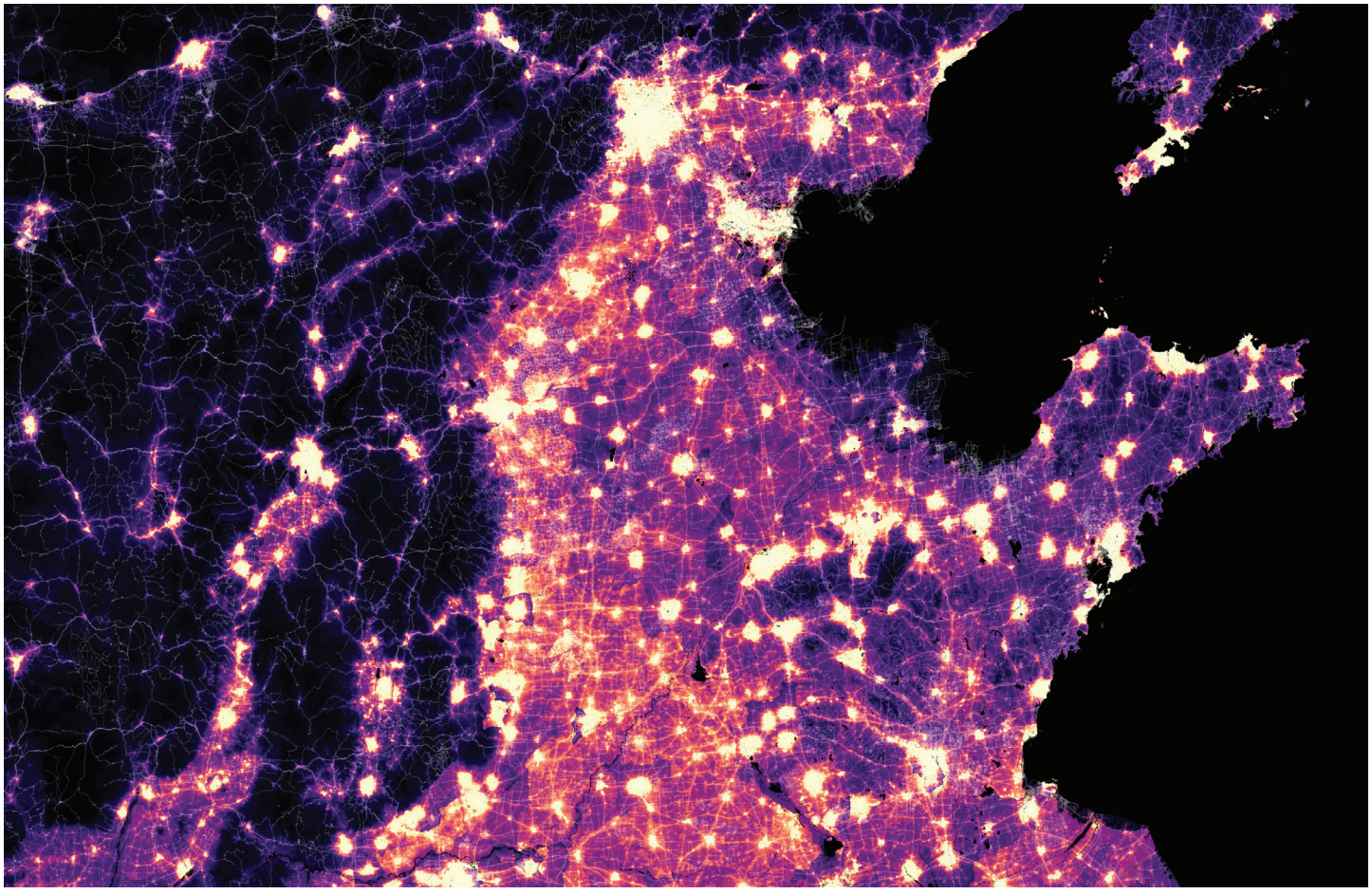
International Transport Forum



Connectivity and City Clusters

Summary and Conclusions

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The International Transport Forum

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Foreword

This roundtable investigated international experience and lessons learned from integrated transport development in large-scale urban regions and city clusters and discussed how these may be relevant in the Chinese and other emerging economy contexts. In particular, it addressed potential limits to the scaling-up of these lessons since plans for urban development in The People's Republic of China are unprecedented in terms of size and complexity.

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This report was authored by Philippe Christ (ITF). The Roundtable was chaired by Zhi Liu, Director of the Peking University – Lincoln Institute Center for Urban Development and Land Policy. The Roundtable was hosted by the Transport Planning Research Institute of the Chinese Ministry of Transport (TPRI). TPRI is a public institution directly affiliated with the Ministry of Transport (MOT) of the People's Republic of China. It was founded in March 1998 when a re-organization was undertaken between the Highway Planning and Design Institute and the Waterway Planning and Design Institute. TPRI serves as an internal research-oriented think-tank for the Chinese Ministry of Transport on issues across all transport modes with a focus on policy, strategy, planning, technology, assessment, and general research.

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Executive summary

What we did

This report presents international experience and lessons learned from integrated transport development in large-scale urban regions and city clusters. It serves as an input to discussions around city cluster development in China and other emerging economy contexts. First, it assesses how regional urbanisation delivers socio-economic benefits via both agglomeration and network externalities. It then examines differences in how these benefits are delivered in single versus clustered city networks. The role of governance structures and how they might best be adapted to ensure positive outcomes is also discussed. Finally, the report addresses the potential for reforming local government financing mechanisms in China in order to guide urban growth in a sustainable manner. The report is based on a roundtable organised by the International Transport Forum and the Transport Planning Research Institute of the Chinese Ministry of Transport (TPRI).

What we found

Rapid urban growth poses formidable challenges regarding governance, financing of infrastructure and the delivery of satisfactory living conditions. These challenges will be particularly acute in the realm of urban transport as local and national authorities seek to deliver high quality access and mobility to underpin labour productivity and income growth while delivering liveable cities for citizens.

These challenges will be especially acute in China, where the scale of urbanisation is unprecedented. With over 700 million urban inhabitants, China is the world's largest urban nation. Chinese cities have grown by about 100 million people every five years for the past 15 years. A central question for China and for other rapidly urbanising nations is whether urbanisation and transport investment should focus on mega-cities or city clusters?

Investing in transport infrastructure to strengthen urban connections may drive growth, but any assessment of the potential value of such investments needs to identify exactly how such benefits would arise. In addition to the direct benefits of improving connections, usually assessed through savings in travel time, additional benefits may accrue to the wider economy. These arise from increases in density, proximity and accessibility (agglomeration externalities) and from "network urban externalities" that flow from connecting agglomerations and improving inter-urban travel times. Both can drive economic growth but the existence of such benefits is highly dependent on context. There are functional differences between single cities and clusters of cities. Unlike transport systems within single cities, city clusters and the networks that support them will not necessarily cater for daily urban commutes. In some cities, weekly or monthly commuter travel may be significant, implying that the maximum time people are willing to spend travelling is higher than the threshold generally applied for daily commutes. Travel patterns and use of the city space will not be uniform across population groups. In the case of China, low-income and migrant workers are likely to travel largely exclusively within the city, whereas mid- to upper income workers will have a greater propensity to move across the region.

The over-reliance of local governments on revenue from land sales contributes to low-density development. This effect is compounded by subsidies to the development of land for industry. These dysfunctions are in turn spurred by inter-city competition to meet national growth targets. This results in a pattern of urban development that consumes too much land and thus precipitates issues relating to urban area and size.

What we recommend

Invest in ways that support polycentric urban development where natural regional markets exist

In China, accompanying polycentric development in megacity clusters with transport investments that reinforce the pattern is advisable where these clusters have emerged from non-distorted market interactions. However, forcing polycentricity on regions may not deliver expected efficiencies. Where natural affinities do not exist is also likely to be an expensive proposition. In certain Chinese regions, polycentric development has been driven by intervention that severely distorts markets, with unintended consequences.

Locate strategic functions of the city cluster in areas most accessible by all citizens

Different demographic groups use and access regional functions of cities in different ways. This should be factored into planning urban development. Metropolitan functions of supra-local importance should be located in the most accessible areas for the broadest number of people accounting for the whole urban network.

Adapt governance structures to clustered urban development

Governance structures should be sized to the commuting trip market, including weekly and monthly commuters. This typically extends across multiple jurisdictions and beyond the core city. Integration should extend beyond simple physical infrastructure connections and also encompass closer co-ordination of governance, investment, operations and financing.

Address structural issues that lead to unnecessary urban spread

In the Chinese context, there is a real need to reform local government finance to reduce land-intensive growth. Diversifying local government revenue away from land sales, reducing incentives for industrial land development and rethinking the framework for inter-regional competition would reduce pressure for land consumption. These changes, combined with a property tax that places an incentive on higher-density development, would lead to less land-consuming growth. This, in turn, could reduce pressure to channel expenditure on infrastructure investment to support urban clusters.

Introduction

More than half of the world's population lives in urban areas and this share is projected to grow to nearly 70% by 2050. The 21st century is the urban century and this urban growth, especially in rapidly developing economies, will generate significant benefits in terms of economic prosperity and opportunities for citizens. It will also pose formidable challenges regarding governance, financing of infrastructure and the delivery of satisfactory living conditions. These challenges will be particularly acute in the realm of urban transport. Investments in improved access and better quality transport services can greatly improve economic and social conditions for city dwellers but how these investments are linked to overall agglomeration benefits is not always straightforward and is often highly context-dependent. Further, the scale and speed of urbanisation is unprecedented and may challenge existing models for understanding urban and regional development.

Table 1. Top ten cities by population using official data

Metropolitan	Country	Official population	Year
Tokyo	Japan	36 923 000	2010
Shanghai	China (People's Republic of)	34 000 000	2010
Jakarta	Indonesia	30 000 000	2014
Seoul	South Korea	25 514 000	2016
Guangzhou	China (People's Republic of)	25 000 000	2010
Beijing	China (People's Republic of)	24 900 000	2010
Karachi	Pakistan	24 300 000	2016
Shenzhen	China (People's Republic of)	23 300 000	2010
Delhi	India	21 753 486	2011
Mexico City	Mexico	21 339 781	2015

Note: (Definitions of city limits vary from country to country).

Source: Wikipedia; official government sources.

One complicating factor in assessing the links between transport investments and wider economic and social benefits is that urban regions spanning several jurisdictions, rather than individual cities, are emerging as the most relevant spatial scale for measuring the economic productivity effects of transport investments. This is true for mature economies and it is especially true for rapidly growing urban areas in emerging economies. In this context, there is an important policy question that remains unsettled – is it better to leverage agglomeration benefits by focusing on single metropolitan areas, principally through densification and expansion or should public authorities instead focus on leveraging network effects by connecting separate urban cores within polycentric clusters? This is a particularly relevant question for

the People's Republic of China (hereafter 'China') as city cluster development has now been elevated to national policy.

With over 700 million urban inhabitants, China is the world's largest urban nation as measured by urban population. Chinese cities have grown by about 100 million people every five years for the past 15 years – with this growth mostly concentrated along the urban centres of the eastern coastline. In March of 2014, China announced an official target of a further 100 million new city dwellers by 2020. Absorbing 100 million new inhabitants is no trivial task – to put it into perspective, it took nearly 50 years for the urban population of the EU to grow by 100 million inhabitants (1967-2015) and just 10 years less (1967-2015) for the US urban population to grow by the same amount. China's *National New-Type Urbanization Plan (2014-20)* states that this growth should be channelled into 20 city clusters spanning three tiers from the megalopoli of the East Coast to the medium-sized western frontier cities. Transport investments will play a significant role in meeting the dual challenge of accommodating that growth and doing so across disparate city clusters, whose scale will sometimes test the ability for local authorities to effectively plan, invest and govern.

