and 35) to intermediate regions such as Chengdu (fig. 36) and even to small metropolitan regions such as Lanzhou (fig. 37). Corridors and clusters do not respect administrative boundaries, and invariably traverse municipal and sub-municipal jurisdictions.

There is a serious disconnect between urban and transportation planning in many of China's cities and the actual pattern of suburban development in corridors and clusters. China's planning approaches are still lodged in traditional monocentric and polycentric models: detailed plans are prepared for nodes that are connected through transportation networks to form a larger, ordered urban system – at least on paper. But disparate market forces take advantage of lower land costs (and often lower costs of regulatory compliance) in non-central areas and on the peripheries of nodes, resulting in the corridor and cluster pattern of urban development common to many metropolitan regions around the world. The example of Shanghai is instructive where the Master Plan to 2020, approved by State Council in 2000, has already been superseded by extensive suburbanization along corridors and in several large clusters – all of which were not anticipated in drawing up the Master Plan (figs. 38 and 39).

The population densities of central areas in many of China's

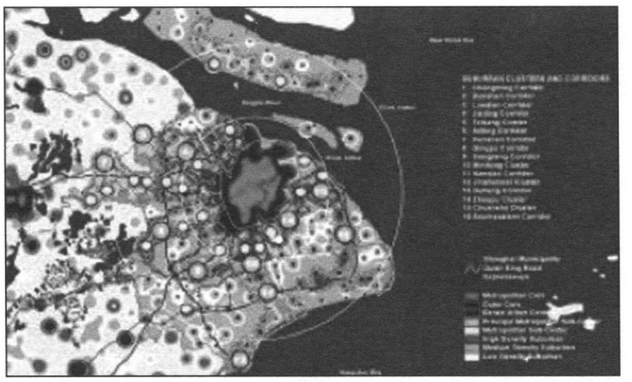


Fig. 34: Shanghai corridors and clusters.

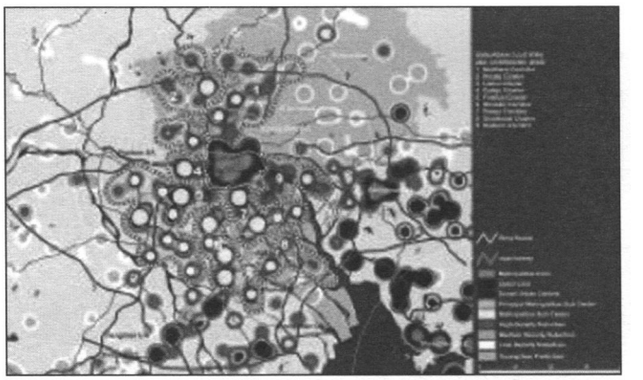


Fig. 35: Guangzhou corridors and clusters

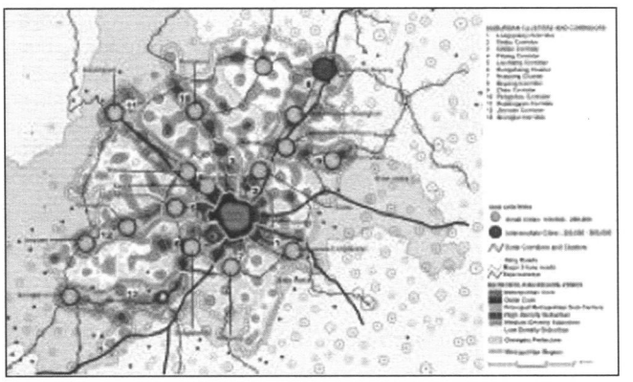


Fig. 36: Chengdu corridors and clusters.

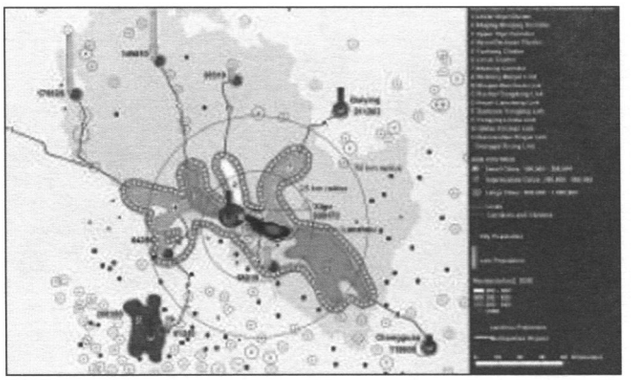


Fig. 37: Lanzhou corridors and clusters.

