Defining Metropolitan and Megapolitan Areas

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Planners, geographers, and economists use many varied areas for spatial analysis. These include: individual parcels or lots, city blocks, neighborhoods, school districts, cities, counties, metropolitan areas, megapolitan areas, regions, nations, and transnational groupings. Many of these areas are well defined based on property descriptions (lots and blocks), government boundaries (school districts, cities, counties, and nations), or specific criteria (metropolitan areas). Some areas have more of an open texture (neighborhoods, regions, and transnational groupings) whose scope depends on the details of the problem being addressed. For example, neighborhood definitions used to develop measures of inequality likely would differ from those used to examine environmental issues. Megapolitan areas are relatively new as a candidate area for analysis, having first been addressed in detail by Jean Gottmann in his study of the north east coastal area in the United States (Gottman, 1961), and they have been subject to much additional attention in the past decade. This paper addresses the definition of megapolitan areas in comparison with the definition of metropolitan areas.

Appropriate areas of analysis are based on including externalities

The rationale for defining particular areas for analysis rests on externalities and governance. The main externalities are social, economic, environmental/physical, and cultural. The rationale for a proposed unit of analysis rests on the proposition that the particular area chosen includes all of the key interactions, spillovers, or externalities relevant to the problem. Thus, an analysis of housing prices might be based on neighborhoods because neighborhood quality and the provision of local public goods are known to be important determinants of housing prices. Or an analysis of parking policy might be based on areas where parking spaces are relatively scarce.

The analysis presented here addresses the definitions and distinctions between metropolitan and megapolitan areas, where the relevant externalities are mainly economic or environmental/physical.

Metropolitan areas encompass spatially integrated markets

In the U.S. the definition of metropolitan areas is based on the scope of a local labor market. A metropolitan area can be conceived as a small open economy that combines labor, capital, land/location, and imported goods to produce outputs used for local consumption and for export. Both capital and imported goods are tradables, in that they can be procured from outside the metropolitan area at “border” prices that are essentially the same for all metropolitan areas in a particular country. The exported goods produced in the metropolitan area are also tradables by definition, though some of them are also consumed locally.

The local metropolitan area also produces nontradable goods (housing, public transport, personal services, etc.) that must be consumed locally. Nontradables are economically important, comprising about 40 percent of household consumption in the U.S. (Dotsey and Duarte, 2006). Determinants of the productive efficiency of nontradables have not been extensively researched,

but evidence indicates that it lags in China (He et al., 2014). The key definition of metropolitan area boundaries in the U. S. relates to the spatial integration of the labor market, although the spatial integration of the housing market is also relevant. Indeed, it is argued here that the U. S. definition of metropolitan areas (based on spatially integrated labor markets) also produces areas with spatially integrated markets for nontradables, of which housing is a major component.

What do we mean by spatially integrated labor markets? Essentially, a spatially integrated market is subject to significant internal arbitrage. For example, workers move among jobs to arbitrage away differences in wages and employment terms across job locations so that the resulting spatial distribution of wages reflects underlying transport costs and housing price differences within the metropolitan area. The metropolitan housing market is closely related to the metropolitan labor market. Spatially integrated metropolitan housing markets are also subject to constant arbitrage so that residential land and housing prices and residential densities exhibit highly regular patterns. Prices and densities are typically high in the urban core and diminish toward the periphery. This is the result of household mobility—from households relocating among dwelling units.

In the U.S. in 2012–2013, nearly 12 percent of households changed their residence annually, and about 80 percent of all these moves covered less than 50 miles (two thirds were within the same county). Accordingly, most residential moves in the U.S. are within metropolitan areas (Ihrke, 2014). Moreover, workers change their jobs about three times more often than their residences. There is a great deal of continuing adjustment in both the metropolitan job and housing markets, and this keeps these markets spatially integrated and in equilibrium (Box 1).

Box 1. Workers constantly keep an eye out for opportunities.

A typical national survey of 1477 workers conducted for CareerBuilder in 2001 showed that almost 4 out of 10 survey respondents were looking for new job opportunities in 2001, even though they were generally satisfied with their current jobs. These "opportunistic job seekers" search for better salaries, good job location, and better work and life balance—rated by them as the most important factors when changing jobs.