Delivering on these and other objectives in the plan will require revisiting incentive structures, planning and carrying out institutional reforms and integrating and co-ordinating the offer of transport services across broad urban regions. It will also require developing innovative and sustainable financing mechanisms. These tasks will have to be carried across multiple transport modes, including intercity rail (high-speed and traditional lines) and will need to integrate major regional transport hubs, including airports. It will also require tractable performance metrics for transport service quality and regulatory flexibility to address new and innovative transport services.

Discussions at the Roundtable focussed on these issues broken down into the following five themes that serve to structure this summary of discussions:

- the context, trends and patterns of urbanisation in China
- agglomeration and network effects: Do benefits of transport integration scale with urban region size and complexity?
- managing transport governance in global city clusters
- financing and managing infrastructure in global city clusters
- managing uncertainty regarding future developments

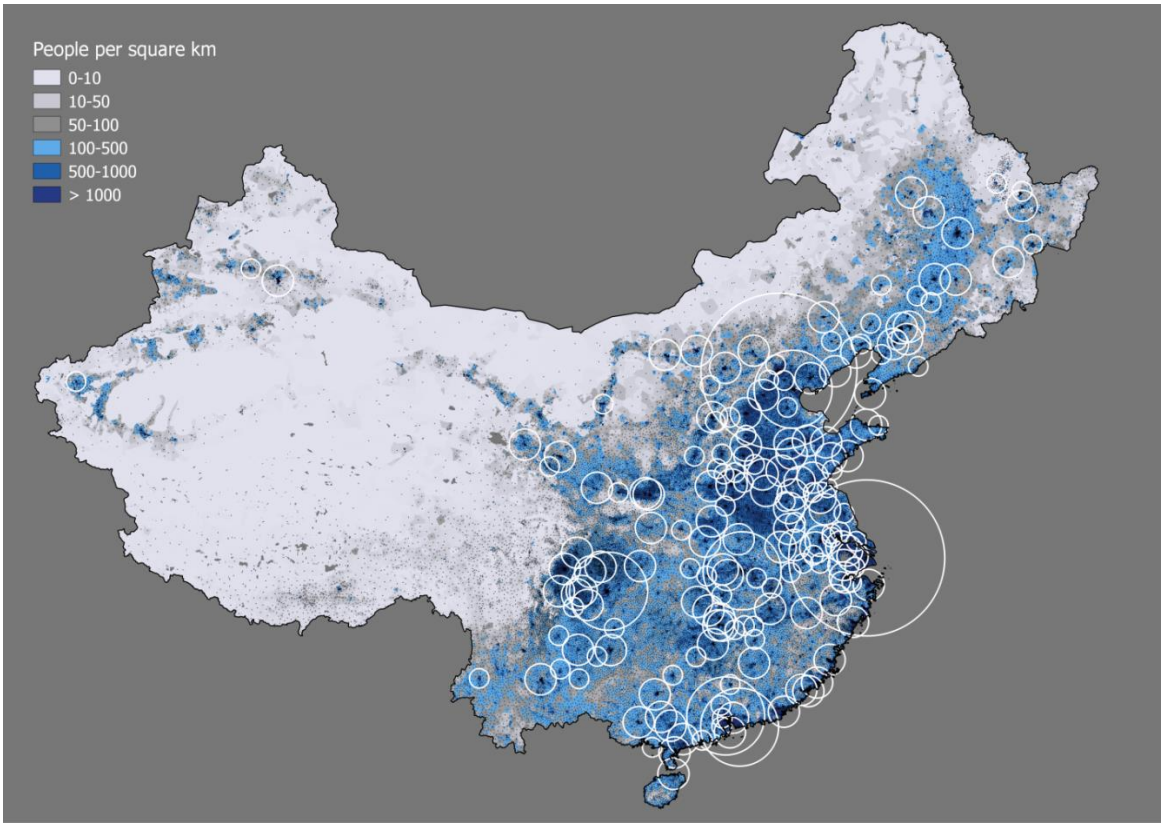
In order to inspire and guide discussions, the Roundtable heard presentations from five experts whose papers (or presentation in the case of Ms. Debrincat) form the following chapters in this report.

Background and context: Urbanisation in China

How and why has China urbanised the way it has?

By most measures, China has successfully navigated a delicate transition from a largely rural population in the late 1970s to one that is predominantly and increasingly urban. In 1978 the urban population accounted for 19% of the total Chinese population, rising to 26% in 1990 and to 56% in 2015 (Webster, et al., 2016). This shift, while not unprecedented in speed, is unique in terms of the absolute numbers of new urban residents. Urbanisation rates have been faster in countries like Japan and Korea but nowhere in the world has the sheer scale of urban population growth equalled that of China (World Bank, 2014). Nonetheless, growth of the Chinese urban population has not been evenly distributed across the country nor have its outcomes benefitted all urban residents equally. Most of the growth has been concentrated in a few of the largest first-tier and second-tier urban regions, essentially located to the east and in particular on the eastern seaboard (Figure 1).

Figure 1. China population density and city population



Source: ITF based on data from Natural Earth, Gridded Population of the World V.4

This growth has been accompanied by a 16-fold increase in real per capita income and has helped to lift half a billion people out of poverty. The combined effects of the greater labour productivity of urban workers and the significant inflow of capital into more productive manufacturing and service sectors has resulted in a 12-fold increase of real output per urban worker (World Bank, 2014).

Rapid and large-scale urban growth is both an opportunity and a potential liability as it poses risks for future development. These risks are compounded by the fact that changes in Chinese urbanisation trends will likely have knock-on effects on other economies due to the interconnected nature of global urban agglomerations and markets. Overall, however, China seems to have managed relatively well its urbanisation process and has avoided the increase in urban poverty and squalor that has often accompanied rapid urbanisation in the past and in other regions. It has done so through a series of targeted plans, one of whose strength lies in the government's willingness to adapt policies in the light of new information. The top-down planning process is nonetheless not without problems and these shortcomings often came up in the Roundtable discussions.

The Chinese central government has historically held a somewhat ambiguous position regarding urbanisation. For both practical and ideological reasons, the National government under the Chinese Communist Party had long favoured rural and agricultural development as a way of securing the livelihoods of its predominantly rural population and ensure food security. Urbanisation patterns reflected both of these preferences for self-sufficiency and pro-rural policies. Non-agricultural jobs were often concentrated in state-owned enterprises that concentrated workplaces, living quarters, small commercial services and public amenities and social services in one location. These were replicated at all city scales and, while contributing to anchor economic activity within towns and within neighbourhoods, these arrangements were inefficient in terms of allocation of labour and capital. Another factor that continues to impact decision making in urban areas is the long-held position that agriculturally productive land must be actively preserved both at the periphery of, and sometimes within, cities.

The central government actively sought to constrain labour mobility by putting in place policies limiting the movement of population from rural areas to cities, particularly through the *hukou*[1] registration system. This served to suppress urbanisation in China up until the reforms of the early 1990s. Indeed, not until then did the notion of encouraging urban growth make its way into the central planning documents that serve as the framework for government policy. Increased agricultural productivity had reduced the need for unskilled rural labour and policy encouraged the measured transfer of this surplus to cities and industry.

Official guidelines sought to strictly control the growth of the largest cities (Beijing and the urban conurbation of the Yangtze River Delta around Shanghai and the Pearl River Delta along the Guangzhou-Shenzen axis), reasonably develop medium-sized cities and encourage the growth of smaller cities and towns. Despite these guidelines, population accrued to the largest urban conurbations at a higher rate than to second and third-tier cities exacerbating crowding in these cities, and straining housing markets and transport infrastructure (see Table 2). The urban population of the largest Chinese cities ("urban" meaning the "city proper" – that is, the largely contiguously urbanised "urban districts" that are distinct from the "urban counties" that may be partially and sometimes contiguously urbanised) more than doubled from 1990 to 2010. The urban population of second-tier cities almost doubled over the same period. Third and fourth-tier cities, often comprised of satellite cities within larger urbanised regions or located along major corridors between these, lost their share of overall urban population despite official policies in favour of these. Nonetheless, these medium and smaller-sized cities added nearly 42 million inhabitants from 2000 to 2010 – or more than the entire population of Canada (Webster et al., 2016).

Central government efforts to channel urban growth to small and medium-sized towns continued in the early 2000s, notably with the loosening of *hukou* restrictions allowing farmers to convert their household registration to non-agricultural status and thus open up possibilities for the conversion of farmland to urban land – largely for industrial use. These initiatives had limited success as illustrated in Table 1, migrant populations continued to crowd into the largest cities drawn by higher manufacturing, construction and, later, service sector wages. However, not all of the population increase in Chinese cities has come from an influx of rural inhabitants; 9% of the urban population growth from 2000 to 2010 was due to the natural birth-led population increase, 35% from the reclassification of non-urban land (and those living on it) to urban land and urban inhabitants, while the remaining 56% came from migration from rural to urban areas (World Bank, 2014).

Table 2. Population and growth rates of Chinese cities and tier status: 1990-2010

	Population						Population: Compound Annual Growth Rate (CAGR)			
	1990		2000		2010		1990-2000		2000-2010	
	Total	Urban	Total	Urban	Total	Urban	Total	Urban	Total	Urban
Tier 1	82 694 845	56 823 944	113 098 621	88 009 352	148 139 767	126 882 202	3.2%	4.5%	2.7%	3.7%
Tier 2	128 420 445	83 896 241	160 297 265	109 974 780	197 876 289	152 602 231	2.2%	2.7%	2.1%	3.3%
Tier 3	123 245 827	62 744 190	140 696 957	71 944 925	155 724 534	94 630 554	1.3%	1.4%	1.0%	2.8%
Tier 4	144 843 800	32 231 898	155 863 581	59 404 321	163 590 465	78 404 231	0.7%	6.3%	0.5%	2.8%
Tier 5	71 970 388	15 687 399	75 841 592	28 316 515	76 914 223	33 252 069	0.5%	6.1%	0.1%	1.6%
Total	551 175 305	251 383 672	645 798 016	357 649 929	742 245 278	485 771 287	1.6%	3.6%	1.4%	3.1%

Note: "Urban" population refers to contiguously urbanised "urban districts". "Total" city population refers to urban districts and surrounding urban counties.

Source: Webster et al. (2016).

While the *hukou* system allowed the rapid and temporary access of generally unskilled non-urban populations to help fill the gap for cheap labour in cities and thus lower production costs, many migrants chose to extend their stay in urban areas – often permanently. This has created a gap between the resident population of urban areas and those living in cities but registered in rural areas or other, smaller cities. In practice this has created a two-tier population within cities that generates friction – one with access to social services and one without. Four in ten city inhabitants cannot access the same basic package of social (education, health care, etc.) and civic participation (neighbourhood and municipal voting) as their city *hukou*-holding neighbours (World Bank, 2014). Migrant workers (those with a *hukou* not in conformity with their actual residence) numbered upwards of 270 million in 2014 (National Bureau of Statistics, 2016) and generally live in urban villages at the outskirt of (and poorly connected to) larger cities. This population of largely unskilled workers face long commutes and pay a higher share of their income on transport.

While the central government had largely sought to favour growth in smaller sized cities and towns through the early 2000s, local-level initiatives – fuelled by a loosening of central planning control and autonomy granted to Provincial and municipal authorities – resulted in growth of the larger urban conurbations. This growth was particularly dynamic as cities sought to achieve economic growth targets set by the central government and *de facto* competed against each other for industries and services. By

2006, locally-led initiatives in support of the development of larger urban regions were already well developed and these attracted ever-increasing numbers of new urban inhabitants. At that stage, central government planning efforts shifted from an emphasis on the development of smaller urban centres towards the balanced development of all cities – with a particular emphasis on the largest ones. It was at that time that locally led efforts to promote the economic development of the first city clusters took place with the idea that growth in "anchor" cities would buoy growth in smaller and less well-off neighbouring cities.

Looking forward, many participants felt that the type of urbanisation patterns – and the trends that fuelled them – was unlikely to continue unchanged and unabated into the future. There are a number of reasons for this.

The first is that the returns on early urbanisation – and in particular, the transformation of rural land to urban uses and the transformation of a rural population to an urban workforce – is yielding lower marginal returns. The large reservoir of unskilled rural workers that boosted early urbanisation in China is drying up as the country's population rapidly urbanises – 70% of the Chinese population is expected to live in cities by 2030. This means that the draw of cities will decline in relative terms as wages start to converge between many rural towns and larger cities (though these will likely not equilibrate).

