The Intersection of Place and the Economy

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Executive Summary

Recent and ongoing policy efforts to increase spatial efficiency at the metropolitan, local, and neighborhood level have focused on interventions such as place-based affordable housing, transit-oriented development, and livability programs. As the nation and its metropolitan areas begin to seek more productive and sustainable sources of economic growth for the future, it is crucial to understand how policies that shape the physical landscape of metropolitan America can help grow economies more attuned to the imperatives of globalization, technological innovation, and production.

In turn, it is equally important to understand how shifts in economic growth impacts the built environment. While these spatial impacts are a product of both national and metro-level macroeconomic factors, public policies that shape urban form can, in turn, shape these macroeconomies.

This paper examines the relationships of urban and metropolitan form with three vital aspects of modern metropolitan economies: globalization and the production of tradable goods and services, technological innovation, and the low carbon imperative. A research agenda follows that derives from the conclusions reached in the previous sections.

Introduction

The Great Recession of 2008–09 revealed the shaky foundations of the American economy. While the economy continued to expand, stagnant wages meant that this expansion derived from easy credit, itself fueled significantly by the assumption of ever-rising housing prices. Indeed, many of the nation's fastest-growing metropolitan areas had economies largely based around consumption and amenities (Rappaport 2008).

In particular, significant portions of these metros' labor forces were concentrated in the construction and sale of residential and retail property—sectors that offered a host of relatively high-paying jobs for all skill levels. When land and housing prices began their dramatic decline, followed by the collapse of credit markets in 2008, a heavy blow was dealt to the economies of almost all U.S. metros—but especially those most oriented around housing-driven consumption (Gabe and Florida 2011).

However, most discussions and media coverage of the Great Recession have overlooked the spatial aspects of these developments. Yet there is no doubt that our nation's economic growth and stagnation left lasting marks on the nation's physical landscape. From the growth and decline in real estate and retail space, to land development and conversion, to urban neglect and decay, the impacts on the nation's physical landscape of the prior economy are stark albeit poorly understood.

To better comprehend these effects, this paper seeks to establish the current state of knowledge regarding the impact of economic changes and likely policy shifts on the populations and built environments of the nation's metropolitan areas. Upon establishing the historical background and contemporary state of knowledge, it identifies unanswered questions ripe for further inquiry. It does so by considering what a rebalancing of the American economy would mean for the spatial landscape of the nation.

In this way, we attempt to nest the discussion at the intersection between place and the economy. Recent and ongoing policy efforts to increase spatial efficiency at the metropolitan, local, and neighborhood level have focused on interventions such as place-based affordable housing, transit-oriented development, and livability programs.

As the nation and its metropolitan areas begin to seek more productive and sustainable sources of economic growth for the future, it is crucial to understand how policies that shape the physical landscape of metropolitan America can help grow economies more attuned to the imperatives of globalization, technological innovation, and production, versus consumption- and amenity-led strategies.

After this introduction, this paper is structured as follows. First, it summarizes the context for the discussion by examining ongoing demographic changes on metropolitan economies and land-use patterns, and the impacts of the previous boom and the Great Recession on the built environment of U.S. metros.

Next, it examines the impact of an increasingly globalizing economy on urban form. In light of the Obama administration's National Export Initiative and the calls by many observers for a revitalization of the nation's manufacturing base after years of decline, it reviews the historical and current land-use

patterns of both manufacturers and service exporters. Finally, it assesses the impact of ongoing changes in global logistics patterns on the distribution of economic activity within and among U.S. metros.

Third, it analyzes two key issues concerning the relationship of metropolitan areas and technological and economic innovation. First, it examines the literature on the impact of urban form on the formation and strength of industry clusters. It then looks at "innovation district" projects that attempt to use urban resources to foster cluster development. It also discusses the burgeoning field of "smart" or "intelligent" cities, in which information technology infrastructure enables dramatic improvements in governance, service provision, and (potentially) democratic legitimacy.

Fourth, it examines various methods by which metros can adapt themselves to achieve low carbon emissions—focusing on those areas in which there is a relationship between space and carbon intensity.

The final section offers a research and policy development agenda for the U.S. Department of Housing and Urban Development (HUD). The focus is on overarching questions that directly affect federal policymaking and practice. It is partly related to redefining HUD's role in regional economic development and thereby placing the department in the vanguard of new thinking about the relationship between physical form and economic growth. But it also reaches beyond HUD to inform the range of federal programs that impact metropolitan areas' physical form, including those related to tax expenditures, environmental policies, transportation, and energy.

By doing so, the goal is to reach beyond narrow agendas of "urban policy" to better make the larger connection between place and the economy.

Trends and Forces That Impact the Discussion of Economy and Place

Without a doubt, the built environment of any American metropolitan area is the result of cumulative decisions made by previous and present generations. The adoption of zoning laws in the 1910s and 1920s, the subsequent rise of homeowner-oriented suburban municipalities, and the federal promotion of homeownership after World War II have slowed the pace of market-driven change within existing developed areas (Fischel 2004; Pendall, Puentes, and Martin 2006). Compared to the rapid turnover that characterized many American cities in the era roughly bounded by the Civil War and the First World War, U.S. metros simply change more slowly today.

As such, it will take decades for structural changes in the underlying preferences or composition of the population to translate into significant alterations to the built environment. Nevertheless, it is clear that the United States is currently undergoing a transformation of dramatic scale and complexity, partly led by sweeping demographic changes.