The survey shows that workers remain engaged with the job market—even if they are not actively searching for a job—by networking, checking online career sites, and posting their resumes. The workers surveyed said they use online career sites because of ease, convenience, and the ability to narrow their search. Internet use is undoubtedly even more pronounced now than in 2001, when 81% of those surveyed used Internet job sites.

Source: HRM Guide for Human Resources; http://www.hrmguide.net/usa/job_turnover.htm

Spatially integrated labor and housing markets produce a variety of benefits. The labor market is more efficient for both employers and workers. In a more efficient labor market, firms draw from a larger pool of workers and can more easily and quickly find workers with appropriate skills to fill vacancies. Workers also have more options and can move more easily from one position to another, lowering the duration of their unemployment. The efficiency and depth of the labor market is especially critical for smaller firms that are unable to train workers and may need to react quickly to market conditions. Small firms constitute the most dynamic element of urban

economies. Spatially integrated housing markets similarly produce thicker markets with more buyers and sellers thereby reducing household search costs for a new residence.
An additional advantage of metropolitan areas is that spatially integrated labor and housing markets are also closely related to the spatial integration of metropolitan markets for all other nontradable goods. These include most personal services, financial services, and much of the retail sector. Indeed, the consumption of nontradable goods is an essential component of urban lifestyles, as they also include entertainment and cultural activities that are integral to urban living. The spatial integration of metropolitan markets for nontradables brings benefits in terms of more efficient provision of these services within the metropolitan area. Trade between metropolitan areas fosters efficiency in their tradable sectors because prices of tradables are similar across metropolitan areas. But the size of the market for nontradables is coterminous with the size of the metropolitan area, and the prices of nontradables differ across metropolitan areas. Based on their underlying definition, metropolitan areas have integrated markets for nontradables within their boundaries. Relatively few theoretical models in economic geography include nontradables, and those that do find that including nontradables reduces the benefits of agglomeration (Cerina and Mureddu, 2014).

Defining metropolitan area boundaries

In the U.S., metropolitan area boundaries are set by the Office of Management and Budget, relying on criteria underpinning the scope of a spatially integrated labor market. The building blocks for metropolitan areas are counties. While various criteria relate to the size of the metropolitan core, a key element in adding outlying counties to a metropolitan area relates to the volume of commuting to work that occurs across county boundaries. The OMB's definition promulgated in 2010 (Office of Management and Budget, 2010) states:

"A county qualifies as an outlying county of a C[ore] B[ased] S[tatistical] A[rea] if it meets the following commuting requirements: (a) At least 25 percent of the workers living in the county work in the central county or counties of the CBSA; or (b) At least 25 percent of the employment in the county is accounted for by workers who reside in the central county or counties of the CBSA.".

Note that the boundary definition is based on the actual movement of persons, and it is this continual movement that yields the spatial integration of the labor market. From a theoretical perspective, a spatially distributed metropolitan labor market and a spatially distributed metropolitan housing market are duals. Integration in one typically implies integration in the other. Theory indicates that if there is a housing price gradient across residential locations (e.g., higher prices in the center than the periphery), there will also be a wage gradient across employment locations (e.g., higher wages in central than in peripheral workplaces). While many studies estimate housing or land price gradients in metropolitan areas, few studies estimate wage gradients. This is because wage gradients are much less steep than housing or land price gradients, and it is more difficult to standardize wages than house prices.

It is useful to give the spatial integration of labor or housing markets a more rigorous basis. After all, housing and labor markets might be linked to one another to some degree without being

completely integrated. One standard to turn to comes from linear programming. A spatial labor market connects workers at specific residential locations to jobs at specific work places. Since the jobs and workers are unitary (whole workers and whole jobs), the matching can easily be conceived as a special type of linear programming problem called a transportation or assignment problem that involves one-to-one assignments. When the origins and destinations are well-populated, the assignment results in shadow prices that are uniquely determined across all locations relative to each other, producing a spatially integrated market.

When origins and destinations are clustered or sparsely populated, the solution can become degenerate. That is, shadow prices may be uniquely determined within sub-groups, but not between sub-groups. Thus there may be spatial submarkets that are only loosely linked to each other. The current metropolitan definition, with its high threshold of commuting across county boundaries, is meant to ensure that the metropolitan labor market is spatially integrated, and not just an amalgam of loosely linked submarkets.