Secondly, the need for a significant new (relatively low-skilled and easily trainable) manufacturing workforce will diminish in relative terms as the focus of the economy shifts from export-led manufacturing to domestic consumption and the services that accompany this structural transformation. At the same time, the shift from a manufacturing focus to a focus on services will generate lower rates of growth than the shift from an agricultural to an industrial economy – largely because the gains in productivity from the latter are much greater than from the former. These combined effects could temper the rate of urbanisation.

Third, it is unclear whether (and probably unlikely that, all else held equal) the relatively small yet growing Chinese middle class can compensate for the drop in exports by generating sufficient home-grown demand. This means that domestic demand will have to depend more on investment than on consumption. Given the high levels of unsustainable debt that is building up in support of this investment, there are clear down-side risks to the economy that could impact urban growth.

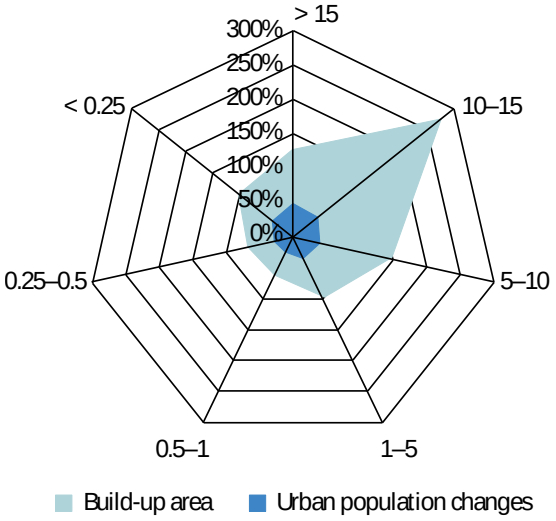
Finally, the high returns on early urbanisation are increasingly being eroded by the negative externalities and other impacts generated by urban growth. These include high levels of unsustainable air, water and land pollution, time and productivity losses due to congestion, inefficient use of natural resources and social tensions caused by restrictions on the internal population movements through the *houkou* system (World Bank, 2014). These all serve to decrease the benefits of agglomeration and urbanisation. For example, while urban agglomerations produce three-fourths of China's economic activity, they also produce more than three-quarters of China's total pollution – and expose a larger share of the population to its effects than in the past (Fang, Ma and Wang, 2015). And traffic congestion – a formidable and growth-sapping phenomenon in the largest and many medium-sized urban agglomerations – exacts a steep and growing "tax" in Chinese cities. Recent estimates indicate that traffic congestion costs equal 12.5% and 9.1%, respectively, of the per capita income of Beijing and Shanghai inhabitants due to time losses inherent with slow traffic speeds – i.e. 7km per hour in Beijing. More to the point of this Roundtable topic and in the context of the integration of emerging city clusters, the inefficient transformation of land to urban use is a key issue that repeatedly came up in the discussion.

The footprint of cities in China has grown at a faster rate than they have grown in population. In a sample of 142 cities including 17 urban agglomerations, city size (in area) grew threefold while population

doubled over the same period. In the coastal urban agglomerations that first implemented market-led reforms and eased restrictions on urbanisation, urbanised land grew even more – up to four to five times more – for all city size classes (Schneider and Mertes, 2014). This expansion has not been uniform in time with the period 2006-10 seeing a sharp uptick in the urban expansion rate. Similarly, not all city size classes have expanded at the same rate (see Figure 2). The growth of the footprint of large conurbations has significantly outstripped that of the population. This isn't necessarily the case for smaller cities though some cities adjacent to the large east coast urban centres have similar urban-expansion-to-population-growth ratios as their larger neighbours. In some instances, growth has been constrained by geographic barriers as in the case of Fuzhou, Kunming and other cities in hilly or mountainous areas where available constructible land is in short supply.

Research indicates that urbanisation generally has little impact or is positively correlated with an increase in the supply of arable land at national scales (Satterthwaite, McGranahan and Tacoli, 2010). This seems not to be the case with China due to lower levels of available arable land per capita than most other countries (Wei and Ye, 2014). This is a cause of concern for national authorities, especially as the urban land-use growth elasticity of China with respect to urban population growth varies between 1.36 and 2.30 – which is higher that the global average of 1.12 (Lian and Lejano, 2014).

Figure 2. Percentage change in built-up area and urban population in China by city size (2000-10)

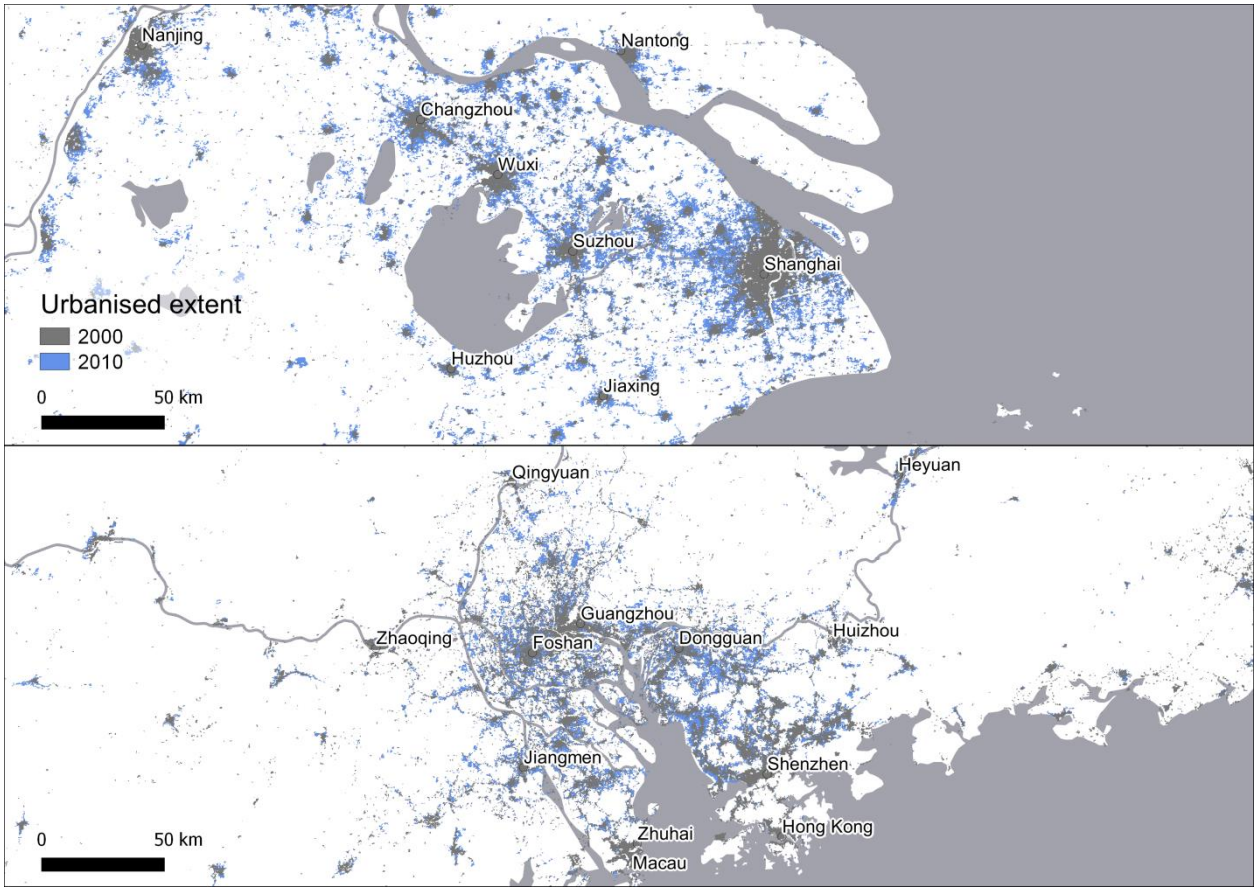


Source: World Bank (2014).

The largest agglomerations have each added 450 km^2 of newly urbanised land from 1978 to 2010. Smaller, neighbouring cities have added only 20 km^2 each on average over the same period. The gap is stark – the sum of all of the newly urbanised land in medium, small and very small cities is from 1978 to 2010 – 190 km^2 – is less than half of the newly urbanised land for just one of the largest agglomerations. This fact, alongside the concentration of population in the largest megopoli, is one of principal motivating factors in seeking to develop more balanced growth centred on urban clusters (Schneider and Mertes, 2014). There is precedent for clustered growth. As noted earlier, local initiatives have sought to facilitate this type of urban development and urban agglomerations on the east coast are now developing into polycentric urban regions as smaller cities have grown in size and have merged with each other and nearby larger cities. This close-knit polycentricism is not replicated in western Chinese regions where government efforts to promote urbanisation have focused more intensely in recent years.

Much of the land expansion that has taken place in recent years has occurred at the edge of existing urbanised zones – a recent analysis by (Xu et al., 2016) finds that 73% of Chinese urban growth from 1992 to 2015 has occurred via edge expansion. A good example of this accretive growth can be seen in the Yangtze River Delta around Shanghai and the Pearl River Delta around Guangzhou-Shenzen (see Figure 3). This growth results in greater sprawl that contributes to a number of negative outcomes including an increase in the cost of the provision of public services and amenities, loss of biodiversity, communities that are poorly connected to public transport networks and increased dependence on single occupancy car travel which exacerbates congestion and contributes to air pollution and greenhouse gas emissions. Infill development which might mitigate some of the above impacts only accounted for 11% of urban growth and leap-frog development, which may further exacerbate the negative impacts of sprawl, accounted for 16% of newly urbanised areas.

Figure 3. Urban Expansion 2000-10: Yangtze River Delta and Pearl River Delta



Source: ITF based on data from Schneider and Mertes (2014).

Participants in the Roundtable underscored that the type of urban sprawl that characterises many Chinese cities has its source in a number of uniquely Chinese factors. In both Europe and North America, urban form and urban expansion are largely the result of two different and often uncoordinated processes. Transport policy and investment in transport infrastructure, principally the responsibility of public authorities, structures urban regions and generates, or accompanies, urban growth. Land-use decisions, however, outside of the framework of general zoning permissions, largely rest with individuals and firms. Land markets operate more-or-less efficiently and urbanisation patterns result from the

interplay between transport and land-use decision making. In China, land markets, land use and transport policy and investment have all been the responsibility of central government until the reforms of the early 1980s. Even so, devolution of some of these functions to regional and local governments and participation by market actors in these areas are recent phenomena and display a mix of central planning influence and market functioning (Schneider and Mertes, 2014). Nevertheless, as in many other world regions, Chinese cities tend to have concentrated, relatively dense cores surrounded by less dense peripheries and hinterlands. But urban expansion and leapfrogged development has been particularly land intensive and rapid in China. Why is this? Participants pointed out three principal reasons.

The first concerns the particularities of Chinese land markets following the reforms of the early 1980s. Land for commercial and residential development is auctioned off (with proceeds going to public coffers) whereas land for industrial use is heavily subsidised in line with official preference for industrial versus commercial uses. The World Bank estimates that around a quarter of all of the built-up area in Chinese cities is devoted to industrial uses (World Bank, 2014). Historically, these industrial areas have been located in the heart of towns and cities in order to gain access to a largely non-mobile workforce. Recently, however, industrial development and relocation has occurred at the periphery of urban agglomerations and/or in greenfield sites contributing to leapfrogged urban expansion. The majority of the new industrial plots are managed by local authorities or city-owned corporations who develop these sites by borrowing money leveraged on land as collateral. These entities seek to attract industries by offering below-market rents to industries – often in competition with other municipalities – with the expectation that this will result in job creation and fiscal revenues for local authorities. Below-market prices for industrial land and intense competition by municipalities for industry has led to an over-supply of industrial land which has fuelled urban expansion. The majority of land administratively allocated for urban construction in recent years concerns industrial plots (about 10 800 km^2) whereas 6 100 km^2 and 2 100 km^2 of land have respectively been competitively auctioned off for residential and commercial uses (World Bank, 2014).