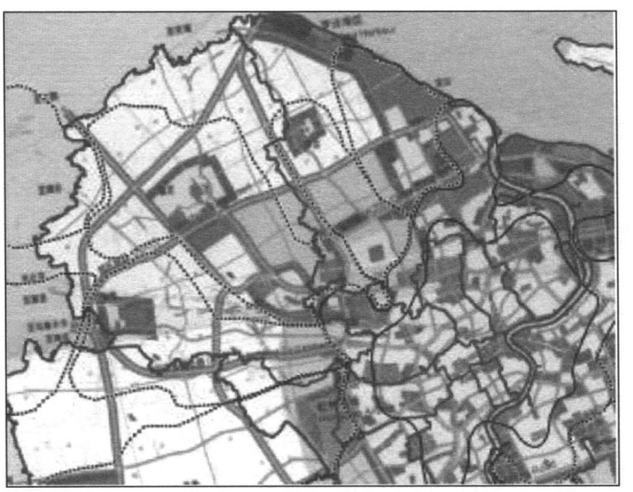


Fig. 38: NW Shanghai in 2020 per Master Plan approved in 2000.

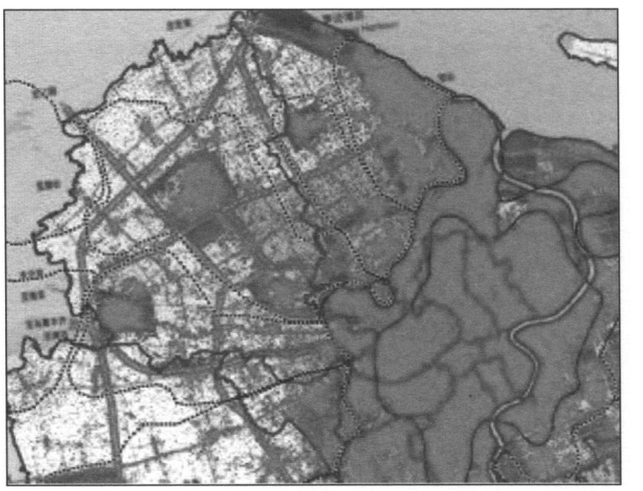


Fig. 39: NW Shanghai actual land use in 2002.

MRs are high, and some governments are attempting to address congestion and environmental externalities by promoting de-densification through resettlement to the outer cores and inner suburbs. But a long legacy of policy emphasis on central areas has yet to be overcome in many metropolises. Their outer cores – the transitional zones between the formal "builtup" urban districts and the more unregulated suburban towns, often now straddling the ubiquitous "outer ring roads" in many cities – are becoming an uncontrolled sprawl of formal and informal land uses with low levels of infrastructure and transport services and, in many cases, growing industrial pollution. This undermines agglomeration economies by decreasing efficiencies and raising the costs of social and economic interactions not only between the outer and inner corers, but also between suburban zones and the inner core.

The principal growth management challenges in China's metropolitan regions are:

- strengthening the development of principal and secondary sub-centers in the metropolitan region;
- increasing the connectivity between these sub-centers and with the metropolitan core;
- minimizing centripetal growth of scattered villages and small towns in suburban areas; and,
- minimizing scattered, centrifugal suburban development in the outer metropolitan core.

For metropolitan regions in China to maximize agglomeration benefits for their residents (including vulnerable groups) and enterprises, the structure and form of urban and suburban development need to be better managed. This will require a major shift in spatial scale by municipal governments beyond their urban districts to the functional metropolitan region as a whole, and by town governments who generally focus on their very limited spatial territories with little reference to wider regional trends and needs.

Governing and managing metropolitan regions

The comparatively rapid emergence of metropolitan regions in China is pushing existing forms of sub-provincial governance beyond their institutional and fiscal limits. Few societies in recent urban history have effectively managed the transformation of cities into large, dynamic and complex metropolitan regions. China has the opportunity to learn from the mistakes and successes of other countries, to modify the most relevant international practices to conform to the country's unique political, social and cultural conditions, and to apply them to harness the benefits of metropolitanization.