Demographic Shifts

Unlike peer countries in Western Europe and East Asia, the United States is continuing to grow by leaps and bounds. By 2050, the nation's population could grow, incredibly, by another 130 million people—essentially adding to the U.S. population everyone who today lives west of the Mississippi River.[1] While

[1] Jennifer Cheeseman Day, "National Population Projections," U.S. Census Bureau, 2009.

population growth slowed during the 2000s, the rate of growth remains much higher than that for both developed economies and China.

An enormous wave of immigration, which slowed during the 2000s but continues at a high level relative to historic norms, will continue in part to fuel this increase in population. Currently, more than 13 percent of our residents—some 40 million people—were born outside the United States, a net increase of nearly 9 million since 2000. About 9 in 10 of these foreign-born residents live in the top 100 metropolitan areas. Motivated primarily by access to employment, a majority of immigrants now lives in the suburban portions of these metros, bypassing traditional inner-city ethnic enclaves (Singer 2011; Suro, Wilson, and Singer 2011).

Half of all U.S. babies born in 2010 were nonwhite; in 14 states, the majority of children born are nonwhite.[2] Among the 100 most populous metropolitan areas, 15 are already "majority-minority," with the nonwhite share of their population above 50 percent; another 20 are between 40 percent and 50 percent nonwhite, meaning that they will likely become majority-minority within the next decade.[3] Nonwhites accounted for 92 percent of population growth during the 2000–10 period.[4] If there are significant differences between whites and nonwhites regarding economic activity and preferences for urban form, this will have a major impact on U.S. metros—especially those in which whites no longer form a majority of the metropolitan population.

Last is the suburbanization of populations historically associated with troubled urban centers: ethnic minorities, immigrants, and the poor (frequently the very same people, particularly in the West). The traditional dichotomy of richer, whiter, native-dominated suburbs and poorer, less white, immigrant-heavy cities has broken down, to the extent that by 2008 more low-income people lived in suburbs than central cities (Kneebone and Garr 2010).

The factors driving this shift are numerous. The formal and informal barriers that prevented minorities from moving out of central cities diminished during the 1970s. High rates of crime and unemployment in many predominantly African American areas, such as the South Side of Chicago and the city of Detroit, led to significant city-to-suburb migration by African Americans—albeit largely to inner suburbs that were either already deeply troubled or became so during the Great Recession (Puentes and Warren 2006).

Well before the Great Recession, longstanding economic decline in many suburbs—particularly manufacturing-dependent inner suburbs in older Midwestern and Northeastern regions—resulted in many of their residents sliding into poverty; it also drove down real estate values sufficiently to make them accessible to lower-income populations.

Partially offsetting the spatial impact of these trends is the aging of the baby boom generation that has made pre-seniors (55–64) this decade's fastest growing age group, expanding an amazing 50 percent in size from 2000 to 2010 with a "senior tsunami" predicted to arrive soon thereafter. The portion of the

[2] Defined as persons reporting their race as other than white, or persons of any race (including white) declaring Hispanic or Latino ethnicity.

[3] Data from 2005-09 American Community Survey.

[4] William H. Frey, Alan Berube, Audrey Singer, and Jill Wilson, "Five Things the Census Revealed about America in 2011," *State of Metropolitan America* #48, December 20, 2011, http://www.brookings.edu/opinions/2011/1220_census_demographics.aspx.

population over the age of 65, now at 12.6 percent, will increase dramatically in the coming decades. While media and political attention to this massive shift in age distribution has focused on its impact on Social Security and Medicare, the aging of America also will lead to significant changes in housing markets, travel demand, and the physical form of metropolitan areas. The metros most likely to be affected by aging are historically manufacturing-oriented Midwestern and Northeastern metros such as Scranton, Pittsburgh, Youngstown, and Cleveland, which lost large numbers of younger adults between 2000 and 2010.[5] With the working-age portion of their populations having declined, the tax bases for localities in these metros will shrink, causing severe fiscal stress for most of these areas' populations.

Partly as a result of these shifts, the average U.S. household size has fallen by nearly one full person—from 3.5 in 1950 to 2.6 today and projected to drop below 2.5 by 2020.[6] Nationally, the share of households composed of a traditional married couples with children under age 18 declined from 43.0 percent in 1950 to just 23.1 percent today. The fastest-growing share of households comprises "non-family households"—households maintained by one person living alone or with nonrelatives only.[7]

What is clear from these demographic changes is that America's metropolitan areas have become much more complex than in previous generations.

The Geography of the Consumption Economy

Fueled by easy credit that expanded dramatically despite stagnant household incomes (which had, by decade's end, begun to decline outright), economic growth in the 2000s was driven primarily by the consumption of housing and related goods and services. Not coincidentally, housing and retail construction surged during the period.

For example, Figure 1 shows clearly shows that until 2006, housing construction occurred at rates considerably in excess of those prevailing in the boom of the 1990s. While an increasing share of housing production took place in central cities and inner suburban areas compared to previous decades, many U.S. metros continued to see substantial accumulation of housing stock on the urban fringe.[8] Per capita retail space in the United States is currently 46 square feet—twice that of the United Kingdom (23 sf), and much higher than in Canada (13 sf,), Australia (6.5 sf), India (2 sf) and Mexico (1.5 sf).[9] The half-empty subdivisions and shopping centers that today litter the fringes of the nation's metros provide clear evidence of the over-exuberance that characterized the last economy.[10]

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[5] William Frey, "The Uneven Aging and 'Younging' of America: State and Metropolitan Trends in the 2010 Census," State of Metropolitan America #35, June 28, 2011, http://www.brookings.edu/papers/2011/0628_census_age_frey.aspx.

[6] Based on projections by the Joint Center for Housing Studies, Harvard University.