The second reason that Chinese urban land expansion has been particularly land intensive is that land conversion (from rural to urban) is one of the principal ways in which cities can secure revenues. In the absence of land or property taxes, cities have few mechanisms available to them to raise revenue for operating costs and capital investments. Cities, however, often have substantial rural areas in their periphery that can be released for urban use. They are in essence “land rich but tax poor”. The sale or lease of this land resolves this conundrum and generates 30% to 70% of municipal budgets which, in turn, often serves to fund the urban development projects (Schneider and Mertes, 2014). There is pressure to continue this cycle since urban development projects, when they are successful, help cities to meet or surpass their GDP growth targets set by higher levels of government. That this vicious cycle of supply-led urban expansion results in inefficient land consumption and stranded assets (the poignant examples of Chinese “ghost” cities and “ghost” malls were cited) was widely recognised by Roundtable participants but resolving this perverse incentive requires fiscal reforms that are both complex and slow to bring about. Nonetheless, the Ministry of Finance is starting to run property tax trials in order to create a stable revenue base for municipalities that avoids unwanted effects such as urban sprawl.

The third reason cited by participants was linked to the design specification for certain types of transport infrastructure that led to an over-supply of road space. While this does not directly lead to sprawl, the fact that smaller towns and cities often borrow road design specifications from the largest conurbations leads to oversized roads and arterials that encourage and facilitate car-based travel. This, in and of itself, is not necessarily a bad thing – at least at first. But by enabling spread-out, car centric communities, it was felt by some that these design specifications certainly encouraged sprawl that was difficult to contain.

City cluster development: "National New-Type Urbanization Plan (2014-20)"

China has a history of normative plan-led development and though the tendency has been to increase the role of the market and private actors in key areas of the economy, the Central Government still very much exercises its prerogative to guide strategic areas of development in support of national objectives. This is the case with urbanisation going forward to 2020. In response to what was seen as unbalanced growth in favour of the largest conurbations and in light of the social, economic and regional frictions this growth has entailed, the Central Government issued the first national strategy focusing exclusively on urbanisation in 2014. The "National New-Type Urbanization Plan" covering the period from 2014 to 2020 sets the framework for future urbanisation in China with the express goal of rendering urban areas and urban growth more "people-oriented". The plan proposes to do this by addressing the manner in which urban growth can better mitigate congestion, rising air pollution, urban sprawl while enabling continued and more equitable economic growth. It does so by laying out key policy directions and areas for future reforms. At its core are the following components:

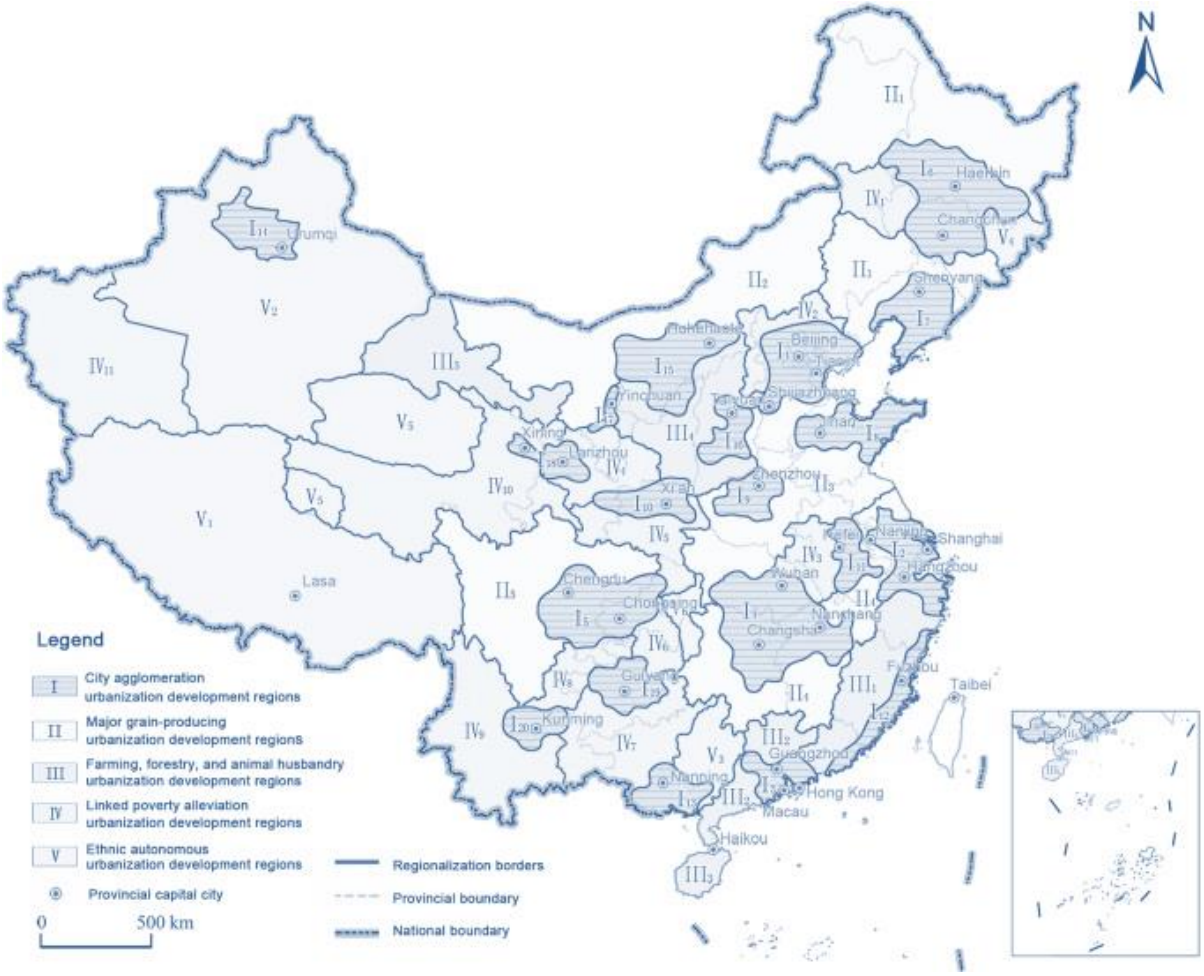
- The plan seeks to close the gap in access to public services and amenities experienced by urban residents and migrant workers. It proposes to do this by significantly loosening *hukou* requirements and facilitating rural-urban and intra-urban mobility.
- It aims to create more liveable urban environments for people by improving public transport, addressing needs for affordable housing and the strengthening the social safety net.
- One key area of reform outlined in the plan lies in the diversification of municipal revenue sources away from land sales and towards more durable, sustainable and reliable revenue streams. The plan calls for the promotion of municipal bonds and, crucially, the creation of a property tax regime. It also calls for better enforcement of urban planning measures and imposing urban growth boundaries where necessary.
- Within urban centres, the plan calls for the promotion of compact urban development, especially higher density, mixed-use, transit-oriented development (TOD).
- Finally, the plan calls for better balancing urban growth at various scales by focusing investment and governance reforms in support of city clusters encompassing functionally linked urban agglomerations with each other and with nearby small- or medium-sized cities and townships. The plan explicitly targets urban clusters as the main foci of all urbanisation policies.

As noted by Ma et al. (2015) in their paper presented to the Roundtable, an urban agglomeration is a complex, open and large-scale system characterised by fuzzy boundaries and periodic changes in the sphere of influence. It can be defined differently from different perspectives. Academics and public authorities around the world have different understandings and designations for urban agglomeration even if they include similar concepts such as conurbation, metropolitan area and megalopolis. In the Chinese context, and particularly in the context of official guidance on urbanisation, an urban agglomeration is an aggregate of a considerable number of cities of different natures, types and sizes, with a small number of megacities or big cities at their core. Furthermore, it is formed on the basis of certain environmental conditions, industry or value chains, and well-developed integrated transport networks. As far as spatial evolution is concerned, driven by the double forces of concentration and expansion, an urban agglomeration usually experiences the transition from the primary stage featuring the expansionary development of a single city to the advanced stage featuring the development of a

cluster of cities. The central government in China expects a similar trend to occur as the country develops from a low-income to a high-income nation and as it becomes increasingly urbanised.

Defining and specifying the geographic composition of Chinese urban clusters for official purposes has proven to be complicated and politically delicate as this designation will open the door (or alternatively, close it) to certain types of funding, reforms and support. As of the middle of 2016, no consensus has been reached on the quantity and scope and extent of the urban clusters to be targeted in the plan. As noted by participants, some clusters are self-evident – those in the Pearl River and Yangtze River Deltas and that of the middle reaches of the Yangtze River (Clustering Changsha-Nanchang and Wuhan) being among them. Others seem more difficult to justify in spatial terms – that of Chengdu-Chongqing described as a good example of "forced clustering" with the two independent cities separated by over 300 kilometres of largely unoccupied and hilly land. Finally, the ultimate composition of clusters has yet to be decided and doubts were expressed as to the coherence of some of the cluster identities being floated – for example, while Beijing and Tianjin certainly look to be an integrated urban conurbation, the inclusion of Heibei, 300 kilometres away, raised some doubts among participants.

Figure 4. China's new-type urbanisation: Indicative urban clusters



Source: Fang, Ma and Wang (2015).

Previous planning documents give some indication of the scale and scope of those urban clusters to be targeted by the "National New-Type Urbanization Plan". Fang, et al described the 21 urbanised areas listed in the National Main Functional Area Plan. These 21 areas are China's priority or preferred development areas as defined by the State Council of China, and also represent an important future direction for cities. The 21 urbanised areas incorporate a total of 198 cities whose combined population and GDP totals represent approximately 890 million inhabitants and CNY 52 trillion, respectively. They therefore account for approximately 66% and 90%, respectively of the national totals. The most developed three urban agglomerations, namely the Yangtze River Delta, Pearl River Delta, and Beijing-Tianjin-Hebei, occupy 4% of the country's territory and are inhabited by 20% of its population but contribute to 38% of its GDP.

The size of these urban agglomerations are unprecedented in history; in 2010, the Beijing-Tianjin-Hebei cluster accounted for over 110 million people, the Yangtze River Delta cluster over 90 million inhabitants and the population of the Pearl River Delta and Chengdu-Chongqing cluster numbered more than 60 million each. Moreover, urban agglomerations are where the majority of China's young population is centralised and also attracts a significant share of China's migrant population.

Another breakdown of Chinese city clusters is presented by researchers at the Chinese Academy of Sciences (Fang, Ma and Wang, 2015). They identify 20 urban clusters ("urbanisation development regions") illustrated in Figure 4. In 2012, these 20 clusters accounted for 26% of the country's land area, 63% of China's total population and 78% of the country's urban population. Average population density in these clusters was 340 people/km^2, 2.4 times the national average. Average GDP produced per km^2 in these clusters reached CNY 14.205 million, or 3.12 times the national average. Table 3 provides detailed information on the characteristics of these city clusters and some notable points emerge.

The first is that there is a steep drop-off in GDP intensity with respect to land area between the two largest conurbations located in the Yangtze and Pearl River Deltas and the rest. The second is that urbanisation rates vary tremendously among the 20 clusters, from a high of 77% in the North Tianshan Mountain cluster (due to concentrated development in valleys and lack of constructible land) and 72% in the Pearl River Delta (due to dense urban development) to a low of 30% in the Central Henan cluster. Likewise, the clusters display great heterogeneity in average population densities ranging from 772 people/km^2 in the Yangtze River Delta and 773 people/km^2 in the Central Henan cluster to 50 to 70 people/km^2 in the North Tianshan Mountain and Hu-Bao-E-Yu clusters. In the case of the Central Henan cluster, a low urbanisation rate coupled with a high population density indicates a spread-out, largely rural population whereas the converse, as in the case of a high urbanisation rate and a low population density indicates severely constrained environments like mountains where urban expansion will be difficult and urban population growth will likely increase the density of the built environment.