Perhaps the most important need is to shift political and institutional cultures to recognize the spatial extent, complexities, and importance of the metropolitan region. This needs to be done both from the bottom up – informing local stakeholders of the benefits of metropolitan regional development and how their individual actions can incrementally strengthen or detract from efficient and effective development – and from the top down, including at the highest political level. A first step could be the design and implementation of education programs and policy inquiries abroad for senior government leaders in municipal governments – and their policy advisors, both cadres and academicians. To be useful, such programs should be carefully designed as systematic and continuous acquisition, questioning, and application of new knowledge and not merely quick study tours abroad or short technical courses to mid-level technocrats. A growing number of multilateral and public agencies, and research organizations abroad are similarly trying to acquire, assess and synthesize understanding of how metropolitan regions evolve and how governments and other stakeholders can support their development most effectively. China needs to engage far more actively with these international agencies and organizations at every level.

A second important requirement is to rationalize the number and responsibilities of administrative jurisdictions in most of the country's metropolitan regions. Most current administrative boundaries and governmental jurisdictions were established decades ago (in some cases, centuries ago) to govern an agrarian society. Current administrative units are extremely fragmented in many of these regions (fig. 40), making inter-jurisdictional coordination and collaboration – a hallmark of well-functioning metropolitan regions – very difficult for all levels of government.

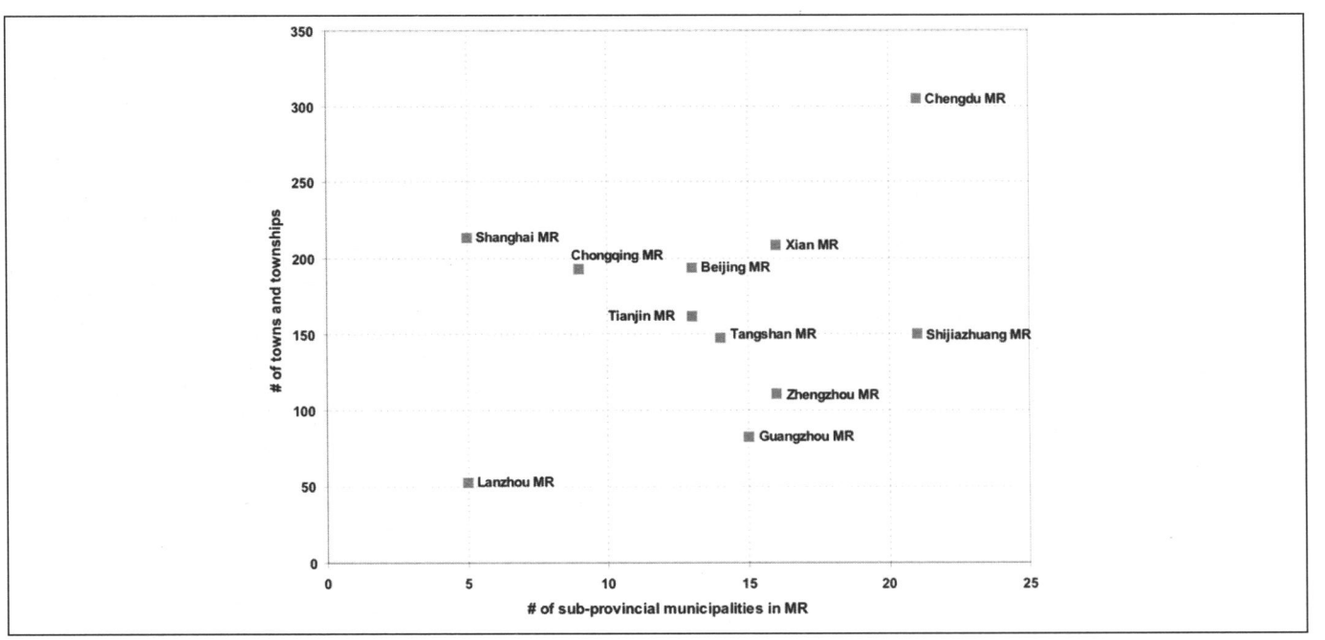


Fig. 40: Jurisdictional fragmentation in selected metropolitan regions, 2004.

In many areas, there are more than ten municipalities within a functional metropolitan region (PLCs, CLCs, and counties), and well over 100 relatively autonomous towns and townships.

But changing boundaries and administrative designations will not, on their own, improve metropolitan governance. These actions should be viewed as a rationalization measure to enable the re-allocation of functional responsibilities (and hence fiscal revenue assignments and expenditure responsibilities) among levels of government to support the efficient and equitable development of metropolitan regions.

