Land Use and Transport in Developing World Megacities: Theory and Reality

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ABSTRACT:

The migration of people from rural areas to urban area started centuries ago and has now spread throughout the world. One consequence has been the rise of "megacities" (in English, "megacities") --- urban areas with more than 10,000,000 population. Megacities provide superior economic opportunities because they are larger labor markets in which there is greater potential for efficiently matching employees and employers. This paper examines land use and transport in megacities, especially in the developing world. The examination includes the role of mobility in the economic growth and affluence (poverty reduction) in urban areas, the relationship between land use planning, transport, economic growth and affluence in urban areas. A potential set of urban performance indicators is proposed.

La migration des populations des zones rurales vers les zones urbaines a commencé il ya plusieurs siècles et s'est maintenant répandu à travers le monde. L'une des conséquences a été l'émergence des «mégalopoles» --- les zones urbaines de plus de 10.000.000 habitants. Mégapoles fournir des opportunités économiques parce qu'ils sont plus grands marchés du travail dans lequel il est plus grand potentiel pour correspondre de manière efficace les employés et les employeurs. Cette étude examine l'utilisation des terres et des transports dans les mégapoles, en particulier dans le monde en développement. L'examen comprend le rôle de la mobilité dans la croissance économique et la prospérité (réduction de la pauvreté) dans les zones urbaines, la relation entre l'aménagement du territoire, des transports, la croissance économique et la prospérité dans les zones urbaines. Un ensemble de potentiel urbain des indicateurs de performance est proposé.
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Introduction

Throughout history, urban areas have been magnets for people seeking greater opportunity. Urban areas have agglomeration economies that create more efficient labor markets, which improve economic growth, increases employment and reduces poverty.

This paper provides an overview of the world's megacities and provides tentative projections to 2030. It also includes urban transport and land use policy analysis related to economic growth, affluence and poverty reduction in megacities.

The starting point is a principle --- that a primary purpose of urban policy is to foster sustainable economic growth for the greatest share of residents (and certainly not to retard economic growth). Moreover, virtually all nations seek to improve the economic status of their population. Benjamin Friedman argues in *The Economic Consequences of Economic Growth,* that economic growth is more than desirable; it is a necessity for social cohesion (Friedman, 2005).

Background: Megacities

"Megacities" is a term used to describe urban areas of 10,000,000 or greater population. This paper uses "urban area" (urban agglomeration or urban footprint) megacity definition, rather than the

metropolitan area definition (See Appendix: "City: Defined). This is because urban areas, as areas of continuous development, best reflect the principal urban transport and planning area. Urban areas exclude the rural areas that are included in metropolitan areas.

Overview of World Megacities

It is estimated that there are 22 megacities in the world as of 2008, 16 of which are in the developing world. The developed world has only 6 megacities, Paris, Tokyo-Yokohama, Osaka-Kobe-Kyoto, Seoul, New York and Los Angeles (Table).

Two megacities --- Jakarta and Manila --- warrant special mention, because international data sources often substantially understate their sizes.

Jakarta: Sources such as the UN report only the population of the DKI Jakarta, which is a province level jurisdiction rather than an urban footprint. However, the urbanization of Jakarta (the larger area is often referred to as Jabotabek) extends into the regencies of Tangerang, Bekasi, Bogor and Karawang and includes the separate cities of Bekasi, Depok and Bogor. The population estimate in this paper is from an analysis of available data in the suburban jurisdictions. Jakarta is now estimated to be the 2nd largest urban area in the world and could become the largest by 2030 (Demographia, 2008 #3).

Manila: Sources such as the UN report the population of the National Capital Region (also called Metro Manila), which is a province level jurisdiction rather than an urban footprint. The continuous urbanization of Manila extends outward into Bulucan, Cavite, Laguna, Rizal and Quezon provinces. The Demographia population estimate is a "build-up" of municipality population within the urban area. Manila is now estimated to be the 5th largest urban area in the world and is projected to rank 3rd, behind Jakarta and Tokyo-Yokohama by 2025.

The population of other urban agglomerations appears to be overestimated. UN population estimates for Dhaka and Karachi appear to encompass much more than the urban footprint. and appear to be metropolitan area numbers. Further, Lagos had been widely reported to have more than 10,000,000 population, but it is now generally accepted that this figure has not yet been achieved. Each of these is likely to become megacities by 2025.