Table 3. China's New-Type Urbanization: Urban Cluster features and statistical indices

ID	Type	Area (% total)	Population (% of national total)	Population density (per km^2)	Urban population (% national total)	Urbanisation (% of cluster total)	GDP (%)	Economic density (Ten thousand CNY per km^2)
I1	Beijing-Tianjin-Hebei	1.9	6.3	463	10.11	60.48	9.06	2169.77
I2	Yangtze River Delta	1.14	6.33	772	11.28	66.5	16.17	6430
I3	Pearl River Delta	0.58	2.25	546	4.71	71.83	8.62	6819.93
I4	Middle reaches of Yangtze River	2.94	8.44	402	8.35	36.33	7.32	1135.07
I5	Chengdu-Chongqing	2.5	8.07	450	10.32	43.86	5.31	965.17
I6	Harbin-Changchun	2.92	3.46	166	4.23	41.84	3.74	583.97
I7	Mid-southern Liaoning	1.22	2.77	318	4.11	52.85	4.49	1674.91
I8	Shandong Peninsula	1.17	4.68	556	5.31	46.29	7.47	2896.22
I9	Central Henan	0.61	3.39	773	3	30.29	3.06	2273.18
I10	Guanzhong	0.93	2.19	330	2.05	32.02	1.58	773.44
I11	Jiang-Huai	0.74	2.27	427	2.73	41.25	2.02	1242.69
I12	West Coast of Taiwan Strait	0.87	3.9	625	3.5	39.52	4.1	2144.65
I13	Beibu Gulf	0.76	1.69	312	0.91	38.37	0.98	587.25
I14	North Tianshan Mountain	0.62	0.31	70	0.7	76.6	0.56	410.48
I15	Hu-Bao-E-Yu	3.08	1.11	50	1.25	38.52	2.35	347.61
I16	Central Shanxi	0.93	1.48	222	1.73	40.16	1.27	622.67
I17	Ningxia Yellow River	0.54	0.37	94	0.5	46.89	0.33	279.51
I18	Lanzhou-Xining	0.79	1.04	185	0.92	30.46	0.57	328.48
I19	Central Guizhou	0.57	1.23	299	1.36	38.03	0.58	461
I20	Central Yunnan	1	1.54	215	1.35	36.62	0.98	444.59
I	All urban clusters	25.82	62.83	340	78.42	45.43	80.57	1420.5

Investing in improved connectivity has been a major concern for both the Central Government and local authorities and China has achieved tremendous and historically unprecedented progress in this area. From 2006 to 2012, the country has added 780 500 kms of roads, 50 860 kms of motorways, 65 230 kms of rural highways, 20 900 kms of railway 41 airports and 2 361 kms of world-class inland waterways. At a total length of 16 456 kms in 2014, China Rail Corporation now operates the largest high-speed rail network in the world and this infrastructure, alongside the national motorway network, has contributed to cutting travel times by 50% to 70% on the routes served. Municipalities have also invested heavily in intra-urban connectivity. Between 2000 and 2010 urban road networks have nearly doubled from 2.8 to 5.2 billion square metres and from 134 826 to 294 443 kms. Metro networks expanded from 117 kms in 2000 to an astonishing total 1 755 kms in 2012 across 16 cities. A further 20 cities have had their metro plans approved by the Central Government and, if constructed, the total length of metro systems in operation in 2020 will reach 6 000 kms. Bus lines have also grown from 126 000 kms in 2006 to 521 000 kms in 2012. Total ridership of urban rail has reached 7.1 billion passengers in 2012 and that of bus and trolleys has reached 67 billion in Prefecture-level cities. These are staggering numbers and in many ways, they help to explain how China has effectively (and sometimes expensively) been able to achieve such a sustained and fast rate of urbanisation without falling into many of the traps other rapidly developing countries have (World Bank, 2014).

Nonetheless, participants noted that there were likely diminishing returns to several types of transport investments – particularly high-speed rail – and though it was unclear where this may be the case, there is a strong rational for more rigorous appraisal of transport projects in the context of city cluster development – as well as a need to align transport infrastructure planning and financing.

Participants also stressed that the types of urban clusters being considered and eventually targeted in future growth plans are very different one from another, precluding the use of simple one-for-all approaches and complicating certain policies such as those relating to connectivity-enhancing infrastructure investments when the returns on these, due to the very nature and structure of the city cluster in question, may be uncertain.

Agglomeration and network effects: Do benefits of transport integration scale with urban region size and complexity?

Much of the Roundtable discussion centred on the motivations behind city cluster development and the role building or improving intra- and inter-city transport infrastructure could play in this process. One of the principal reasons (and perhaps the most important one of all) that urban areas drive economic prosperity is because they deliver increased economies of scale. In his presentation to the Roundtable, Bertaud (2015) described how large cities generate scale economies that allow enterprises to reduce their costs by increasing output, thereby reducing costs per unit. Scale economies are only possible in cities with a large labour market. When many related activities are located in close proximity, they also generate "knowledge spillovers." New ways of doing things in one firm are soon imitated by other firms and eventually by other sectors as a result of the proximity and close contact between workers of different firms and sectors within the urban economy. Knowledge spillovers are one of the key external (i.e. un-priced and thus external to the market) benefits of clustering and responsible for agglomeration economies, i.e. increase in productivity due to the rapid dissemination of new ideas in areas where large numbers of workers are in close contact. Agglomeration economies also result from a lowering of transaction costs in larger cities because of the proximity of competing suppliers and consumers. Cities can also deliver economic benefits through specialisation and more efficient allocation of labour in a deeper and wider labour pool (sometimes labelled network effects) (Table 4).

Table 4. Urbanisation: Main drivers of economic benefits

	Supply side	Demand side
Agglomeration		
Higher economic concentration; high spatial proximity of firms and consumers	Supports knowledge sharing, labour matching and pooling; promotes accumulation of capital	Support consumption of urban amenities and more efficient distribution of public goods and services like education and health care
Specialisation		
Economies of scale	Leads to higher productivity	External competitiveness supported by export demand. Requires industrial upgrading
Network effects		
Efficient allocation of factors of production through mobility and connectivity	Supports the increase in total factor productivity through more efficient allocation of factors of production (labour and capital)	Requires investment in infrastructure

Source: Adapted from World Bank (2014).

The Roundtable discussion largely left aside the issue of specialisation, nonetheless certain transport investments – especially in gateways such as ports and airports can influence urban specialisation and thus help leverage economic growth indirectly. The case of Tianjin port was cited in that it has helped a competent logistics industry to emerge in that city which has been a source of growth. In addition, there is evidence in support of the notion that investment in intra-city networks within a urban cluster can lead to increased specialisation amongst the component cities and thus contribute to growth (Burger and Meijers, 2016; Glaeser, Ponzetto and Zou, 2016). This phenomenon is at work in the Randstad region of the Netherlands, for example, where different urban centres have by design and by organic growth evolved some level of specialisation (Rotterdam: trade and logistics; The Hague: government, law and international institutions; and Amsterdam: education and culture).

Much of the discussion focussed on issues relating to agglomeration and network effects centring on two principal questions:

1. What are the principal ways in which urbanisation contributes to economic integration and growth and what role do transport networks play in this?
2. Should urbanisation focus on mega-cities or city clusters?

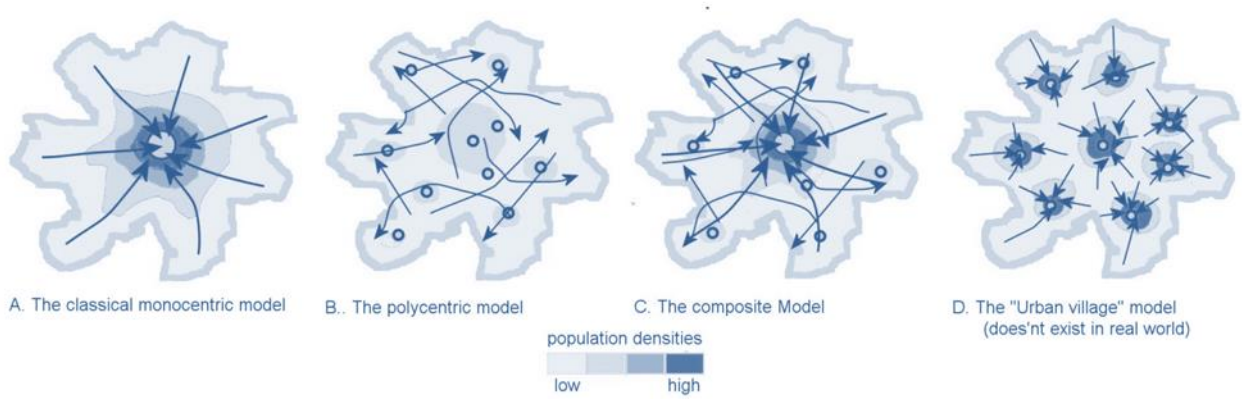
The role of urbanisation in contributing to economic activity

Bertaud (2015) suggests that the efficiency of large labour markets is the main cause of ever-growing cities in China and elsewhere. Cities, for Bertaud, are primarily labour markets and evidence supports the view that large labour markets are more productive than smaller ones. Thus, in the case of rapidly growing urban regions, the higher productivity of larger labour markets is driving the growth of cities. Proximity of firms to workers matters but even more so does the access of firms to a large and diverse labour pool. Because of this, Bertaud posits that a city's productivity depends on its ability to maintain mobility (and this access to a deep pool of labour) as its built-up area is growing. This means that as cities grow, transport networks deliver must compensate by increasing their speed. Investments in transport infrastructure and improvements in transport speed, therefore, allow labour markets to expand and thus contribute to the growth of cities. As long as labour markets remain unfragmented, then increases in city size are beneficial.

Labour markets may be fragmented due to the result of policies or due to physical limits of networks to adequately serve urban basins. In the case of the former, Bertaud (2015) noted the perverse impact of an undue focus on developing dense, independent, urban "villages" as opposed to investing in city-wide speed and connectivity (see the "urban village model" in Figure 5).

Such compact development strategies may lead to a fragmentation of the city-wide labour market by reducing mobility and thus the available pool of labour available to firms if they do not include an element of cross-city connectivity. A secondary dis-benefit of a focus on this type of "disconnected" density is that low-skilled labour is priced out of the market as increases in density increase housing costs to the detriment of lower income households. These workers must locate far from centres of employment and face high commuting costs and generally unpleasant and stressful commutes absent investments in fast inter-city connectivity. Even if investments are made in rapid transport, if they are unaffordable to low-income workers, the resultant loss in the quality of mobility is the same. Discussions underscored that this was the case for many metro systems in China that cater to middle and upper-middle class workers. Migrant and low-income workers often face much longer commutes by bus or by electric bicycle, or simply have much fewer jobs to choose from which, in turn, penalises growth.

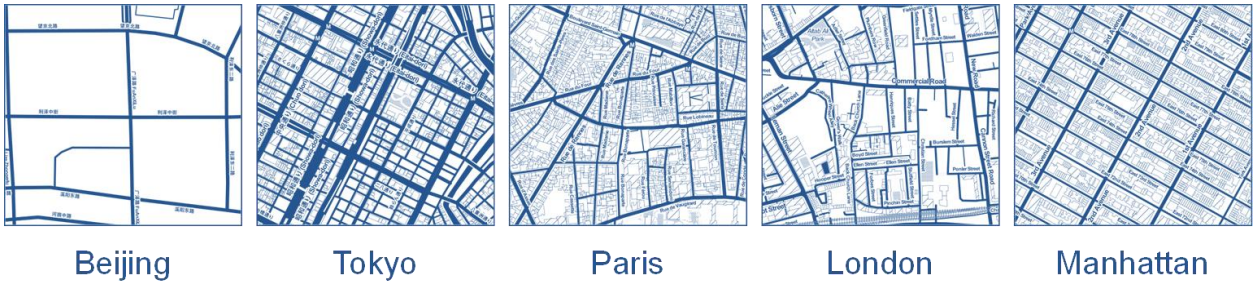
Figure 5. The spatial pattern of labour mobility



Source: Bertaud, A. (2015).