China's "Law of The Local Peoples' Congresses and Local People's Governments" was enacted in 1979 and last revised in 1986: it does not define precise functional responsibilities that municipal governments are expected to exercise. Therefore, the delegation that is occurring is by administrative directive from the central and provincial levels. During this period of transition, understandably these directives are unpredictable and subject to modification which makes municipal planning and budgeting difficult. The best way to deal with such uncertainty is through the explicit and transparent codification of functional and fiscal assignments through constitutional amendments, new or revised legislation, clear regulations, and establishment of objective mechanisms to regularly monitor problems with assignments and recommend improvements.

Given the wide economic, social, cultural, and institutional differences among cities in China, it would be inappropriate to try to devise a model of functional responsibilities that would apply to all metropolitan regions in all provinces. Rather, some latitude needs to be given to provincial governments to develop models and structures most appropriate to their particular conditions. However, to ensure basic levels of equity and efficiency, the central government needs to clearly define the lower and upper margins of municipal functional responsibilities and explicitly tie these to expenditure and revenue assignments. For this framework to be effective, changes need to be made to the structure of municipal and sub-municipal administration so that assignments are made to units of government that have the territorial and functional mandates to exercise their responsibilities efficiently for the benefit of all residents.

Research needed now to support public policy

Public policies on metropolitan regions are at a tentative, embryonic stage of development in China. There are therefore two major policy needs. The first is to make policymakers aware of the existence and importance of metropolitan regions as a higher order scale of human settlement that needs to be better managed if agglomeration benefits are to accrue to China's enterprises and households. The second is to define at least an initial set of policies that:

- maximize the benefits of metropolitan regional growth;
- minimize the externalities of this growth; and
- distribute economic and social agglomeration benefits widely across regions, including to vulnerable populations.

In parallel, adjustments need to be made to existing governance arrangements and mechanisms so that policies can be developed, tested and implemented quickly and widely with the greatest benefit at the least possible cost.

Given the pace of development and resulting exigencies, our experience is that policymakers at all levels of government have limited interest in basic research on urban development in China, particularly by foreign analysts. They are, however, very interested in learning about international experiences of policies – both positive and negative – so that they can take lessons learned and apply them to China's unique social, cultural and institutional context. Indeed, this also applies to experiences in other cities within China, since there are few channels for meaningful exchanges among municipal governments. Comparative international and domestic research rooted in policy execution is, therefore, of greatest interest to policymakers.

While there is extensive experience in many countries in the development and management of metropolitan regions, some will be more relevant than others, given China's unique constraints to labor mobility (the hukou system), its system of state- and collectively-owned land and associated tenure rights, the allocation and security of public, quasi-public, and private rights over property, low levels of motorization, the historical legacy of population distribution within metropolitan regions, and China's tri-modal system of governance (Party, People's Congresses, and Administration). Within the context of these unique conditions, we propose the following policy-based agenda for research on metropolitan regions in China. The agenda is framed as questions that comparative research could seek to answer:

- **Theme A: Defining metropolitan regions**
  - How do other countries define metropolitan regions, both functionally and administratively? What criteria and measures do they use and why? How have these definitions changed over time, and why?
  - How important are metropolitan regions in other countries to output and employment growth? Do they matter more than smaller cities?
- **Theme B: Promoting agglomeration benefits of metropolitan regions**
  - How have governments promoted the growth of metropolitan regions? Which policies and instruments have worked best, and why? Which policies and instruments have failed, and why? Do proactive policies of government actually matter?
  - What measures (policies and instruments) have governments pursued (if any) to ensure the widest possible access to input and output markets across and between metropolitan regions, including those in global supply chains?
  - What conditions are required for localization economies (including from business clusters) to flourish in metropolitan regions? How have governments helped or hindered the development of localization economies across metropolitan regions?
  - What roles does human capital play in the economic development of metropolitan regions? How have local governments strengthened human capital, including inducing skilled and knowledgeable workers to move to their regions? Have government actions actually mattered?
  - What can local governments do, if anything, to foster innovation in their metropolitan regions, including supporting the development of regional innovation systems?
- **Theme C: Addressing Needs of Vulnerable Populations**
  - How have governments supported the integration of rural migrants into labor markets of metropolitan regions?
  - How have governments supported the integration of rural migrants into systems of social services and social security?
  - What policies, if any, have helped to integrate farming populations in suburban areas into metropolitan region labor markets?
  - How has farmers' land requisitioned by government or purchased by the private sector for conversion to urban uses been valuated? How have landholders been compensated?
- **Theme D: Managing the spatial structure of urban and suburban growth**
  - Has the spatial structure of metropolitan regions mattered to the realization of agglomeration benefits? If so, how?
  - How have the economic roles of suburban towns changed in the course of the development of metropolitan regions? How have governments supported these changing roles?
  - In market economies, how have land values across metropolitan regions changed as these regions have developed? What