Omitted dimensions and challenges at the metropolitan level

Note that environmental/physical or governance considerations play little or no role in defining metropolitan labor markets. However, it is also the case that metropolitan areas often become relevant areas for implementing some environmental policies. In the U.S., programs and policies to improve air quality are typically promulgated at the metropolitan level. This is partly because such programs often emphasize emissions from transportation. Achieving air quality goals can then require transport control policies (e.g., parking restrictions, high occupancy lanes, transit expansion, etc.) that are best implemented at the metropolitan level because they create large externalities or spillovers across communities within the metropolitan area. This is a case where the metropolitan area encompasses the relevant externalities for policy implementation.

Water quality issues, especially sewage treatment and water supply, are sometimes handled at the metropolitan level because supply provision has both large scale economies and network effects. However, more often these services are managed by special sanitary or water supply authorities whose areas of responsibility are larger than the city but smaller than the metropolitan area. The boundaries of such special authorities are often based on physical features and/or on local population densities. Many outlying counties in U. S. metropolitan areas encompass large rural or low density undeveloped areas, and such areas are typically excluded from coverage by special water and sanitation authorities.

The selective coverage of specialized authorities—including those for sanitation, water supply, transit, and parks—raises the overall issue of governance, which is an ongoing challenge for most metropolitan areas. Because the extent of metropolitan areas changes over time—with population growth, the addition of outlying counties, and the emergence of new metropolitan areas—establishing a government unit to oversee a metropolitan area would require the continuous adjustment of its boundaries. In the U.S., very few metropolitan areas have metropolitan governments. To coordinate activities across municipalities and counties, many metropolitan areas use special authorities with a narrow focus such as those described in the prior paragraph. Thus there has been a proliferation of commissions and authorities that oversee

actions within specific sectoral areas. However, the coordination and alignment of policies, revenues, and expenditures across these sectorally focused entities at the metropolitan level leaves much to be desired (Bahl, et al., 2013). It is noteworthy, however, that metropolitan areas in the U.S. are not the products of metropolitan governments. In fact, the current 2010 OMB sanctioned definitions of metropolitan areas explicitly exclude local preferences when delimiting metropolitan areas (OMB, 2010).

Defining megapolitan areas

The definition of megapolitan areas is not set by a government agency such as the OMB or Census Bureau. Competing definitions have been proposed by several researchers. Of the many approaches that exist, two will be summarized here. The first is associated with Robert E. Lang and Dawn Dhavale (Lang and Dhavale, 2005), and the second with Richard Florida (Florida, et al., 2007). The first uses ten criteria to identify megapolitan areas:

- Combines at least two existing metropolitan areas, but may include dozens of them
- Totals more than 10 million projected residents by 2040
- Derives from contiguous metropolitan and micropolitan areas
- Constitutes an organic cultural region with a distinct history and identity
- Occupies a roughly similar physical environment
- Links large centers through major transportation infrastructure
- Forms a functional urban network via goods and service flows
- Creates a usable geography that is suitable for large-scale regional planning
- Lies within the U.S.
- Consists of counties as the most basic unit

The second definition is summarized by its authors as follows:

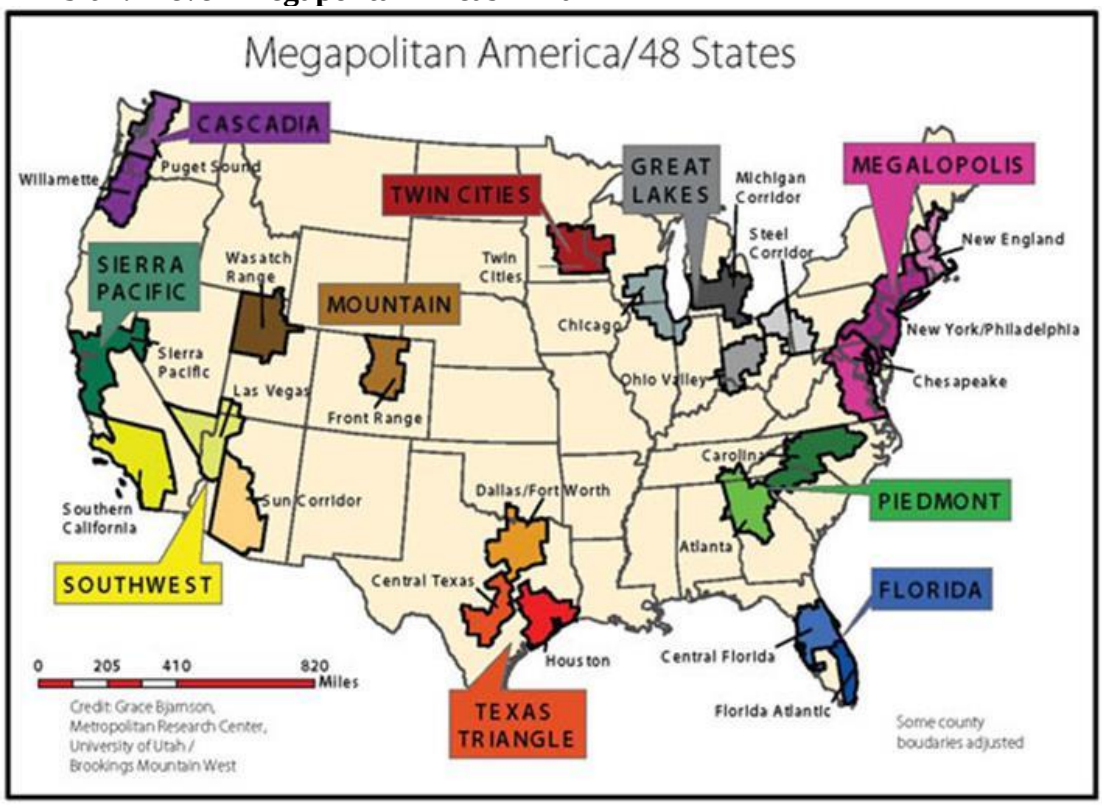
> "We distilled estimates of economic activity by using satellite images of the world at night. We define mega-regions in terms of contiguously (or very nearly contiguously) lighted areas as seen from space at night. … contiguous development is a good enough proxy for economic integration that it can meaningfully be used in this context. Intuitively, then, we are defining a mega-region is a very large area across which one could walk, carrying only money, without getting hungry." (Florida, Gulden, and Mellander; 2007)

The first definition has been applied by Robert Lang and his colleagues and produced depictions of megapolitan areas in the U.S. Exhibit 1 is taken from Lang and Dhavale, 2005. Exhibit 2 builds on the Lang-Dhavale criteria above and is taken from Nelson and Lang, 2011. The Florida definition based on night lights produced the map of North American megapolitan areas in Exhibit 3 that is taken from Florida, et al., 2007. The maps are most consistent for the megapolitan areas on the east and west coasts, and least consistent for areas in the Midwest and South of the U.S. The criterion of contiguity appears to break down somewhat in Exhibits 2 and 3. A comparison of Exhibits 1–3 suggests that analysts have not yet converged on a consistent definition of megapolitan areas.

Exhibit 1. Ten Megapolitan Areas and their Interstate Highways, 2005.