Labour markets can be fragmented by reaching the physical limits to mobility. This may come about as cities grow beyond a certain size or when friction caused by congestion reduces speed and access. Increasing travel speed with faster modes may be one way forward with the caveat that not all workers can afford to pay for speed. Another issue is that when investing in speed – which in the Chinese case and for large cities generally no longer means investing in road capacity since the sheer volume of cars may erode any benefits that new road construction confers, the appropriate metric is door-to-door travel times and not just speeds achieved on various infrastructure segments. This, it was pointed out, was because focusing only on speeds on primary links in the network overlooks the considerable delays that may accrue in the first and last kilometres on and off these networks (i.e. "access time"). In particular, many Chinese cities have inherited and continue to adopt very large block sizes that limit urban permeability and reduce rapid access to destinations and across the city – especially by foot or bicycle. Block size for newly-planned urban expansion areas range from 400 to 800 metres a side whereas the average for Tokyo is just 50 metres a side and the average for Paris, London and Manhattan is 120 metres a side (Figure 6). This lack of permeability is further complicated by planning requirements for a major road every 500 metres and a major arterial (eight lanes or more) every kilometre. These planning guidelines are followed even at the level of smaller-sized cities in China resulting in urban areas that are difficult to cross by foot and increase first and last kilometre travel times which erode the benefits of the investment in faster transport modes (World Bank, 2014).

Figure 6. Indicative block sizes, various cities, same scale



Source: ITF based on OpenStreetMap, Stamen.

Overlooking micro-scale connectivity is not unique to China. Varela (2015) gave the example of the poorly co-ordinated interchange between the Metro, the suburban train and feeder bus services at Buenavista station in Mexico City, a major interchange north of the centre. Travellers must walk up to 1.5 km to transfer from one mode to another thus penalising approximately 150 000 users every day and imposing significant costs for both users and operators. The interchange was designed primarily for the transfer of bus passengers between concessions granted exclusive rights to serve specified geographic areas inside and outside of the central city boundary. Retail property development at the interchange resulted in circuitous routes to access transport services designed to increase footfall in the shops. Other examples of poor connectivity were discussed in Jakarta and Moscow and the interests of shopkeepers similarly provide a disincentive improve facilities at interchange in stations in the Tokyo metro and surface rail networks, delaying construction of direct underpasses for which central government currently provides financial support.

In their contribution, Stead and Meijers (2015) point out that the not all cities within urban clusters or networks may benefit equally from investment in connectivity-improving transport infrastructure. Understanding these mechanisms is particularly important when considering the potential benefits or dis-benefits of promoting polycentric versus monocentric urban development strategies and key to this understanding are the concepts of “borrowed size” and “agglomeration shadows”.

Figure 7. Poor quality modal interchange in Buenavista, Mexico City

Source: Adapted from CTS EMBARQ Mexico (2013). *Asesoría especializada de accesibilidad y seguridad vial. Tren Suburbano 1 Ciudad de Mexico – Estado de Mexico*.

The concept of borrowed size describes and explains the situation whereby smaller cities located in a larger metropolitan region perform more favourably through access to agglomeration benefits offered by larger neighbouring cities. This may result in small cities exhibiting some of the characteristics of a nearby larger city. But evidence suggests that borrowed size is not strictly the domain of smaller cities since evidence indicates that different agglomeration externalities can be borrowed by small and large cities alike, as well as on various scales, also beyond that of city clusters. Analysis by Meijers and Burger

suggests that borrowed size is less a product of distance or access than it is of true interaction (Meijers and Burger, 2015; Meijers, Burger and Hoogerbrugge, 2016). This is discussed in more detail below.

Contrary to what the borrowed size concept might suggest, being located close to other cities in city clusters is not always positive. Growth in one city may supress growth (or slow the rate of growth) in other nearby and smaller cities via competition effects. This is captured by the concept of agglomeration shadows, i.e. the shadow effect of agglomerations over their surroundings. Neighbouring cities may cast an agglomeration shadow over their surroundings, consequently limiting regional development opportunities. Agglomeration shadows is thus opposite to of the notion of borrowed size.

Stead and Meijers point out that research suggests that a dominant prime city (i.e. exhibiting a higher degree of monocentricity) increases agglomeration benefits. This conforms to the general finding that an increase in city size leads to more agglomeration benefits as noted by Bertaud (2015). This would possibly be the case of large dominant cities in China, but perhaps not the case of all clusters – and certainly less and less the case of highly polycentric clusters like many on the east coast of China. There is also evidence indicating that a high degree of functional polycentricity (measured as a balanced spread of centralities in terms of incoming flows) is associated with a higher level of labour productivity, but has a negative association with labour productivity growth. However, quite different conclusions about the role of dominant prime cities on city cluster advantages and disadvantages have also been reported. Van Oort et al. (2010), for example, find that there is a positive association between polycentricity and productivity growth, and Meijers and Burger (2010) report that polycentric metropolitan areas are associated with higher levels of labour productivity. However, this does not imply that polycentric metropolitan areas have more agglomeration benefits. On the contrary, research consistently shows that the spatial, institutional and cultural fragmentation inherent to polycentric urban systems implies that they cannot exploit their critical mass to the same extent as single large cities. Polycentric regions that fare better than others share a variety of common characteristics: their constituent centres are closer together, retail development is concentrated in one centre (i.e. a less polycentric distribution of retail compared to the population distribution), and where competition from centres outside the region is lower (Burger et al., 2014).

In the Chinese case, some participants pointed out that the labour productivity impacts of urbanisation may vary over time. In the early stages of urbanisation, labour productivity grew rapidly due to productivity gains from shifting from a farming economy to an industrial economy. At that stage of development, large urban centres benefitted from both population growth and labour productivity growth. Transport investments sought to improve travel conditions within cities and this increased inter-city labour mobility. Over time, however, the growth of polycentric regions on the east coast was accompanied by the emergence of more skilled labour and a shift to a more service-based economy. Labour productivity improvements were smaller since the gains realised from shifting from manufacturing to services are smaller than the productivity gains resulting from shifting to industry from agriculture. In addition, transport investment in regional connectivity does not have a uniform impact across all workers. Skilled workers have greater intra-city mobility whereas unskilled workers principally travel within each city. Thus, participants noted that the direct impacts of investment in faster intra-city networks were to improve prospects for mid- to upper-income households and to increase the size of the pool of skilled workers for firms.

The productivity-improving impacts of urbanisation also differ across firms. Though firms stand to gain from the higher productivity of large urban areas, it is not in all firms' interest to relocate there. Firms located in large cities face higher operational, labour and capital costs than those that are located in smaller cities and towns. They must absorb the costs of traffic congestion and higher rents. Finally, the

nature of some firms' activities means that they cannot benefit from agglomeration effects of economies of scale. This means that firms, all else held equal, will naturally locate themselves across urban areas according to their particular profile and needs. Even within single companies, different divisions may locate themselves across the urban area to take advantage of access to skilled labour, low land costs or ease of access to transport facilities. However, one complicating factor in the Chinese case is the distortion that exists in industrial land markets which may cause inefficiencies in industrial siting and lead to lower agglomeration benefits. In these cases, it was suggested that intra-urban transport investments can serve to "re-connect" firms that otherwise would have located in closer proximity to each other.

Stead points out in his contribution out that there are many reasons to assume that transport and infrastructure play a key role within city clusters. Synergy is generally described as "the rise in performance of a network through efficient and effective interaction", so synergies in city clusters depend on interaction, facilitated by transport and infrastructure policy. Spatial interaction could be interpreted as both a factor stimulating economic performance, as well as an indicator of economic performance. There is also the notion that networks may substitute for proximity. Transferring this principle to city clusters would imply that the benefits of agglomeration (proximity) could be increased in a cluster of cities that are strongly networked.

There is support for the notion that cities which are strongly integrated with other cities perform better than cities that are only moderately or weakly integrated with neighbouring cities (Meijers, Burger and Hoogerbrugge, 2016; Meijers and Burger, 2015). The conclusion is that a higher degree of functional integration between neighbouring cities can override the negative effects of competition thus diminishing agglomeration shadows. Greater functional integration allows cities to better exploit their aggregate urban size, leading to more agglomeration benefits. This relationship is also significant when other types of integration (e.g. cultural or institutional) are included in the analysis.

Ultimately, the discussions underscored that benefits from investments in inter-city versus intra-city transport networks differ according to the local context, mix of economic activities, and past trajectories (i.e. there is a "path dependency" that can impact the utility of new transport investment – particularly when the path in question has favoured early and widespread motorisation). Further, these benefits are not immutable and vary according to the stage of economic development. Participants also highlighted that the benefits from transport investments do not accrue evenly across the entire population. Investments may benefit the mobile middle class but may not improve travel conditions or times for lower income workers and migrants. This, it was suggested, should be explicitly accounted for in appraisal.

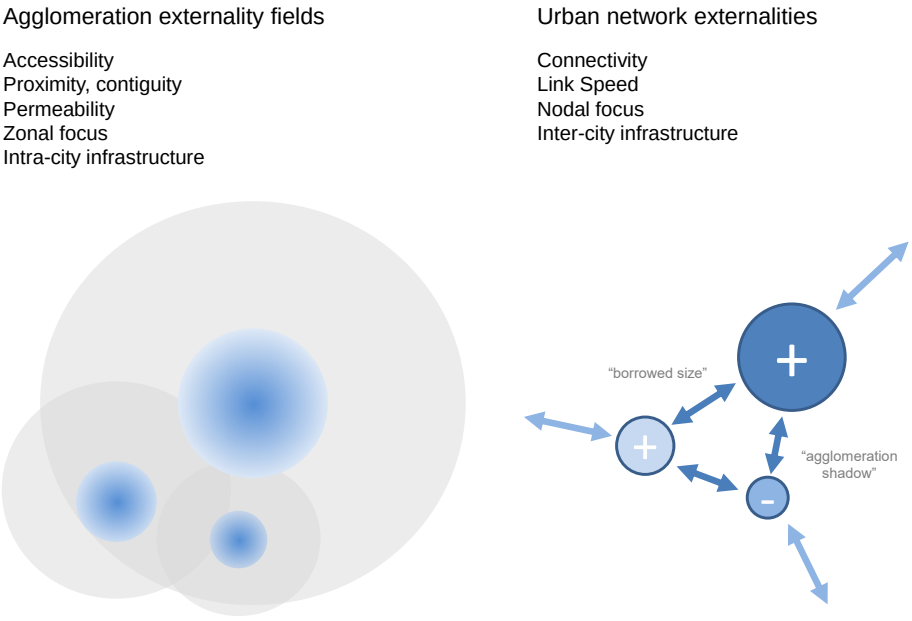
Should urbanisation and transport investment focus on mega-cities or city clusters?

China has made the decision to focus urban development on city clusters to the (relative) detriment of the largest mega-cities. Without calling that decision into question, participants explored why this should be the case and if city-cluster development uniformly brings about improved outcomes. The Roundtable discussed whether rapidly developing countries like China should focus on megacities and invest in inter-city transport infrastructure commensurate with the growth of their massive conurbations or, alternatively, should they invest in connecting multiple polycentric regions into one functional cluster via investments in inter-city networks. The answer was of course that urban regions cannot afford to ignore either form of investment but they may (and arguably, should) choose to prioritise one over the other. The question to the Roundtable from the Chair was whether policies should seek to develop intra-city connectivity as a substitute for large scale agglomeration or vice-versa (Glaeser, Ponzetto and Zou 2016).

The answer to that question partly relates to the size and timing of agglomeration externalities – e.g. external economies that firms benefit from when located in proximity to each other. These are the types of externalities described earlier – externalities that relate to broad and deep labour markets, scale economies among firms and across sectors and to the knowledge spillovers that result from proximity. As stylised in Figure 8, these externalities result from greater proximate accessibility, contiguity in urban networks and communities, permeable urban zones that improve interaction effects, a focus on zones of impact. Investment in inter-city transport, a reduction in within-city transport times and improved access within an urban area all deliver agglomeration externalities.