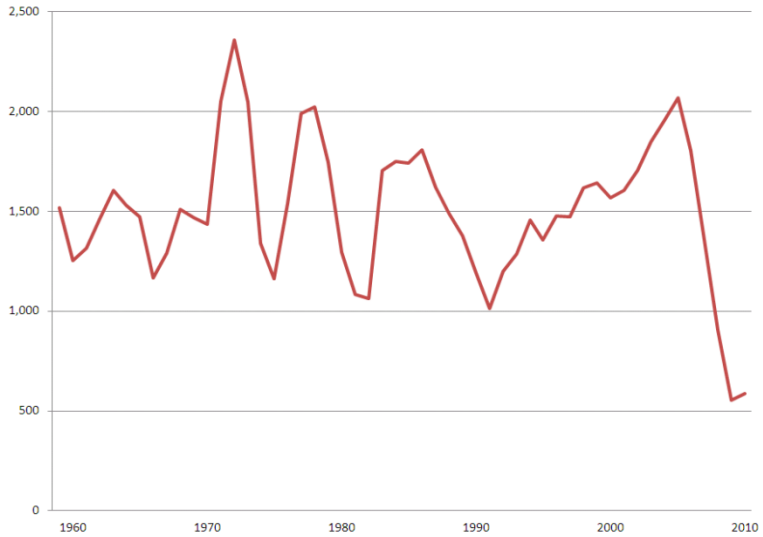
[7] Sabrina Tavernise, "Married Couples Are No Longer a Majority, Census Finds," *New York Times*, 26 May 2011.

[8] U.S. Environmental Protection Agency, "Residential Construction Trends in America's Metropolitan Regions," Development, Community, and Environment Division, 2010.

[9] Barbara Farfan, "2011 Retail Store Closings Roundup: U.S. Retailers Closing or Liquidating Stores," *About.com Retail Industry*, 21 July 2011, http://retailindustry.about.com/od/storeclosingsandopenings/a/2011-US-Retail-Industry-Store-Closings-Liquidations-Roundup-Chains-Going-Out-Business.htm.

[10] "CoStar Retail Vacancy Rates through Q1 2011," *Retail Traffic,* 3 May 2011, http://retailtrafficmag.com/charts/costar_vacancy_rates_05032011.

Figure 1: New Privately Owned Housing Units Started (in 000s)



Source: U.S. Census.

Virtually all American metros display a high degree of dispersion in employment, with no American metropolitan area having a majority of its jobs located in either a central business district or various subcenters (Lang and LeFurgy 2003; Giuliano, Agarwal, and Redfearn 2008). To a certain extent, this is expected: many employers directly serve the local population, such as schools, supermarkets, police and fire departments, and primary medical services. General-purpose retailers, such as supermarkets and big-box stores, follow rooftops instead of other firms. Specialty retail, personal services, and restaurants display some agglomeration economies because of customer base-sharing (Glaeser, Kolko, and Saiz 2000), but not to the same extent as manufacturing or tradable services production.

In a country where less than 10 percent of land is urbanized, concern about its scarcity might seem unwarranted. However, metropolitan decentralization has new meaning today given the strained fiscal conditions of states and localities that bear the primary responsibility for providing infrastructure to accommodate new development (Cho 2011). A tense new climate of austerity has sharpened debates over government spending, economic development, and the physical growth of states and metropolitan areas. Leaders in this environment are eager for fiscally prudent ways to simultaneously support their communities and stimulate their economies. Compact development patterns and investment in projects to improve urban cores could save taxpayers money and improve overall regional economic performance (Muro and Puentes 2004).

The challenge has been that for many years, in an effort to shore up their fiscal bases in the face of rapid deindustrialization and depopulation, municipalities in the central portions of their metropolitan areas have allowed sites of production to become sites of consumption. Beginning in the 1980s, and especially throughout the 1990s and 2000s, urban and suburban municipalities alike generally sought to redevelop industrial land—sometimes vacant, but often occupied by viable productive uses—with retail and housing. Elected officials and their appointees in many central cities contended that manufacturing was on its way out and that lofts and condominium buildings were a higher and better use of urban land (Rast 2001).

Sometimes, these conversions result in the construction of high-tech office complexes or other facilities in which intellectual property generation and other high-end services production occurs. Examples include high-profile former aerospace factories in Downey, California, and the Playa Vista district of Los Angeles that have become movie studios.[11] However, in states where municipal governments retained an increment of sales taxes, retail has proven particularly tempting, regardless of the broader economic impact of a production-to-consumption shift. In New York, for example, a functioning ship repair facility on the highly contested Brooklyn waterfront gave way to a major big-box retail development.[12] At a smaller scale, hundreds of industrial properties in northern Brooklyn were either converted into lofts or demolished outright for residential redevelopment during the early 2000s—despite the fact that many of them hosted thriving small manufacturers whose products were essential to the operations of larger firms in the region (Mistry and Byron 2011).

Big-box retail also occupies former factory sites throughout Chicago, with more planned for large abandoned industrial tracts on the city's long-troubled West and South Sides. Large portions of the shuttered Chevrolet automobile assembly plant and Price Pfister plumbing fixture factory in San Fernando Valley neighborhoods of Los Angeles have yielded to retail centers anchored by, respectively, Home Depot and Costco.[13] In nearby Burbank, most of the land previously occupied by the Lockheed aircraft factory—which had employed 12,000 at the time of its closure in 1992, and was once the proposed site of an automobile plant during California's 1990s flirtation with the electric car—now hosts the Empire Center, a sprawling big-box shopping center that advertises itself to travelers on nearby Interstate 5 with two-dimensional models of the civilian and military aircraft once manufactured there.[14]

Some of these retail developments are net positives for the cities in which they are built. In many American central cities and inner suburbs—particularly in the Midwest and Northeast—former industrial sites have sat vacant for so long that virtually any development on them is welcome. The wire factory in Harlem that became the site of Manhattan's first Costco had lain empty for nearly four decades.[15] Wal-Mart's planned Supercenter in Pullman, a deeply impoverished Chicago neighborhood that has yet to recover from the 1980s closure of its namesake rail car manufacturer, occupies a former steel company site that has sat vacant since the 1970s.[16] The store will provide hundreds of jobs to an area with few employers, and a source of decent groceries to a "food desert" shunned by Chicago's two major grocery chains.