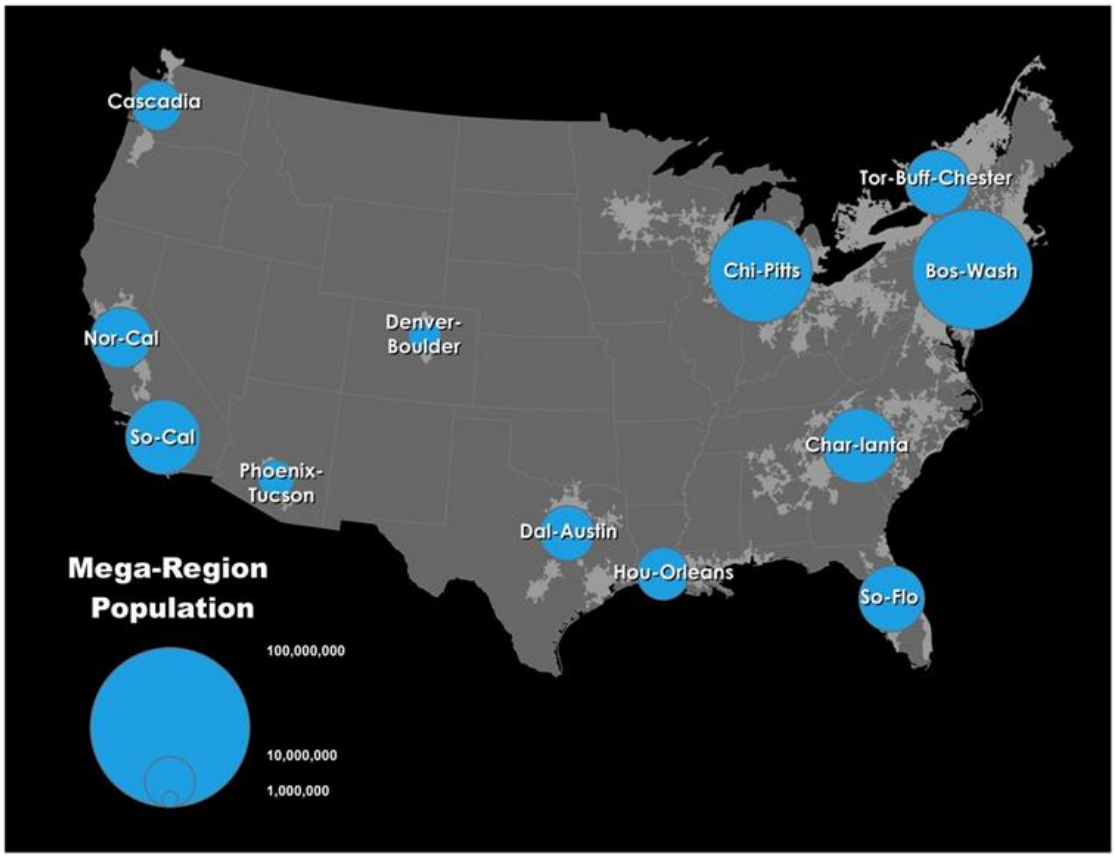
Source: Lang and Dhavale, 2005

Exhibit 2. Eleven Megapolitan Areas in 2011



Source: Nelson and Lang, 2011

Exhibit 3. Twelve Megapolitan Areas Based on Night Lights, 2007



Source: Florida, Gulden, and Mellander; 2007

It is notable that economic criteria are virtually absent in the two definitions used to specify megapolitan areas. This is particularly surprising given the frequent claims that megapolitan areas are emerging as the new drivers of global economic activity, potentially replacing large cities and even nations. The Lang-Dhavale criteria include one reference to flows of goods and services—which presumably refers to the movement of tradable goods. These megapolitan areas are quite large, often covering several hundreds of miles on their longest axis. It is unlikely that over these distances markets for nontradables (including labor) would be spatially integrated. In terms of other externalities, there is little mention of environmental aspects, a surprising omission given the rising concerns about long distance transport of air pollution.

Linkages and flows within megapolitan areas

One type of movement that may strengthen links within megapolitan areas is commuting to work, which is the key element used to define metropolitan areas. There is some evidence that long distance commuting between metropolitan areas is increasing in the U.S. With the improvement of electronic communication and computerized networks, many workers do not come to the office every day, but may do so on an irregular basis. In the U.S., this pattern may be reinforced by the growth of the part time work force. Some studies do indicate recent growth in "super commuters"—those who commute outside of their own metropolitan area (Moss and

Qing, 2012). Exhibit 5 shows the five metropolitan area pairs with the highest shares of workers employed in the central counties of metropolitan areas who travel from residences outside the metropolitan area. These numbers include workers who may travel to work as little as once a week. While the number of super-commuters has been growing recently, the share of workers who are carrying out these commutes remains low. Given that the shares in Exhibit 5 are for the five highest-share metropolitan pairs, the average share across all metropolitan areas is likely to be less than two percent. This is not a large enough share to produce the kind of spatial integration of markets for labor, housing, and other nontradables that is observed within metropolitan areas, nor does it seem large enough to produce substantial benefits to economic growth.