Productivity effects and other benefits analogous to agglomeration externalities can emerge when agglomeration are connected – when a "network of agglomerations" emerge. These externalities arise from connecting regional nodes, investments in higher speed travel and inter-city transport infrastructure.

Figure 8. Agglomeration externality fields vs. urban network externalities



Source: Adapted from Burger and Meijers (2016).

The discussion highlighted the fact that relatively little is known in terms of the relative importance of network urban externalities in relation to standard agglomeration externalities – and indeed, disentangling the two is a challenging research proposition (Burger and Meijers, 2016). It isn't clear what type of cities might most benefit from urban network externalities and it equally isn't clear as to whether they flow more from physical versus knowledge networks. What seems to be evident is that there are limits to the size of cities that ultimately limit the accumulation of agglomeration benefits. If there is anywhere in the world that these limits are being tested, it is surely in China. The scale of urbanisation, especially when looking at plans for urban cluster development, is far beyond the scope of historic city development elsewhere in the world (Figure 9).

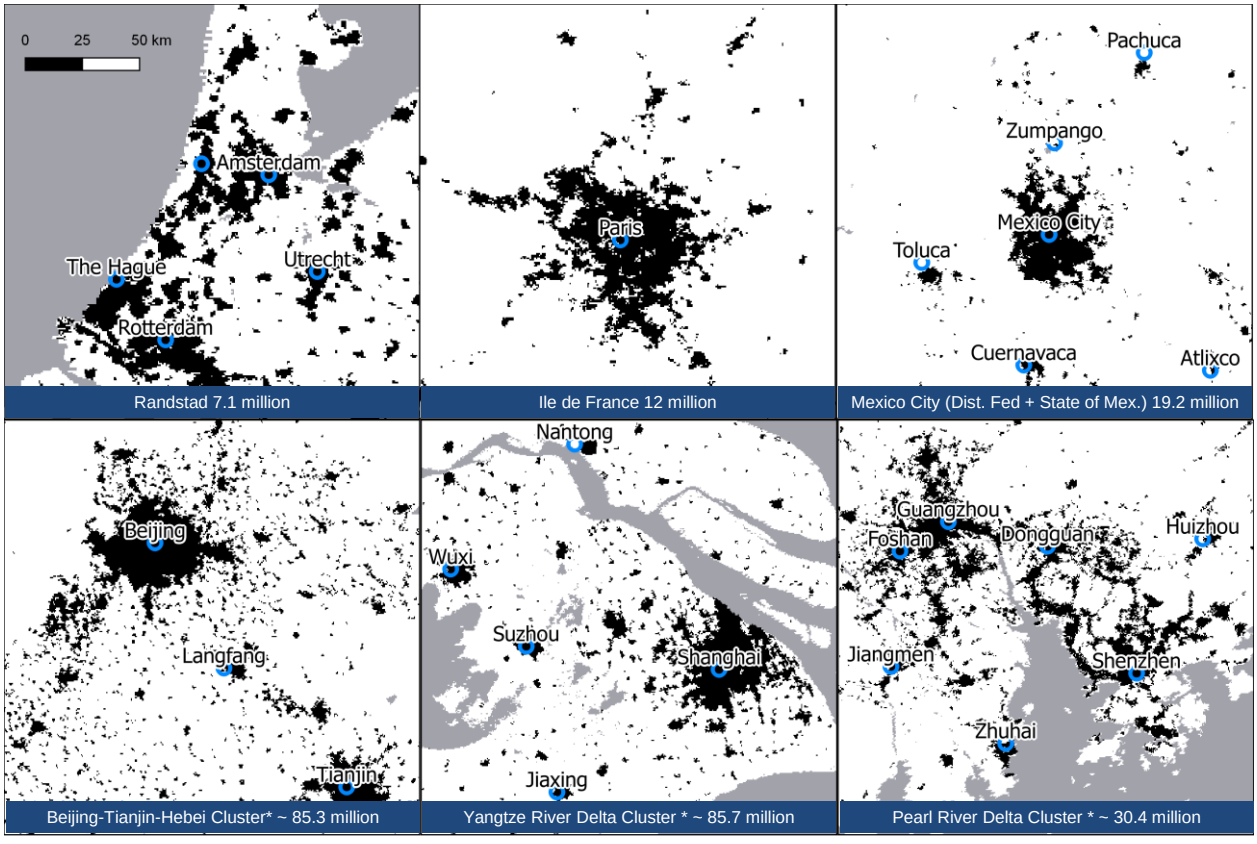
Changes in scale often require changes in structure and this seems to be the case for cities and urban regions. What works well for a city the size of Amsterdam or even Paris, may not necessarily function as well for a conurbation the size of Mexico City. And when one considers that the combined population of

the Beijing-Tianjin-Hebei and Yangtze River Delta urban clusters are more than the combined populations of France, Germany and the Netherlands, the need for new urban models seems evident. At the same time Greater Tokyo, at around 37 million people, is for now the largest megalopolis in the world.

The constraints of urban scale in the largest Chinese conurbations are formidable and according to many Roundtable participants sufficiently justify investments in "buying" space to grow by investing in connectivity. The massive investment in urban metro systems delivering intra-city connectivity and substantial investments in regional and national high-speed rail networks and motorways have improved inter-urban connectivity – especially in the most dense, polycentric regions. However, it was pointed out that network externality benefits should not be expected to flow evenly, or at all in some cases, from investing in inter-city connections. This might be the case for far-flung cities and in the case of cities where few cultural, business or knowledge networks exist.

Even in well-connected networks, the attraction and benefit of proximity remains. For instance, in cases where significant polycentricity exists, as in the Randstad and efforts to improve intra-regional connectivity have benefited firms, connections are still thicker amongst firms *within* each city than *between* firms in different cities.

Figure 9. Urban extent and population, various conurbations



Note: The full extent of the Chinese city clusters in question is not visible on these maps.

Source: ITF based on 2002 urban extent from Schneider, Friedl and Potere (2009); Natural Earth, Chinese Statistical Yearbook 2013; and Fang, Ma and Wang (2015).

Participants noted that the attraction of cities may be thwarted by certain dysfunctions – and in particular distortions in land markets (discussed earlier for industrial land) and housing. The ability to build substantial new housing and, equally important, offer a diverse range of housing (in terms of cost and size) help both skilled and unskilled workers remain or move closer to employment centres in megacities. Without this, housing naturally migrates to where it is less expensive - to the urban periphery as well as to other sub-regional centres if transport networks allow reasonable access times. In the Chinese case, rigid specifications for housing supply and inflexible super-block level zoning restrictions make it very difficult to allow for more varied, in-fill housing development thus exacerbating housing-led urban expansion. Were these relaxed, more unskilled workers may choose to locate closer to their potential places of employment. This might alleviate the need to extend transport networks far into the low-density periphery of cities and avoid some of the dis-benefits of sprawl.

Participants also discussed the type of transport investments that might benefit city-clustering most. When investing in connectivity, metro-like systems are generally helpful as they imply frequent connections between cities, to such an extent that timetables are not required as waiting times between train services are low. High-speed trains are a desirable option in larger city clusters, but maximum speeds are of less importance than frequency, particularly as distances between city centres in clusters are relatively small. Traditionally, road and rail infrastructure have developed radially from the core in city-regions. In city clusters, tangential infrastructure systems are often as important. One effective model is a metropolitan loop connecting all the main cities of a city cluster. Clearly this model is dependent on the situation of cities with respect to each other. Such systems may have symbolic importance in promoting the unity of city clusters, which in turn can foster greater integration. Transit oriented development is also important in city clusters; here transit nodes should be regarded as "interaction environments" that augment the benefits of networked regions. At the same time the property developed around the transport nodes needs to be planned carefully so that it doesn't become a barrier to efficient transfers and the accessibility of stations.

However, unlike transport systems within single cities – or indeed isolated cities themselves – city clusters and the networks that support them should not necessarily be seen as based around daily commuting patterns. Some may act more as "weekly" or "monthly urban systems", implying that the maximum time people are willing to spend travelling is higher than the threshold generally applied for daily urban systems. Strategic functions (i.e. metropolitan functions of supra-local importance) should be located in the most accessible areas for the whole urban network. Disentangling local and metropolitan through-traffic, both in road and rail infrastructure, may have benefits for the performance of city clusters.

In the end, the answer to the question "Should urbanisation and transport investment focus on mega-cities or city clusters" was: "it depends". Discussions did not support one single approach to all urban regions. Accompanying polycentricity with transport investments that reinforce the pattern where it has emerged from non-distorted market interactions is likely to be advisable. However, "forcing" polycentricity on regions may not deliver expected efficiencies and is likely to be an expensive proposition. In the past, urban development in China (as in the Netherlands and France) was based more on normative plans that sought to strengthen the strategic position of cities in the economy. This may have helped with nation building but was sometimes inefficient and resulted in unexpected and costly outcomes. The discussions highlighted the need to move away from such normative plans and China is increasingly doing so. However, determining where and when it makes sense to focus on cities or city clusters, and to understand the marginal benefits of either strategy, will depend on employing robust and transparent appraisal tools that are not yet fully deployed.

Managing transport governance in global city clusters

A recurrent theme in the Roundtable (and indeed in most discussions of urbanisation) was the need to adapt regional governance structures to the scale of the challenges posed by clustered urban development. Specifically, governance structures or arrangements should be sized to the commuting trip market which typically extends across multiple jurisdictions and beyond the core city. At the outset of the Roundtable, discussion of integration focussed first on the physical integration of city clusters via transport networks but over the course of the discussions it became clear that participants felt that it was equally important to address issues of institutional integration that cover governance, investment, operations and financing. Like many other countries at all stages of development finding the right level of integration is challenging in China. Finding the right formula for governing transport investments and operations at the scale of city clusters is still a work in progress.

Transport governance is fragmented across many levels in Chinese urban clusters. The Central Government offers planning guidance through both the Ministry of Transport and through the National Development and Reform Commission, which approves investments in urban metro systems. National investments in rail – and high-speed rail in particular – fell until recently under the Ministry of Railways but railways are now integrated in the Ministry of Transport. Expressways connecting provincial capitals were approved at the national level but funded via a mix of local taxes, bonds and both domestic and foreign investment. The core of the motorway network is tolled and was financed by private companies contracted by provincial governments. Local roads and urban public transport services, including buses and bus-rapid transit systems are the responsibility of urban governments. Public transport services are operated by municipalities themselves or by wholly publicly owned companies. Planning capacity and expertise is high in China and, on paper, the planning processes is well organised. However, participants noted that in practice planning processes are cumbersome and plans take a long time to develop – so much so that when they are ready for implementation they are outdated and have been overtaken by events. The long history of urban planning for Beijing and the difficulty in implementing successive plans was cited as one of several examples. Plans have traditionally been top-down and gave little room for public participation, which has weakened their relevance to the population and local actors.