Megacity Urban Form and Transport

Urban Footprint: Megacities vary substantially in the extent of their urban footprint. More developed work megacities cover an average of 5,400 km^2 (range from 1,900 to 11,200), developing world. Less developed world megacities have smaller, but still large urban footprints. The average is 2,000 km^2, with a range of from under 800 to 2,700. By contrast, London and had the largest urban footprint in 1900, at approximately 285 km^2. As urban footprints become larger, the potential origin-destination pairs increase geometrically, which favors personal transport and is to the disadvantage of public transport.

Urban Population Density: At the same time, the developing world megacities have generally higher densities, averaging 8,800 persons per km^2, nearly double the 4,700 of developed world megacities. There is a large difference however, with densities as low as 4,100 (Guangzhou-Foshan) and as high as 21,900 (Mumbai). While higher density urban areas are more conducive to public transport service, larger urban footprints are far more difficult to serve for public transport. This is illustrated by two examples involving the world's most dense megacity, Mumbai.

- Mumbai covers 777 km^2, compared to London's estimated 285 km^2 in 1901 (Demographia, 2005). Despite the fact that Mumbai is 1.25 times London's 1901 density, the potential origin-destination pairs in Mumbai's larger urban footprint is 7.4 times that of 1901 London (assumes public transport catchment areas with a maximum distance from origin or destination of 400 meters). Thus, theoretically, serving Mumbai's larger urban footprint is approximately 6 times as complex as service 1901 London.
- Mumbai's density is 14.5 times that of New York, the lowest density megacity. Serving all of the origin-destination pairs in New York's larger urban footprint, however, would require a public transport system more than 200 times as comprehensive as in Mumbai.

Central Orientation: Popular and sometimes planning conception tends to think of urban areas as monocentric. However, even the strongest cores have a relatively small share of overall employment in the megacities. For example, the Tokyo central business district (CBD) --- the largest in the world, represents less than 30% of the urban area employment. The second largest CBD is in New York and represents less than 25% of the urban area employment. Despite the growth of central Shanghai, the CBD represents less than 20% of urban area employment. At the other extreme is Los Angeles, with a concentrated CBD containing less than 3% of the urban area employment (Demographia, 2006).

In a number of developing world megacities, CBDs have an even smaller share of urban area employment, such as in Delhi, Manila and Jakarta. Manila, like a number of developing world urban areas, has experienced strong development of peripheral business centers ("edge cities"), such as Makati and Ortigas. Edge city development is also particularly evident in Istanbul (Levant), Mexico City (Santa Fe) and Sao Paulo (Paulista and Berrini).

The strongest CBD's may be more or less dense. Particularly high CBD employment densities are in New York and Osaka. Strong, but lower density CBDs are found in Tokyo, Paris, Moscow and Beijing.

For conventionally designed, radially oriented rail public transport, the ideal is a high concentration of jobs in a single business center of high density. To the extent that core employment centers are smaller or less dense, personal transport tends to gain advantages relative to public transport. Significant exceptions to this are Tokyo, Paris and Moscow, where a dense mesh of rail lines --- both metro and suburban rail more than compensate for the lower concentrations.

Megacity Projections to 2025

This number of megacities is expected to rise to 31 by 2025. All of the 9 new megacities by 2025 are expected to be in the less developed world.

There is likely to be strong growth in the megacities exceeding 20,000,000 residents. In 2008, there are 4 such urban areas. By 2025, the number is expected to rise to 11. As noted above, there is the prospect that Jakarta could exceed Tokyo as the world's largest agglomeration by 2030. That would end a period of 75 decades during which Tokyo was the largest urban area. By comparison, New York was the world's largest agglomeration for 30 years (1925-1955), London was largest for 84 years (1840-1925) and Beijing for more than 100 years (early 1700s to 1840) (Chandler and United Nations).

MEGACITIES AND AFFLUENCE

Low-income megacities often portray an image of intense poverty to high-income world observers. However, poor as they may be, people who migrate to the low-income megacities and other large urban areas do so because their economic prospects appear better in the megacities than where they came from.

Mobility and Affluence

Mobility is a substantial factor in driving economic growth and reducing poverty.