are the principal drivers of changes to land values?
- What measures work best in rapidly-expanding metropolitan regions, at similar levels of motorization and economic development as in China, in providing cost-effective public transport across regions?
- How have governments controlled the location, density, and uses of land in rapidly-expanding suburban areas? How have they integrated suburban land development with regional public transport?
- How do governments in other metropolitan regions conserve agricultural and ecologically-sensitive land from urban and suburban uses? What instruments are most effective in land conservation?
- How have governments planned development of metropolitan regions that cross multiple jurisdictional boundaries? Which policies and institutional arrangements work best – and which have not worked? Why?
- How should governments monitor urban and suburban growth across metropolitan regions? What institutional arrangements are needed for effective monitoring and communication of findings?
- What urban development controls work most effectively in dispersed metropolitan regions with multiple administrative jurisdictions? Have these controls had negative, positive or only negligible effects on production and employment growth? On integration of rural populations into metropolitan regional labor and housing markets? Where in metropolitan regions have these affects been felt?

- **Theme E: Governing and Managing Metropolitan Regions**

- How have governments allocated functional responsibilities for delivery of public services (including infrastructure) across their metropolitan regions, particularly during periods of rapid growth?
- How have revenue entitlements (including transfers) and expenditure assignments matched with these functional responsibilities? How well do they work?
- What institutional mechanisms and arrangements work best in planning, regulating, and monitoring urban and suburban growth across the metropolitan region? What kinds of public participation in these arrangements work most effectively?
- What forms, if any, of regional delivery of infrastructure services have been pursued at the metropolitan regional scale? Which work best, and under what kinds of institutional conditions?
- How is the delivery of public services at the metropolitan region scale financed? What fiscal, regulatory and domestic capital market conditions are needed for the most cost-effective financing of regional infrastructure services?

While perhaps an ambitious agenda, governments at all levels in China will increasingly need answers to at least these 25 questions. Many researchers can, if they engage actively with China, provide answers to at least some of them based on their national experiences.

Economic and social changes over the past 20 years have created conditions in China that are likely to accelerate urban growth in many of the country's 53 metropolitan regions. These changes are supported by much greater mobility of labor, capital, technology and information than even a decade ago. If managed effectively, the agglomeration benefits that accrue to metropolitan regions in open economies could help drive China's continued economic growth and support social development well into this century. But if markets remain restricted, if vulnerable populations continue to be excluded from the benefits and opportunities enjoyed by more established urban citizens, and if the negative impacts of agglomeration in the form of uncontrolled sprawl and pollution are allowed to persist – all of which are beginning to happen, to varying degrees, in a growing number of China's metropolitan regions – then many of these regions could well become drags on provincial and national economies and focal points of social discord. Dysfunctional metropolitan regions in China could, given the country's scale, also have serious impacts on the future stability of global supply chains (including of energy resources and industrial commodities), on migration flows, and on regional and global environmental quality.

Focused, policy-oriented, and comparative research on metropolitan regions could help to inform China's policymakers on actions that could lead to more optimal outcomes.