In tighter land markets, however, the loss of industrial-zoned land is problematic. It is not at all clear that the low-priced products and low-paying jobs at a big box store in Brooklyn justify the closure of a ship repair facility in the nation's second-busiest seaport area. This especially true given the public commitment of the Bloomberg administration and the Port Authority of New York and New Jersey to

[11] Roger Vincent, "Howard Hughes complex in Playa Vista is getting a $50-million makeover," *Los Angeles Times,* 14 October 2010.

[12] "Brooklyn Neighbors Admit a Big Box Isn't All Bad," *New York Times*, 10 August 2008.

[13] "NUMMI," *This American Life,* 26 March 2010; and "Work begins on Pacoima's new Costco," *Los Angeles Times*, 9 January 2009.

[14] Greg Braxton, "Electric Car Plan Sparks New Interest," *Los Angeles Times,* 4 April 1992.

[15] "Costco Opens First Manhattan Store, Looks at Sites," *Bloomberg News,* 12 November 2009.

[16] "Walmart Critical to Pullman Development Plans," *Chicago Defender,* 28 April 2010.

maintaining a working waterfront on the eastern side of New York Harbor. The loss of industrial-zoned land in relatively central portions of Los Angeles is equally unfortunate in light of the area's tight market for industrial property, a longstanding phenomenon that has prevailed across two consecutive business cycles.[17] Perhaps more important, it represents a loss of decent-paying jobs accessible to the nation's largest concentration of low-income immigrants.

The conversion of industrial land to housing presents additional challenges. The observation that "a diamond is forever, a suburban R-1 zone only slightly less so" could just as easily apply to urban loft districts (Levine 2006). Often the new urban residents in these areas begin to press for quality-of-life measures that drive out small manufacturers, and sometimes even the artists and other "creative class" businesses that attracted them to "bohemian" loft living in the first place (Mistry and Byron 2011). Barring a dramatic increase in telecommuting or change in zoning laws, it is unlikely that areas that have undergone an industrial-to-residential conversion will ever again regain their potential to host manufacturing or tradable services production.

The spatial impacts of the 2000s boom have significant implications for the continuing recovery from the Great Recession that followed, and for the shift from an economy based on housing and amenities consumption to one based on the production of goods and tradable services. The prospects for the nation's metropolitan areas in this new environment vary considerably.

Metropolitan Prospectus

While the Great Recession hit nearly every major U.S. metro area harder than any of the previous three national recessions (in 1981, 1991, and 2001), the impact was nonetheless uneven. While nearly every metro suffered some decline, some fared better than others. For example, state capitals such as Nashville, Austin, and Madison benefited from the relative stability of large-scale government employment. Metros with large exposure to the oil and gas industry, such as Houston, Dallas-Fort Worth, and Denver, also did relatively well thanks to continuing high oil prices and a natural gas drilling boom. Metros with a traditionally large portion of federal spending in their economies, including Washington, DC; El Paso; Virginia Beach; and San Antonio; also performed relatively well.[18]

The most troubled American metros fall into two broad categories. Economic prospects vary within each general group, but within each cohort there are more similarities than differences. The first group consists of manufacturing-oriented metros—mostly in the Great Lakes region and inland Northeast—that lost significant employment even during the 2002–07 growth period. This group includes Detroit, Cleveland, and Buffalo, as well as smaller metros such as Youngstown, Syracuse, Akron, Scranton, and Providence. From 1970 to 2010, both the economies and the populations of most of these metros either grew more slowly than the national average or declined outright.

While many metros in this group (e.g., Detroit, Youngstown, Milwaukee, and Grand Rapids) have outperformed the national economy as a whole during the recovery, they still struggle with the effects

[17] From the first quarter of 2001 to present, industrial vacancy rates in Los Angeles County have never exceeded 5 percent (University of Southern California Lusk Center, *Casden Forecast Industrial and Office Report*, 2010).

[18] For most of the economic comparisons for metros in this section, see Howard Wial and Richard Shearer, "MetroMonitor: Tracking Economic Recession and Recovery in America's 100 Largest Metropolitan Areas," http://www.brookings.edu/metro/MetroMonitor.aspx.

of decades of deindustrialization. In particular, large portions of the central cities in this group of metros were experiencing overall decline even before the Great Recession, while growth continued on their suburban fringes. The subprime lending collapse of 2007–08 accelerated this "hollowing-out" process, leading to calls for planned shrinkage in order to reduce expenditures on municipal services.[19] To a significant extent, the economies of these regions have shifted so the center cities are now peripheral. For example, the central business district of Detroit now contains less office space than does the "edge city" Southfield, in suburban Oakland County (Lang, Sanchez, and LeFurgy 2006). As mentioned previously, these metros also have lost many younger adults, likely depressing real estate values and causing fiscal stress for most of their constituent municipalities.