Prud'homme and Lee find that as the percentage of jobs that can be reached increases in a particular period, urban economic production improves by a factor of 0.18 (Prud'homme and Lee, 1998). Thus, a 10 percent improvement in employment access would theoretically lead to an improvement in economic output of 1.8 percent. At the same time, more efficient transport aids in the movement of freight, which results in lower product prices, which allows people to purchase more with their incomes. The importance of internal freight movement is illustrated by recent research in Portland, Oregon (Economic Development Research Group, 2005) and Vancouver, BC (Delcan and Economic Development Research Group, 2003), on the necessity for improving traffic flows to improve urban area competitiveness.

Our urban area research found that urban travel is strongly associated with higher urban income levels. This econometric analysis of data from the 99 urban areas indicates that average gross product per capita is strongly related to at least two factors --- (1) the extent of economic freedom, as measured by the Heritage Foundation *Index of Economic Freedom*, and the amount of travel (Johnson and Sheehy, 1996). This research finds much weaker relationships between higher incomes as other factors, such as public transport market share, public transport service intensity, and total population.

This research indicates that the efficiency of urban economies is improved as travel speeds are improved and as the ability to travel throughout the urban area is maximized, whether for people or freight. The personal mobility modes, principally the automobile and the motorcycle, usually have a advantage over public transport in this regard. Public transport requires longer travel times for most trips in urban areas.

The developed world experience is well documented. In the United States, the average work trip travel time by public transport was 70 percent more than that of the automobile in 2000 (Calculated from United States Bureau of the Census). In 2005, the average public transport work trip travel time was 80 percent higher in Canada than the average automobile commute (calculated from Turcotte, 2006). Public transport work trip travel times in the Paris area are approximately double the automobile commute time (Gerondeau, 1997).

A similar dynamic is evident in Paris, which may have the best public transport system in the western world. Research indicates that from the new towns with RER (regional metro) service, the car provides access, within one hour, to 84 percent of the jobs in the Ile-de-France. This is more than double the 41 percent of employment that is accessible in one hour by public transport (Calculated from Fouchier and Michelon, 1999).

Moreover, research in the United States shows that low income employment requires is enhanced by personal mobility. Raphael and Stoll, at the University of California, estimate that if automobiles were available to all African American households, the gap between non-Hispanic-white and African-American unemployment would be reduced by nearly one-half (Raphael and Stoll, 2000). A

Brookings Institution report concluded: "Given the strong connection between cars and employment outcomes, auto ownership programs may be one of the more promising options and one worthy of expansion" (Blumenberg and Waller, 2003). The conclusion from this research is that, at least at present, personal mobility generally provides superior mobility than public transport throughout the *entire* urban area.

The attractiveness of personal mobility is evident in developing world urban areas, where there is substantial use of transport modes capable of speeds fast to move people throughout the urban area. Motorcycles and motorbikes are the most obvious such modes. However, in many places, three wheeled vehicles, such as auto-rickshaws (called tricycles in the Philippines and becaks in Indonesia). Despite its comparatively low income, Ho Chi Minh has already achieved a high level of personal mobility with the motorcycles and motorbikes, which account for more than 80% of motorized urban travel (calculated from UITP, 2002). Finally, the development by Tata Motors (and the inevitable competitors) in India of the $2,500 automobile is likely to substantially expand personal mobility in developed nations.

None of this is to suggest that public transport cannot better compete with personal mobility in larger parts of the urban area. However, as presently provided, public transport does not provide the comprehensive mobility that can be obtained by personal mobility.

More effective public transport competition would require a strong focus on the dispersed travel needs of the public. This would require a shift of focus from the high-capacity modes that are too expensive to be provided at sufficient intensities to compete with personal mobility. The perhaps uncomfortable reality is that variation of the public transport models already in operation in Manila along with many Latin American and African urban areas --- intense service provided by small, individual vehicles --- may be a necessary element in providing an alternative to the personal mobility that people routinely seek as their incomes rise.

Land Use and Affluence

The predominant view in urban planning is that automobile use must be curbed and that urban areas should become more dense (more compact). Yet, throughout many high-income world nations, the spread of urban areas into less expensive suburban land has allowed a home-owning middle class and contributed to an unprecedented "democratization" of prosperity (see for example, DeSoto, 2000)

Further, the externalities of compact city policies --- higher land and thus housing prices --- have generally received little attention in the transport and urban planning literature. This is similar to the dichotomy Godard notes in the potential policy conflict between limiting mobility to reduce greenhouse gas emissions and the need to increase mobility to reduce poverty (Godard, 2007).