Notes

1. The City Development Strategy (CDS) program is a global initiative operated by the Cities Alliance, a multi-donor initiative under the auspices of the World Bank. Its objective is to assist cities with the preparation of long-term municipal development strategies, from which short-term action plans are derived. While the CDS focus is on strengthening economic competitiveness, key components typically include poverty reduction, environmental protection, infrastructure improvements and institutional reforms. The CDS program in China is largely driven by requests from municipal governments. The first round of CDS in China (CDS 1) occurred in 2001; participating were the Changsha-Zhuzhou-Xiangtan City Region in Hunan province and Guiyang City in Guizhou province. The second round (CDS 2) in 2002-2004 included the city regions of Chengdu in Sichuan province, Erdos in Inner Mongolia Autonomous Region, Lanzhou in Gansu province, and Zhengzhou and Xinxiang in Henan province. CDS2 was launched by the World Bank and Cities Alliance after extensive consultations with the municipal governments of the client cities, and with central government agencies including the National Development Reform Commission, Ministry of Finance, and Ministry of Construction. The consensus from those consultations was that the second CDS in China should explore measures for improving the social, economic, and institutional linkages between the traditional "city proper" (comprised of districts of the statutory cities) and surrounding small and intermediate cities, towns and villages that together comprise the "city-region." See www.citiesalliance.org.
2. Chreod Ltd was commissioned to provide technical consulting inputs to both CDS projects after international competitive tendering by the World Bank. Other assignments for the World Bank and ADB which addressed the 15 other city-regions included: Review of Suburban Development Trends in Metropolitan Shanghai (2003; World Bank, with NTFESSD support); Metropolitan Development in Chongqing (World Bank; 2003); Review of Urban, Economic and Environmental Trends in Pearl River Delta (2002; for World Bank with CIDA INC support); and Preparation of a Provincial Development Strategy for Hebei (2004; Asian Development Bank; conducted in collaboration with the Shanghai Development Research Center).
3. Data on production inputs and outputs (input-output analysis), labor markets (labor force surveys, journey to work surveys, origin-destination surveys), retail markets (retail surveys), land markets (data on land transactions by location and type of use), and housing markets (sales, rentals, construction by location) are either not collected in China, are collected but are then tightly held by individual government agencies or, in the case of origin-destination surveys, are collected individually in cities every five years but are also tightly held by local transportation institutes.
4. Nomenclature of Territorial Statistical Units is a system used by Eurostat to break down administrative units of EU member countries, and against which all countries now report statistics.
5. Population data from the 2000 Census are available in tabular form by Town, Township and Street Committee. Given the magnitude of obtaining accurate polygon boundaries for all of these units, the data were digitized as 51,000 points on Chreod's China GIS, using location data obtained from a wide variety of local sources. Densities are calculated through a process called kriging, which approximates Gaussian kernels on a grid surface: densities decline proportionally to a value of zero at a distance of 4 km from the point, unless interpolated with densities from another point within the 4 km radius. Considerable calibration was conducted of the most appropriate radius for calculating densities, given the average number of data points (population) available within a 50 km radius of the city center. This was done by overlaying calculated density

grids over recent satellite (30 meter Landsat TM) imagery until built-up land use and the extent of calculated population densities generally matched. Tests were conducted of radii of 10, 8, 6, 4, and 2 km; the 4 km radius had the most significant match to builtup land on recent satellite images of the Pearl River Delta, Shanghai, and Chengdu.