The second group of troubled metros comprises most of those that grew rapidly during the 1970–2010 period. In these places, large portions of the metropolitan economy formed around building houses for new arrivals and providing services for them. The new residents in turn found employment in housing-related sectors such as construction, real estate development, and mortgage lending. Although some of these regions developed clusters of high-value-added manufacturing and services (e.g., aerospace in Phoenix and Palm Bay-Melbourne-Titusville), the housing sector remained the driver of their economies throughout the 2000s—with disastrous results as housing prices began their severe decline in 2006 and construction ground to a halt during the global credit crunch of 2008.

Metros such as Las Vegas, Stockton, and Cape Coral-Fort Myers remain afflicted by some of the nation's highest unemployment and foreclosure rates, and they have struggled to regain their footing during the recovery.[20] As with the Northeastern and Midwestern metros in the first group, sizeable portions of these metros have high rates of housing vacancy, but it is more evenly distributed across their geographic areas and often higher in outlying areas than in central cities.[21]

For these two groups of metros, the way back to prosperity differs markedly. In the first group, expertise in many "old economy" sectors can be leveraged into new industries. For example, Toledo developed a small but significant photovoltaic solar panel cluster because of longstanding expertise in specialty glassmaking, particularly for the automobile industry (Calzonetti 2008). Likewise, the industrial cities of Northeast Ohio (Cleveland, Akron, Canton, and Youngstown) developed a plan that applies their strengths in traditional industries such as petrochemicals and metallurgy to produce advanced polymers and alloys used for high-tech products such as aircraft and wind turbines (Muro and Weissbourd 2011). For the housing-oriented metros, though, the outlook is murkier; finding new economic development strategies for them is essential in order to prevent their populations from sliding further into poverty.

[19] For example, the 2010 Census results showed a 19.0 percent housing vacancy rate for the city of Youngstown, OH, which hosts roughly 67,000 of its region's 566,000 people; the remainder of the Youngstown-Warren-Boardman, OH/PA Metropolitan Statistical Area (MSA) had a vacancy rate of 9.8 percent. The housing vacancy rate for the city of Detroit, with roughly 714,000 of the Detroit-Warren-Livonia MSA's 4.30 million people, was 22.8 percent, compared with 8.1 percent for the remainder of the MSA.

[20] Wial and Shearer, "MetroMonitor."

[21] For example, the 2010 Census reported that the three core cities of the Riverside-San Bernardino-Ontario, CA MSA, representing 680,000 of the region's 4.25 million people, had a combined housing vacancy rate of 9.8 percent; the remainder of the metro had a housing vacancy rate of 14.1 percent. In the Orlando-Kissimmee-Sanford, FL MSA, the city of Orlando—with 238,000 of the region's 2.13 million people—had a housing vacancy rate of 15.4 percent, compared with 15.2 percent for the remainder of the metro.

While policy attention naturally focuses on those metros that are most troubled, those that fared relatively well in the recession and/or the recovery should not be treated as a homogenous group. Each has prospered for different reasons, and each faces its own set of potential pitfalls. The automatic cuts to the defense budget triggered by the failure of the deficit reduction "supercommittee" could negatively impact the economies of metros such as Washington, DC, Virginia Beach, and El Paso. Although Houston has diversified considerably from its 1970s oil-patch heyday, its prosperity still owes significantly to high oil and gas prices; the potential adoption of restrictions on hydraulic fracture extraction of oil and gas, for example, would reduce demand for the energy services sector that has driven much of the metro's growth in the past decade. The imposition of a global carbon tax on air travel, like that used by the European Union (and fought bitterly by the United States and China), would suppress the growth in demand for both passenger and cargo movement by air, impacting metros such as aircraft-building Wichita and air cargo–dependent Memphis and Louisville.

Summary

The nation's metropolitan economies and physical environments have undergone considerable changes as a result of the boom of the 2000s and the subsequent Great Recession. They have done so in a context of dramatic demographic change. The implications of these developments on the necessary shift of the nation's economy from a consumption orientation to an emphasis on production deserve close study.

Key Research Questions for Policymakers

Adequately framing the trends, forces, and policy opportunities that this section introduces deserves a separate paper in itself. While the priorities for this paper lie elsewhere (discussed in the next three sections), it does raise a number of interesting, albeit cumbersome, research questions:

- The large number of baby boomers relative to younger generations is at the root of many of the thorniest policy issues affecting the United States—not merely at the national level regarding taxation and entitlements, but at the metropolitan level as well. **How will the retirement of the baby boom generation impact housing markets, travel demand, and urban form?**
- The aging of the white and black populations is taking place in the wake of decades of large-scale immigration from Latin America and Asia, dramatically shifting the ethnic composition of younger generations. **What will be the effects of this shift in racial/ethnic composition on urban form? Are there clear preferences based on these shifts? Will majority-minority metros develop differently from white-majority ones?**
- While central cities still host a disproportionate share of low-income and minority populations, numerous factors lead an ever-increasing portion of each of these groups to suburban locations that frequently do not offer the employment and social services opportunities that previous generations had available in central cities. **How can policymakers use land-use and transportation tools to enhance opportunities for traditionally disadvantaged populations that have suburbanized?**
- The combination of (among other factors) high fuel prices, changing preferences, an aging population, tight credit, and the increasingly limited ability of municipalities to provide the infrastructure for greenfield development may have curtailed the outward growth of urban areas. Meanwhile, a growing number of policymakers at all levels of government have recognized the failure of an economy based on consumption and amenities to provide upward mobility, and are

crafting plans to reorient local and state economies around the production of goods and tradable services. **What are the impacts on metropolitan economic performance and fiscal strength from a move to more compact and production-oriented growth patterns?**

Spatial Impacts of a Globalizing Economy

Developing nations—most notably Brazil, Russia, India, and China (the BRICs)—now power the world economy to a degree far greater than was the case a decade ago. The share of global economic output produced by developing countries increased from 37 percent in 2000 to 45 percent in 2008, with the BRICs accounting for roughly half of that amount.[22]

The traditional narrative, then, of a wealthy developed-world core obtaining raw materials and cheap manufactured goods from a developing periphery, bears less and less relationship to reality with each passing year. Rising middle classes in these rapidly growing nations increasingly demand consumer goods and services of the sort to which average Americans and western Europeans have long been accustomed.