Exhibit 4. Top 5 Super-commutes Among Major U.S. Cities*, 2009

City Pair	% of workforce	Number Commuting
1. Tucson to Phoenix, AZ	6	54,400
2. Houston to Dallas, TX	3	44,300
3. Dallas-Ft.Worth to Houston, TX	2.7	51,900
4. Austin to Dallas, TX	2.4	32,400
5. San Diego to Los Angeles, CA	2.2	78,300

*Among top 5 super-commuting home destinations of central county workers in the 10 largest metro areas by workforce size, 2009

Source: Mitchell Moss and Carson Qing, "The Emergence of the "Super-Commuter," NYU Wagner School, 2012

The housing market may provide some evidence of market integration, and housing price data are much more readily available than data on long distance commuting or standardized wages. The data used here are quarterly housing price data for standard metropolitan areas that are compiled by Morris Davis (Davis and Palumbo, 2006) and drawn from the Lincoln Institute website at http://www.lincolninst.edu/subcenters/land-values/. The data series begins in 1984 and runs to the present. Exhibit 5 shows a graph of average SMA quarterly housing prices for the six major SMAs that comprise the North East Corridor of the U.S. Two results are evident: First, average housing prices differ dramatically across the six SMAs, with very large differences across adjacent SMAs (New York and Philadelphia, or Washington and Baltimore). There is little evidence that the housing markets across these metropolitan areas are integrated because of the large housing price differences. Second, the quarterly price series across the SMAs seem to be correlated, suggesting that there may be some linkages among these housing markets, or that external forces are impacting them in a common way.

To test the extent or uniqueness of potential linkages across SMAs within a megapolitan area, housing price data were also obtained for SMAs for the Bay Area (San Francisco, Oakland, and San Jose) and for the Los Angeles region (Los Angeles and San Diego). Time series correlations among the resulting 11 SMAs are shown in Exhibit 6. Correlations of housing prices over time are certainly high among the SMAs in each megapolitan area, with values typically above 0.98. However, correlations are also high for SMAs in different regions and even on different coasts. Exhibit 6 highlights in yellow the four correlations in the table that are less than 0.95 (none are

below 0.93). Accordingly, while nearby metro areas may have some influence on each other's house prices, the major determinants of housing prices across metro areas appears to be common across many metro areas. These influences include financial market and overall economic conditions, among other things (Follain and Giertz, 2013).