6. Slopes over this level are usually not technically and economically compatible with infrastructure and building construction required to sustain large-scale urban settlement. Slopes were calculated using 90-meter grid data from a USGS Digital Elevation Model covering all of China.
7. Chreod digitized on its GIS several years ago a data set on traffic flows along all 3,063 segments of China's national highways in 1996. The data set includes road quality from Class I to Class IV roads (and often below Class IV) for all segments which are, on average, 35 km long. The data show traffic flows, and hence the intensities of connections between cities, in 1996, the year that NTHS expressways began to open across China. However, all NTHS links are tollroads, and a large proportion of local (i.e. within 50 km of a city) traffic continues to occur along the old national highway network (which is toll-free). NTHS is predominantly carrying medium and long range freight traffic. Therefore, while the 1996 traffic flow data set does not reflect actual flow patterns in 2004, the locations of production have not changed appreciably since 1996. In the absence of current traffic flow data, the 1996 data set provides at least an indication of the relative intensity of links within metropolitan regions that probably continue to exist today.
8. Eurostat, the statistical agency of the European Union, has for several years been attempting to develop an approach for defining what it calls "densely populated areas" that conform to functional metropolitan regions (or "conurbations") without relying on labor force data that is difficult to obtain and compare temporally across member states. As a provisional measure, it has decided to define such areas as "groups of territorial units at NUTS level 5 [the smallest administrative unit of EU countries] with more than 50,000 population inhabitants and consisting of contiguous local units each with a population density of over 500 inhabitants per km^2" (EUROSTAT, 1999).
9. Jones (2002) summarizes recent research on Southeast Asia. The GEMACA II project in Europe, a comparative study of 14 major metropolises in northern Europe, is described in Lecomte (2002). More recent research on European metropolitan regions under the EU-supported POLYNET research program is described in Institute of Community Studies (2005).
10. China's National Census in 2000 provides information at the county/city level of the principal occupation of the head of household. The breakdown of types of employment is quite detailed, and enables the estimation of non-farming populations based on type of employment.
11. The ten strategic challenges are: 1) focusing urbanization in the 53 metropolitan regions; 2) maximizing access to markets across MRs; 3) promoting inter-firm linkages across MRs (localization economies); 4) improving strategic production capacities across MRs; 5) enhancing innovation capacities; 6) addressing needs of vulnerable populations across MRs, including in suburban areas; 7) managing urban development at the MR scale; 8) managing the environment at the MR scale; 9) improving governance and management of MRs; and 10) improving the financing of MRs. A set of 55 policy recommendations were made in the report which is available from the Cities Alliance (CHREOD Ltd, 2005).
12. Urbanization is defined here as non-farming population resident longer than six months as percent of total population.
13. Acs (2002) provides a recent, thorough analysis of the impact of innovation on metropolitan regions in the USA. This work suggests a possible approach to similar analysis that could be followed in China.
14. The government-sponsored innovation system is very centralized with the highest concentration of enterprises, personnel, and innovations located in Beijing, Shanghai, and Tianjin. There is growing evidence that the government-sponsored system is losing innovation capacities through the net loss of knowledge creators. A recent survey by the Ministry of Science and Technology of science- and engineering-based government research institutes found an alarming net loss of their personnel through retirement, departures overseas (either immigration or for advanced studies), and to commercial enterprises. Attenuating this threat to innovation capacity is the commercialization of universities and their research institutes over the last ten years whereby they are increasingly expected to become self-financing. This results in the hoarding of knowledge and weak transfers to government and enterprises.
15. The domestic enterprise innovation system is also disaggregated and highly internalized. Individual companies, particularly those not within state-controlled "enterprise groups," closely hold acquired knowledge and its translation into innovation as key attributes of their competitiveness. This is exacerbated by weak regulatory mechanisms to protect intellectual property, an issue that affects not only foreign firms but also a growing number of domestic innovators. Linkages between firms and universities are also weak, largely due to a tradition of vertical knowledge flows in state-controlled educational institutions.
16. Tan (2001) provides a systematic review of this process in China, and describes how a few large Chinese companies are beginning to break the "interrupted product cycle" pattern by developing "reversed cross-national production networks" [Chinese firms investing abroad] in the telecomm sector.
17. The transferring of mature technologies to China is not a cynical action of large multi-national corporations – much of the technology has come from SME investors – but simply a recognition that, with China's low labor costs, the level of technology input required to realize output prices that global markets are prepared to pay is lower than in countries where labor costs are higher (e.g. Malaysia and Republic of Korea, to which more advanced technologies have been transferred by foreign firms over the last decade).
18. Satellite data were prepared by Annemarie Schneider, K. Seto, and D. Webster, from The Urban Dynamics of East Asia Program, Asia Pacific Research Center, Stanford University, California, USA. Chreod Ltd gratefully acknowledges the sharing of these data and associated insights of the Stanford team.
19. Editor's note: In the original version of the text at this point there was a reference to Annex A consisting of 14 pages of drawings and diagrams that we had to finally eliminate due to lack of space. However, for the benefit of the reader, we thought of reproducing here the brief introductory statement written by the author to this Annex entitled "Spatial structure and population densities of selected metropolitan regions in China and other countries" which is as follows:

    The maps and diagrams on the following pages show spatial structure and population densities of 20 metropolitan and urban regions in China, Japan, France, the US, and Canada. All density zones were computed using 2000 population data at the towns/township/Street Committee level for China, and census tract or NUTS 5 data for other countries: the spatial size of these data units are virtually the same. Density zones are calibrated according to the descriptive spatial model of metropolitan regions shown in figure 2. Population densities are all shown on the profile diagrams at 1 km increments (with densities calculated in a 4 km radius from each population point).

    This work is ongoing. The purpose is to identify key spatial characteristics of metropolitan regions, compare these characteristics across as large a sample as possible, and then to explore if and how spatial structure has affected social, economic and environmental conditions at various times in the formation and growth of metropolitan regions, and the impacts that governance practices have had on spatial structure. Lessons learned could then, hopefully, be translated into specific policy and then program recommendations to better guide developments in China and elsewhere of this large and complex scale of human settlement.

    For further information, the reader may contact the author at e-mail: leman@chreod.com; www.Chreod.com.

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