American firms can take advantage of this global demand directly by selling goods and services to these consumers, or indirectly by selling capital equipment and working knowledge to local firms serving these fast-growing markets. This creates an excellent opportunity for the United States to reorient its economy from the credit-fueled housing and amenities boom that characterized the 2000s to a more balanced, production-oriented future (Istrate, Rothwell, and Katz 2010).

To this end, in March 2010, President Obama announced the National Export Initiative, the vehicle to achieve his administration's ambition for the United States to double the value of its exports by 2015.[23] The current mix of American exports—heavily dependent on agricultural products and raw materials—cannot scale up to the extent necessary to meet this goal. In order to meet the national goal, the U.S. manufacturing sector, vastly shrunken from its 1990s peak, will have to increase its share of economic output.

Since the manufacture and production of exported goods generally takes place within metropolitan areas (and high-value service production usually does) the spatial impact on the nation's cities and suburbs could be significant.[24] In addition, since roughly one-third of American exports are service-oriented and largely metropolitan, we need to consider their spatial impacts as well. The important question becomes, then, whether major changes to American metros will be a necessary precondition to substantial increases in exports; and, if so, how best to achieve these changes.

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[22] "Not Just Straw Men," *The Economist*, 18 June 2009.

[23] "National Export Initiative," Executive Order 13534 , issued 11 March 2010.

[24] Fully 92 percent of the value of service exports is produced in metropolitan areas, including 77 percent in the 100 largest metros; for goods, these figures are 84 percent metropolitan and 60 percent in the top 100 metros, respectively. (Jonathan Rothwell, "Are Service Exports Leading the Recovery?" *The New Republic: The Avenue,* 22 April 2010, http://www.tnr.com/blog/the-avenue/are-service-exports-leading-the-recovery)

The Geography of Manufacturing

Until the 1910s, the primary land-based means of intra-metropolitan goods movement was the horse-drawn wagon—a slow and expensive conveyance. In the previous century of industrialization, manufacturers preferred to locate near wharves (whether at sea or on navigable rivers) or rail terminals, to minimize the need for drayage of inputs and outputs. Where they were available, inland waterways—whether natural (e.g., the branches of the Chicago River) or man-made (e.g., the canals of Manchester and Birmingham)—were heavily used, since they offered a smoother ride and enabled a single team to carry a much larger load.

Railroads often built spurs and loops to provide direct access to newly developed industrial tracts—sometimes in elaborate networks, such as those found in Chicago's Central Manufacturing District or the planned industrial city of Vernon, adjacent to Los Angeles—but the expense and hassle of condemnation made it difficult for new rail infrastructure to penetrate existing industrial districts. As a result, 19th century industrial areas tended to be densely developed, dominated by multistory loft buildings.[25] Only relatively large firms could afford the infrastructure improvements necessary to locate on the urban fringe, where they often built company towns to house their workers. Prominent examples include Steinway near New York City and Pullman near Chicago, both of which eventually were absorbed into major cities (Walker and Lewis 2004).

The development of reliable motor trucks dramatically altered location decisions for firms of all sizes, but especially for small and medium-sized manufacturers that previously had been tied to locations near docks and railheads. Newly "footloose" firms could now bid on land anywhere in the metropolitan area that suited their needs. This led directly to the establishment of comprehensive zoning ordinances intended to keep factories away from residential areas favored by the middle and upper classes (Fischel 2004). Electric machine tools facilitated new "through-flow" production methods such as the assembly line; for manufacturers large enough to have occupied multiple floors of a loft building, moving to a single-story building with equivalent floor area enabled big increases in efficiency.

As early as the 1920s, moving to the periphery became the obvious choice for most expanding firms, particularly in then-cutting-edge sectors such as automobiles and aerospace (Hise 1999). With the dramatic increase in accessibility provided by the automobile, land became relatively inexpensive.[26] The steady increase in the power and size of trucks during the interwar period made many inner-city industrial buildings, with loading docks too small to accommodate the ever-larger trucks of the period, increasingly obsolete for medium and large enterprises.[27] Additionally, as metropolitan populations

[25] Motive power for manufacturing machinery provided another significant constraint on the spatial expansion of industrial activity by smaller firms. Water power was limited to very small areas adjacent to rivers. Steam power had no such limitations, but the high fixed cost of a boiler led many firms to buy steam from third parties instead—requiring them to locate within close proximity of a steam generation plant. Even after the commercialization of electric power, transmission distances remained short until the widespread adoption of alternating current (Nye 1997).

[26] Yale economist Robert Shiller's research has shown a nearly 40 percent drop in housing prices between 1912 and 1921 when adjusting for inflation, and little appreciation throughout the 1920s (Shiller 2006). Not coincidentally, car ownership in the United States rose from 13 automobiles per 1,000 people in 1913 to over 200 by 1930, and one car per household by 1940 (Chanaron 1982).