One of the purposes of compact city policy is to create a "clear edge" between urbanization and rural areas. Land rationing policies seek to put limits on the land available for urban development and to avoid the "ragged edge" that occurs as development on the fringe in the absence of such policies. However, by definition, compact city policies tend to limit the amount and location of land that can be developed and by rationing land increase its cost.

An example of the cost increasing impact of compact cities policies is provided by the United Kingdom government's Barker report that raw land with residential planning permission is valued at

more than 250 times land without planning permission (Barker, 2006). Similar trends have been identified in other nations (Demographia, 2008, #5).

The United States, with its federal system, provides a contrast between metropolitan areas with and without compact city policies. A large difference has developed. As the "housing bubble" developed in some markets in the United States, but not in others.

Median house prices rose more than $160,000 in compact city policy markets relative to prices in markets with traditional policies between 2000 and 2007 (Demographia, 2008, #4). This outcome contrasts with predictions by advocates of compact city policies, who predicted that such policies would reduce average new house costs $11,000 (inflation adjusted) per unit in the United States between 2000 and 2025 relative to areas without such policies (Burchell, 2002).

The Median Multiple --- the median house price divided by the median household income --- doubled or even tripled in markets with compact city policies (such as Portland, Los Angeles and New York). Similar cost escalations occurred in urban areas of Australia, Ireland, New Zealand and the United Kingdom, where compact city policies have been virtually universally adopted (Demographia 2008, #1).

In contrast, in United States markets without compact city policies, median housing prices retained their historical 3.0 Median Multiple. The Median Multiple remained below 3.0 in Atlanta, Dallas-Fort Worth and Houston, (which are the three fastest growing metropolitan areas with more than 5,000,000 population in the developed world), indicating that demand was not the driver of the house price increases. The Median Multiple in markets without compact city policies remained within historical bounds in most markets of the United States and Canada where compact city policies had not been adopted.

The higher costs that are attributable to land rationing need to be considered as urban plans are adopted. In developing world nations, higher than necessary land prices can seriously erode the potential for home ownership and force people to live in more crowded and sub-standard conditions (because their housing costs are higher than they would be otherwise). Such policies are also likely to lead to a longer entrenchment of poverty.

Planning Professor Shlomo Angel of New York University, a co-author of the United Nations and World Bank housing indicators program, wrote of the dynamics that could destroy housing affordability in many markets in the developing world: *Enabling mortgage finance and subsidy policies, for example, can increase the demand for housing, while heavy-handed regulations and infrastructure shortages can constrain supply. The overall result can be a shortage of housing, accompanied by high prices and low affordability for all* (Angel, 2000). Angel notes the importance of encouraging home ownership in developing world urban areas by making land available on the urban fringe rather than rationing land. The principal element would be the designation of a suburban and exurban arterial grid of dirt roads that would be completed as development requires it.

The 2007 published United Nations Population Report recognizes this difficulty and notes that: *There is no lack of land. The problem is dysfunctional land markets, misguided regulations and a lack of proactive management policies.* The report goes on to point out that *Lack of good regulation actually increases poverty.*

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The United Nations characterizes the situation facing developing world urban areas as follows: *An alleged shortage of land has been a main obstacle to more effective housing policies for the poor. The need to safeguard environmental and agricultural land from chaotic urban expansion is a genuine concern. However, most cities still have buildable land in good locations, but it is owned or controlled by private interests or by state agencies with no interest in socially directed uses of the land. The real shortage is thus not of land, but of serviced land at affordable price.*(United Nations, 2007).

Indicators

The following objectives would be of particular importance in designing urban transport systems to meet the needs of megacities and other large urban areas.

1. Public transport access should be provided from every point (catchment area) to every other point in the urban area. Public transport indicators that would be useful in measuring progress on this objective might be the share of the population living within 400 meters public transport access and the share of employment in the urban area or within a particular radius that can be reached by public transport in a particular period of time (such as 30 minutes).
2. House prices should be as low relative to incomes. Housing indicators that would be useful in measuring progress toward such an objective would be the Median Multiple (median house price divided by median household income) standard (such as 3.0 or below) and achievement of a pre-determined annual objective to reach that objective.

In view of the priority for alleviating poverty, it would be appropriate to urgently establish policies to seek these objectives.