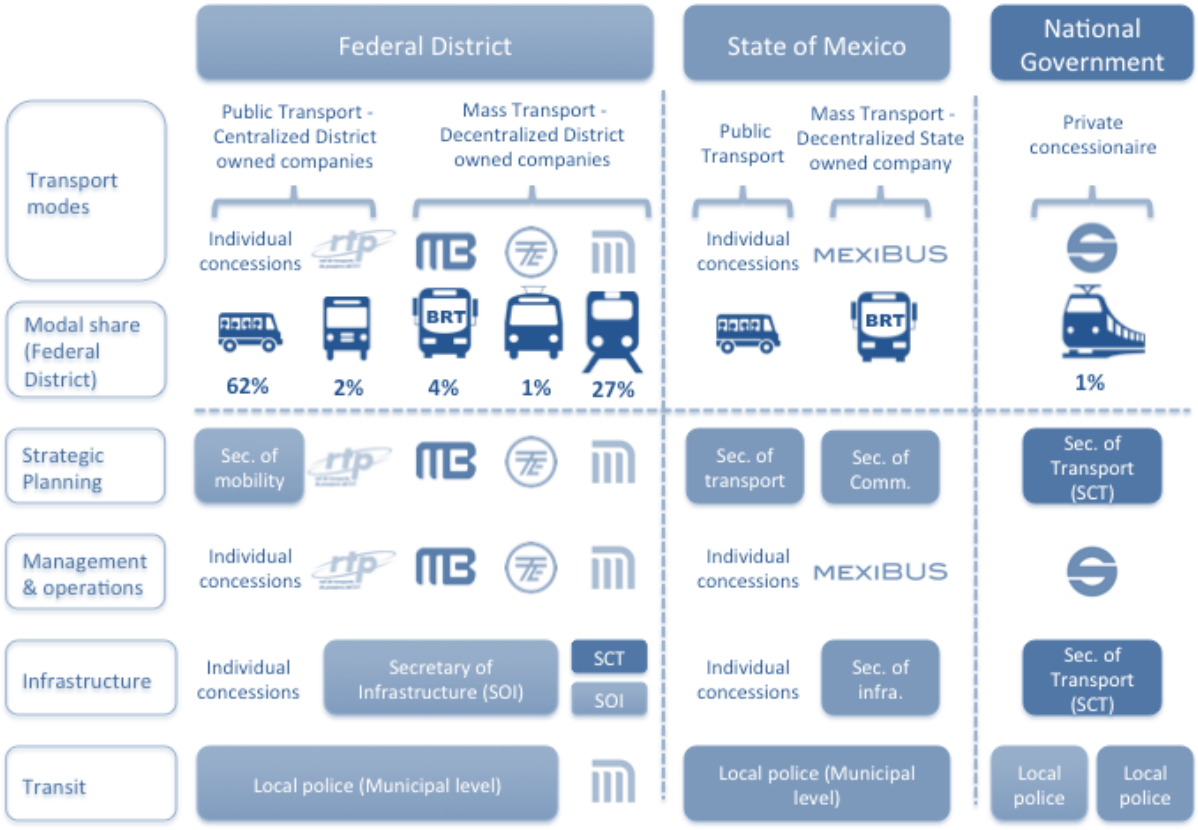
Without a formal mechanism to co-ordinate investments across broader urban regions, incentives for cities to compete against each other have been stronger than incentives to co-operate on planning, construction and co-ordination of operations across boundaries and across transport modes and services. The spectre of agglomeration shadows leading to the decline of some urban centres within a greater urban region has sometimes led to a situation where connectivity has been avoided – the most glaring examples being a number of “ghost” highways that fail to connect to a neighbouring city. This is changing but participants underscored that the co-ordination challenge is still acute in a number of Chinese urban regions. Generally, individual transport modes and services operate to a high standard but interconnections can be difficult, time-consuming or inexistent in some cases.

Varela (2015), in his description of the co-ordination challenges operating in Mexico City, indicated that China was not unique in its experience. The system of governance for public transport in Mexico City is highly fragmented not only at the level of the Federal District, but also within the larger, encompassing State of Mexico. A total of eight different service providers operate at the metropolitan level: five in the

Federal District, two in State of Mexico and only one envisioned as a suburban transport service (Figure 10). This fragmentation can be seen at various levels from planning to operations, and imposes serious difficulties when it comes to integrating different modes of transport within and across administrative boundaries. These issues are addressed in detail in OECD (2016).

An example of the difficulties posed by this lack of integration is illustrated in the delivery of Line 1 of the Mexico City Suburban railway network. In order to cut costs for this new suburban railway line that sought to provide an alternative to car travel to the city centre, the project favoured state-owned right-of-ways and pre-existing terminals (Buenavista). This strategy had a major drawback: main access to the system would be embedded in industrial zones only accessible by car-oriented infrastructure. The project assumed that 65% of the daily demand (around 187 thousand passengers) would access the system by a feeder system based on minibuses mainly regulated by State of Mexico. The rest 35% would have directly access by foot or less frequently by taxi or car.

Figure 10. System of governance for public transport in Mexico City



Source: Varela, S. (2015).

When the project was delivered, several components were missing. Some vehicular overpasses and pedestrian bridges were not finished or, in some cases, not even started. Most importantly, only few minibus operators modified their itineraries and routes to connect residential zones with the railway system. After the first year of operations, Mexico´s first suburban railway attracted just half of the projected demand (148 000 daily passengers), 78% of which access the system by foot, taxi or car. This situation greatly differs from the original plan which foresaw most users accessing the stations by minibuses (65% of the projected demand). Why did the line underperform? Operators of minibuses

looked at the train as a competitor and had no clear incentive to reorganise their routes. The government failed to negotiate changes to the exclusive concessions awarded to minibus operators to provide incentives or regulatory directions to provide a reliable feeder system, connecting infrastructure was not completed or poorly designed and the integration of fares between minibuses and the suburban train was simply not considered.

The overall lack of integration between the train and its feeder system at many levels (infrastructure, operations and fare) was difficult to reverse due to unregulated competition. Even though competitors operating minibuses are slower (Line 1 is up to 40 min faster), total fares are less expensive (almost USD 1 cheaper) and therefore more attractive for low-income users. Moreover, frequent criminal activity around stations and pedestrian bridges, fuelled by the lack of streetlights and poor public safety, discourages current riders and diminishes the attractiveness of the suburban train option for potential travellers.

In the discussion following the presentation of the Mexico City example, numerous examples of similar dysfunctions were described at various levels in China. One clear outcome was that government officials should focus beyond the provision of infrastructure when looking at connectivity investments. They must have a holistic view of the strategic nature of the transport task within the region, how this links to other regional (and national goals) and the ability to guide investments and policies at a regional scale.

Laurence Debrincat's description of the governance structure for transport in the Ile de France region provides one model for effective, regional-scale transport governance for public transport. The *Syndicat des transports d'Île-de-France (STIF)* is the public transport authority for the Île-de-France region. At the scale of the greater Paris region, it defines the strategic orientation and organisation of public transport services, sets fare policy and contractual relations with operators and ensures the financial balance of the system. It plans and monitors network extensions and sets quality standards for intermodality and accessibility. Transport investments are carried out by the STIF supported by a dedicated employee payroll tax ("the *versement transport*") which covers 65% of regional public transport capital expenditures. The STIF carries out comprehensive planning in support of improving the functioning of all transport modes within the region through the *plan des déplacements urbains* (Urban Mobility Plan). It also implements significant parts of this plan, notably by negotiating service contracts with public transport providers that may be either publicly-owned or private companies. One of the strengths of the governance model is that the STIF centralises public transport decision making across a much larger region than would otherwise have been the case if municipal governments had retained control. Large-scale urban regions need some form of co-ordinating entity when it comes to transport investment and planning of operations but these are difficult to put into place since they imply a redistribution of power away from municipal governments. This is a delicate issue but not one that is insurmountable since many countries have successfully put into place similar arrangements.

Financing and managing infrastructure in global city clusters

The need to chart a pathway to more sustainable financing mechanisms for urban areas as well as for transport investment was a recurrent theme echoed throughout the Roundtable. The perverse impact of over-reliance of local governments on revenue from land transfers contributes to lower density development than otherwise would have occurred. This effect is compounded by dysfunctions in land markets, particularly as they relate to industrial land. These dysfunctions are in turn spurred by inter-city competition to meet national growth targets. This result in a pattern of urban development that consumes too much land and thus precipitates issues relating to urban size (in area). Arguably, without these two effects, and in combination with a property tax that places an incentive on higher-density development, urban conurbations in China would be less "land-heavy". This would make the need for investment in transport infrastructure to support the functioning of urban clusters less intense. For example, another 4.2 million people could be housed in Guangzhou if that city had the same housing density profile as Seoul (World Bank, 2014). Increased density would certainly change the types of transport investments that could best serve urban populations and could de-emphasise reliance on cars and motorcycles.

Urban transport financing in China is relatively unstable, subject to market fluctuations and debt exposure risks. Participants underscored that a real gap exists between urban transport finance practice in China and that in other mid- and high-income countries. Dependence on Central government financing and local land sales are unreliable sources of income – particularly as the latter may not bring consistent returns in a more market-oriented economy. In any case, with sprawl, the value of peripheral land continues to erode and land sales will show declining returns. Many local authorities turned to debt markets for capital funds in the 1980s and 90s. As many projects proved unable to generate the returns expected, local authorities can no longer borrow money on commercial markets in China except under very restrictive conditions. Given that the gap between expenditures and revenue continues to rise and that municipal governments must return balanced budgets, pressure has mounted to seek off-budget revenue sources. This has resulted in increased recourse to the urban development investment companies (UDICs) which both facilitate land transfer processes for local government and provide an avenue for accessing debt markets. UDICs can also issue bonds and stocks which are collateralised by land-use rights and future revenue from land development projects. The reliance of local authorities on UDICs, and the reliance of UDICs on future land development revenues, are both vulnerabilities. Chinese cities generally have a lower debt exposure profile than other developed country cities (World Bank, 2014) but the fact that the value of the collateral backing these loans is subject to great uncertainty, especially as cities sprawl, magnifies the risk with this form of debt. Furthermore, some cities are very much more exposed to UDIC liabilities than others, placing them more at risk.

Participants noted that it was hard to imagine moving forward on delivering the benefits of more integrated city clusters in China without reforming local government financing. Experimentation underway with setting up a property tax system is very encouraging but this will involve a number of complimentary reforms that will take time. In the meantime, there is a need for re-directing local revenue generation away from its current unsustainable sources. Land-value capture mechanisms in association with transport infrastructure investments represent one possible way forward. Another

might involve incentivising urban densification by relaxing some of the rules relating to the re-classification of urban land uses. In-fill development could also generate fees that could help local governments both densify and raise revenue at the same time.

In addition to seeking more sustainable revenue sources, the discussion revealed a real need to better align city cluster policy with project planning and with identified revenue sources. Currently, funding decisions are made piece-meal, often after the policy decision to invest, and are uncoordinated with existing planning documents, processes and timelines. This leads to sub-optimal outcomes and lowers the ability to strategically decide on priority investments at the scale of multi-city clusters.

Managing uncertainty regarding future developments

The question of managing uncertainty and de-risking decision making came up many times in the discussion, primarily in trying to understand how to account for potentially large changes in patterns of trip-making that deviate from experience and from forecasts. A recurring example was how to address the impact that IT platform-based commercial transport services, like those offered by Didi Kuadi (now Didi Chuxing) and Uber, might have on the need for transport investments – particularly for thin public transport markets. Participants felt that these types of services could potentially obviate the need for certain bus services and might contribute to greater mobility in smaller urban clusters and regions but that they were unlikely to play a significant role in the largest urban clusters since these regions suffer from congestion that would equally impact private cars, taxis and app-based services.

Generally, there seemed to be a consensus that current forecasting efforts, especially coupled with monitoring of key trends and performance statistics, were sufficient since the momentum of growth in China is so great that it was not likely to change course, at least not in the short-run. If demand uncertainties manifest themselves for specific projects, several options could be considered. The first is that opportunities to increase capacity on existing networks via investment in intelligent transport system services exist and have not fully been exploited in China – particularly in many second – and third-tier cities. The second is that upgradeable infrastructure could also be developed thus mitigating the costs of getting forecasts wrong and reducing the costs of providing entirely new infrastructure. The example of the rail-road bridge built for, but not with, rail infrastructure was given as one example of such an options-based approach.

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Chongqing Traffic Commission

China Highway and Transportation Society

Note

1 Hukou is a mandatory household registration document that specifies where Chinese citizens can live and, thus, what social services they can access (education, health care, etc…).

International Transport Forum

Connectivity and City Clusters

This report presents international experience and lessons learned from integrated transport development in large-scale urban regions and city clusters. It serves as an input to discussions around city cluster development in China and other emerging economies. First, it assesses how regional urbanisation delivers socio-economic benefits via both agglomeration and network externalities. It then examines differences in how these benefits are delivered in single versus clustered city networks. The role of governance structures and how they might best be adapted to ensure positive outcomes is also discussed. Finally, the report addresses the potential for reforming local government financing mechanisms in China in order to guide urban growth in a sustainable manner.

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