[27] Plenty of small enterprises, many quite prosperous, have continued to make productive use of these buildings into the 21st century (Mistry and Byron 2011.) Pre-WWII industrial buildings previously occupied by a single firm often were subdivided for occupancy by multiple small firms.

rapidly suburbanized following World War II, it simply made sense for factories to follow their workers. Development-hungry suburban municipal governments, fiscally strained by rapid population growth and seeking new sources of property tax revenue in order to provide the parks and schools their residents demanded, welcomed factories—albeit under contemporary zoning rules that usually put such establishments into that seeming contradiction, the industrial park (Altshuler and Gomez-Ibañez 1993).

Traffic congestion, and the highway construction policy that constituted the primary response to it for most of the 20th century, has long been another significant contributor to decentralization of all types of economic activity—manufacturing very much included (Gordon and Richardson 1997). As trucks increasingly replaced trains for long-distance goods movement, traffic congestion became as serious a problem for freight shippers as it had been for commuters. While smaller firms with primarily local customer bases could remain in the urban core, moving to the urban fringe enabled larger industrial firms to receive inputs from, and ship products to, distant locations more quickly than was possible in congested locations near the urban core—while still having access to local customers and suppliers.

The huge increase in intra-metropolitan mobility provided by circumferential freeways made decentralization even more attractive, since roads like the Tri-State Tollway in metropolitan Chicago or the 610 Loop in Houston enabled commuters and freight alike to reach nearly any part of a metropolitan area without having to go through the typically congested central business district.[28] One currently debated question in urban economics is whether such dispersion dilutes the agglomeration economies that make firms in urban areas more productive than their rural counterparts (Lee 2007; Matsuo 2011). If it does, it is likely that unpriced traffic congestion is to blame—in which case policies to encourage manufacturers to locate in central cities and inner suburbs might be less necessary in the event that a reasonably comprehensive congestion pricing policy were put in place. This is especially true for specialized, high-value manufacturing establishments that need to send or receive numerous small shipments throughout the day (Figliozzi 2010). It is for this reason that there is increasing support by shippers (as opposed to trucking firms) for congestion pricing.[29]

Given the long-established forces pulling manufacturing to the urban fringe, it might seem pointless to encourage its return to urban centers. However, these forces have weakened in recent years. Central business districts may still be congested places, but the ring roads built to bypass them have become just as gridlocked, thanks in large part to the high-density but automobile-dependent business districts that sprouted alongside them beginning in the 1970s (Lang and LeFurgy 2003). As fuel prices have increased, access to rail has once again become important; while intermodal terminals are increasingly located at the urban fringe, the bulk of rail infrastructure still remains relatively close to urban cores. For smaller firms, the emergence of "mass customization" technologies such as 3D printing may make small-scale industrial properties in or near the urban core considerably more viable, despite the difficulties motor carriers face in accessing them. **Determining the best location for manufacturing, and the impacts of various locations (central city, inner suburban, and outer suburban) on neighboring populations, is a useful research task.**

[28] These bypass routes themselves often became the most congested freeways in their metros: consider the segments of I-405 in metropolitan Los Angeles and Seattle, or the Beltway in metropolitan Washington, DC.

[29] See Mike Erlandson, Vice President for Government Affairs, SUPERVALU, Inc., remarks at the Transportation Research Board Annual Meeting, 24 January 2012.

Social implications of manufacturing decentralization

The principal social impact of the suburbanization of manufacturing has been the loss of job opportunities for low-skilled residents of central cities, particularly African Americans. Since the oldest and generally least efficient factories were those closest to the urban core, these were the first to close in the 1960s, as foreign competition began to affect the American economy for essentially the first time in its industrialized history.

In the wake of riots during 1965–68 by disaffected African Americans in cities such as Los Angeles, Newark, Detroit, and Chicago, economist John M. Kain (1992) noted a distinct "spatial mismatch." Years of both overtly and implicitly discriminatory policy at all levels of government had effectively barred nonwhites from most suburban municipalities, limiting them to central-city ghettos, but the factories that provided them with their best employment opportunities increasingly were in suburban and not central-city locations. Since blacks' and Hispanics/Latinos' rates of car ownership have always lagged the rate for whites, jobs in suburban factories were therefore inaccessible to many of them.

Additionally, much of the job growth that did take place in central cities after World War II was in corporate management and high-value-added services (Glaeser 1998)—sectors that offered little opportunity to displaced factory workers with no postsecondary education. Kain and like-minded peers such as Melvin Webber (1964) recommended heavy investment in bus service and carpool facilities to bring transit-dependent inner city residents to jobs in suburban industrial parks. To their dismay, federal dollars instead tended to go toward building rail systems to carry car-owning suburbanites to central business districts.[30]

More directly solving the spatial mismatch problem, there has been considerable suburbanization of low-income minorities as well—although it largely has been to inner suburbs that are in economic decline themselves (Kneebone and Garr 2010). While some transit agencies have had success in serving city-to-suburb and suburb-to-suburb commutes, most have not done particularly well at linking low-income individuals to jobs that match their skill levels (Thompson and Matoff 2003; Tomer et al. 2011). Even if there were to be a dramatic recentralization of employment—unlikely for many of the reasons mentioned above—enough manufacturing jobs would still be located near the urban fringe that it would still be of vital interest to develop strategies to connect low-income households in central cities and inner suburbs to manufacturing establishments. **Developing and evaluating new strategies to connect low-income workers to skill-appropriate employment, particularly in manufacturing, is an essential task for policymakers.**

The Geography of Global Services

In 2010, services accounted for roughly one-third of the value of American exports (Istrate et al. 2010). While revitalizing the manufacturing sector is vital if the United States is to achieve dramatic increases in exports, service exports will have to increase significantly as well. This necessitates inquiry as to what the land-use impacts of significant increases in service production will be.