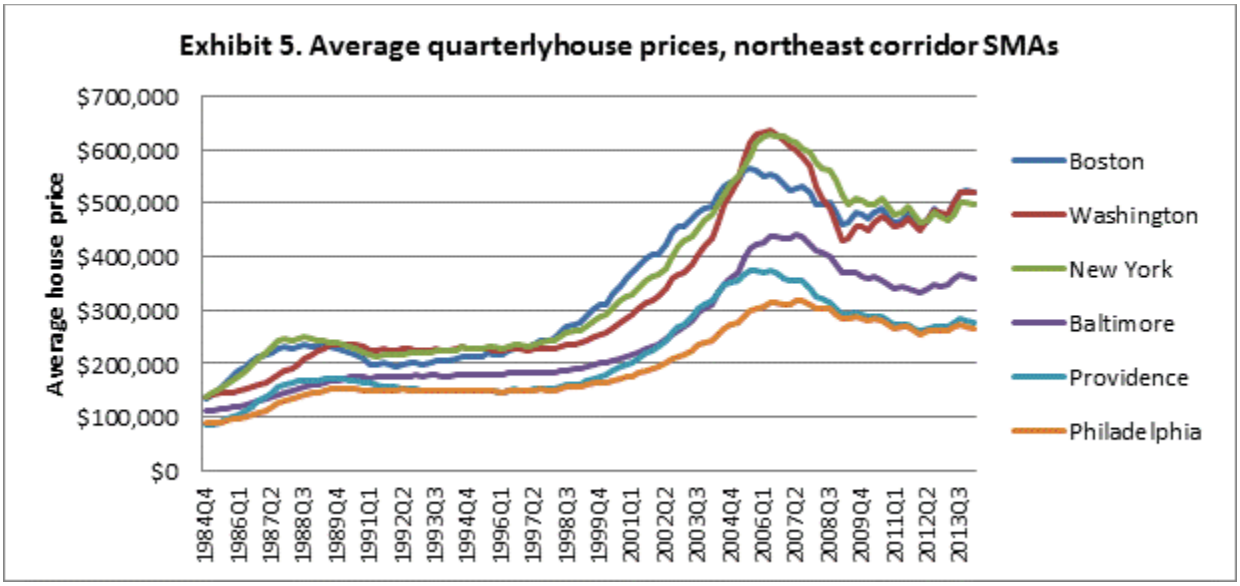


Exhibit 6. Correlations of quarterly house prices, 1984-2013, for Northeast, Bay Area, and LA SMAs

	Washington	*Baltimore*	*Philadelphia*	*New York*	*Providence*	*Boston*	*SanFranc*	*Oakland*	*San Jose*	*Los Angel*	*SanDiego*
Washington	1.000										
Baltimore	0.990	1.000									
Philadelphia	0.982	0.995	1.000								
New York	0.985	0.988	0.986	1.000							
Providence	0.974	0.965	0.968	0.985	1.000						
Boston	0.959	0.953	0.956	0.979	0.969	1.000					
SanFranc	0.967	0.942	0.933	0.957	0.963	0.958	1.000				
Oakland	0.975	0.957	0.950	0.969	0.974	0.970	0.997	1.000			
San Jose	0.967	0.958	0.955	0.966	0.952	0.976	0.983	0.988	1.000		
Los Angel	0.989	0.970	0.959	0.970	0.972	0.938	0.975	0.979	0.958	1.000	
SanDiego	0.977	0.952	0.942	0.965	0.980	0.958	0.989	0.991	0.965	0.986	1

Source: Data are from http://www.lincolninst.edu/subcenters/land-values/

Megapolitan areas can become more like metropolitan areas over time if they experience significant changes in transportation opportunities. Much has been written about the potential and actual effects that high speed trains could have in promoting commuting and the spatial integration of markets for housing and other nontradables among contiguous metropolitan areas that become connected by high speed trains. One recent study (Zheng and Kahn, 2013) examines changes in housing prices between adjacent metropolitan areas in China now linked by high speed rail service. The study demonstrates that smaller adjacent cities or metro areas with high speed rail experience increases in housing prices that diminish the price differences across cities. This result is consistent with historical experience following the opening of major expressways and interstate highway systems in the U.S. which led to suburban expansion and price increases in more distant communities as development took place. High speed trains are likely to have a

similar effect as their presence produces a new equilibrium by spatially integrating housing markets that are currently only weakly linked. Commuters will seek to obtain the productivity and consumption benefits of large cities while living further away and avoiding the congestion and environmental costs that accompany big city life. However, this outcome is unlikely to be sustainable, any more than the similar attractions of suburban life in the U.S. have been. Why not? Population growth will move the system to a new equilibrium where the advantages of longer commutes will be neutralized by housing price appreciation—an outcome already underway in Chinese cities.

Conclusion

So what is the use of megapolitan areas? The answer is that megapolitan areas will certainly be the appropriate scale of analysis for some particular issues. Such issues are likely to include the analysis of large scale environmental problems, where the transport of air or water pollution, or the availability of fresh water, need to be addressed at a scale larger than that of an individual metropolitan area. In addition, megapolitan regions are likely to be the scale required to plan large scale infrastructure such as intercity rail and highway systems. The use of megapolitan areas as a unit for economic analysis is an open question because so far there is little economic basis for their definition.

The economic strength of metropolitan areas is that they produce spatially integrated markets for labor, housing, and other nontradable goods—which in turn enhances efficiencies in production and consumption at the metropolitan level. Both metropolitan and megapolitan areas face governance challenges because there are few governance mechanisms that could design or implement economic policy at either level in the U.S.

Along with megapolitan areas, other large scale areas are the appropriate scale of analysis for specific issues. For example, river basins are the appropriate unit of analysis for many water problems, and coastal areas are emerging as the appropriate area for designing and implementing solutions to rising ocean levels now being experienced. The type of question asked and its associated externalities will imply the appropriate area to be specified for analysis.

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