Further, transport improvement strategies should take appropriate notice of the objective to reduce greenhouse gas (GHG) emissions. Any strategies should be evaluated based upon their efficiency and effectiveness (cost per ton of GHG removed), consistent with the $50 per metric ton ceiling identified by the International Panel on Climate Change (Barker, Bashmakov, et al, 2008).

Taken together, the objectives and measures above would appear likely to foster economic growth and the alleviation of poverty in megacities and in other urban areas.

Appendix: "City" Defined

There are definitional issues with the apparently simple term "city" The term "city" can be defined on at least three levels, the municipality (as in the ville de Paris or the city of New York), the urban area, "urban footprint" or urban agglomeration (such as the "unité urbaine" of Paris or the New York urbanized area) and the metropolitan area or labor market (such as the "aire urbaine" of Paris or the New York metropolitan area). Even "city" as it relates to municipalities is subject to great variation. For example, municipalities in nearly all nations are smaller than urban areas or metropolitan areas. In China, however, "cities" are generally provincial (state) equivalents or sub-provincial units that can be much larger than either the corresponding urban area or metropolitan area. This is best illustrated by Chongqing, a city (municipality) of more than 30,000,000 population, which covers a land area as large as Austria. Yet the urban footprint of the principal urban area (Chongqing) has a population comprising less than 1/5th of the city.

Table
Megacity Population & Projections

2008 ESTIMATED POPULATION			PROJECTION			BASE YEAR ESTIMATE	
Rank	Urban Area	2008	2025	Rank	Annual Growth Rate	KM2	Population per KM2
1	Tokyo-Yokohama	34,400,000	35,290,000	1	0.15%	7,835	4,372
2	Jakarta	21,800,000	32,960,000	2	2.38%	2,720	7,575
3	New York	20,090,000	20,930,000	9	0.24%	11,264	1,750
4	Seoul-Incheon	20,010,000	21,510,000	8	0.43%	1,943	10,039
5	Manila	19,550,000	28,890,000	3	2.31%	1,425	13,443
6	Mumbai, MAH	19,530,000	27,340,000	4	2.00%	777	21,879
7	Sao Paulo	19,140,000	21,860,000	6	0.78%	2,590	7,220
8	Mexico City	18,430,000	20,410,000	11	0.60%	2,137	8,471
9	Delhi, DEL	18,000,000	26,930,000	5	2.40%	1,425	10,706
10	Osaka-Kobe-Kyoto	17,270,000	17,390,000	13	0.04%	2,720	6,343
11	Cairo	16,750,000	21,680,000	7	1.53%	1,269	12,804
12	Kolkota, WB	15,010,000	20,440,000	10	1.83%	984	13,429
13	Los Angeles	14,730,000	16,840,000	15	0.79%	5,812	2,379
14	Shanghai, SH	14,460,000	18,750,000	12	1.54%	2,396	5,677
15	Moscow	13,260,000	13,710,000	21	0.20%	4,533	2,890
16	Beijing, BJ	12,770,000	16,730,000	16	1.60%	2,616	4,301
17	Buenos Aires	12,390,000	13,410,000	23	0.46%	2,590	4,633
18	Guangzhou-Foshan, GD	11,810,000	15,180,000	18	1.48%	2,590	4,054
19	Shenzhen, GD	11,710,000	16,660,000	17	2.10%	1,295	8,494
20	Istanbul	11,220,000	13,530,000	22	1.11%	1,256	8,837
21	Rio de Janeiro	11,160,000	12,750,000	24	0.79%	1,580	6,899
22	Paris	10,430,000	10,590,000	26	0.09%	3,043	3,417
	Kinshasa	8,190,000	16,990,000	14	4.38%	622	12,629
	Lagos	8,860,000	14,610,000	19	2.99%	971	8,597
	Karachi	9,380,000	14,380,000	20	2.54%	881	9,880
	Dhaka	7,310,000	11,800,000	25	2.86%	311	19,305
	Lahore	6,810,000	10,580,000	27	2.63%	583	10,811
	Dongguan, GD	7,650,000	10,330,000	28	1.79%	1,295	5,598
	Bangkok	8,290,000	10,130,000	29	1.19%	1,502	5,326
	Chennai, TN	7,320,000	10,050,000	30	1.88%	414	15,504
	Ho Chi Minh City	6,710,000	10,040,000	31	2.40%	609	10,269

Note: Complete base estimates at http://www.demographia.com/db-worldua2015.pdf

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