Because their customer bases are often spread throughout a region, firms in high-added-value service sectors such as finance and insurance, legal services, engineering, and management consulting tend to cluster in highly accessible portions of metros. These are primarily central business districts (CBDs) and

[30] See, for example, Lewis (1999).

large subcenters located near major freeway junctions that are either suburban downtowns or 1980s-style edge cities (Anas, Arnott, and Small 1998; Glaeser and Kahn 2001; Lang and LeFurgy 2003).

Intellectual property generators such as software, entertainment, and biotechnology firms also tend to organize in spatially distinctive nodes, albeit at somewhat lower densities than those found in CBDs or the denser suburban centers. Examples include the biotechnology corridor along I-270 in the northwest suburbs of Washington, DC, and the seemingly endless low-rise office parks of Silicon Valley.

Given that these sectors will be the primary generators of increased service exports, it seems likely that the downtowns, edge cities, and "creative campuses" favored by their constituent firms will experience land-value appreciation. However, the ability of developers to react to these market signals will vary by location. Most CBDs, and many suburban downtowns that developed into major employment subcenters (e.g., Pasadena and Glendale near Los Angeles or Alexandria near Washington, DC), are surrounded by areas developed before the widespread adoption of municipal zoning and subdivision regulations in the 1920s. As a result, these "zones of transition" tend to contain a mix of primary and secondary land uses, and they readily accommodate changing development patterns (albeit with the frequent accompaniment of social friction).

By contrast, most edge cities are surrounded by affluent-to-wealthy residential areas with sophisticated, politically adept populations eager to defend R-1 zoning and minimize traffic spillovers. This severely constrains edge cities' ability to expand outward, meaning that any growth must occur through denser redevelopment (Lang and LeFurgy 2003). This is not necessarily a difficult thing, since a very large portion of the archetypal edge city's land area comprises surface parking (Shoup 2005). However, since most edge cities are in automobile-dependent suburban areas and have little residential population, their densification also tends to bring significant additional traffic congestion.

One way many edge cities may be able to grow is through complete reinvention, with walkability, transit access, and finer-grained land-use patterns in mind. This approach is currently being undertaken in the archetypal edge city, Tysons Corner in Virginia, as well as in places like Bellevue, Washington (Leinberger 2010).[31]

Universities

Universities, which generate a substantial portion of the nation's service exports by educating foreign students, are a critical component of most metropolitan economies. They are frequently among the largest employers within their metros: for example, the University of Southern California is the largest private employer in the City of Los Angeles, and one of the largest in the Los Angeles metropolitan area. Of the 59 members of the Association of American Universities—institutions that account for the majority of doctorates granted and federal research funding obtained —39 are located within one of the 100 largest metropolitan areas. Of these, 24 have their primary campuses within the limits of those metros' primary cities, with most of the remainder either in densely developed inner suburbs (e.g., Cambridge, MA, and Pasadena, CA) or large suburban centers (e.g. Irvine, CA, and New Brunswick, NJ). Major universities located outside a top-100 metro often have associated facilities—particularly medical schools—in the urban core of a nearby large metro, such as the Weill Cornell Medical College of Cornell University in New York City or the Indiana University School of Medicine in Indianapolis.

[31] See, for example, "Bel-Red Area Transformation," http://www.ci.bellevue.wa.us/bel-red_intro.htm.

With their outsize influence on metropolitan economies, universities have significant impacts on land use. Most urban universities have large concentrations of student housing adjacent to them, frequently causing conflict with nearby residential areas; increased enrollments can lead to protracted disputes with host communities, particularly for universities like UCLA or Georgetown whose principal campuses adjoin wealthy residential districts.[32] Universities adjoining low-income urban areas, meanwhile, can create gentrification concerns as relatively affluent full-time students bid up rents for housing within walking distance of campus. Universities in densely built-up inner portions of central cities frequently cannot build new facilities without acquiring adjacent parcels of land, a task for which they have often sought the assistance of redevelopment agencies with eminent domain power—often running roughshod over low-income and/or minority communities in the process and creating long-festering resentment between universities and their neighbors.[33]

Today, significant expansion by many universities comes through satellite campuses and research facilities on previously vacant land, whether in central cities (e.g., the University of California San Francisco's large new biotechnology campus on the site of the long-closed Hunters Point Naval Shipyard) or suburban greenfield (e.g., George Washington University's Virginia Center in the outer Washington suburb of Ashburn, VA). A service exports promotion strategy that relies heavily on universities will likely result in developments like these being replicated across the country.

While their direct impact on urban form is significant, universities can have a greater impact when they catalyze the development of new economic clusters or the expansion of existing ones—leading to the export of both goods and services (Holly 2012). The symbiotic relationship between Stanford University and the semiconductor and information technology industries in the Santa Clara Valley south of San Francisco is by far the best-known example of this effect, but it is hardly unique (Bresnahan, Gambardella, and Saxenian 2006). Universities have played critical roles in the development of clusters such as biotechnology in San Diego, pharmaceuticals in Philadelphia, structured finance in Chicago, and interactive entertainment in Los Angeles. These clusters have in turn influenced the spatial development of their host metros: for example, the La Jolla Mesa on which UC San Diego and the San Diego biotech cluster reside has become one of its host metro's most important employment centers (Porter 2001).

The presence of a university in no way guarantees the development of such a cluster, however. Because the Morrill Act of 1862 that spawned most state university systems emphasized agricultural research and education, much of the science and engineering research occurring in U.S. universities takes place at campuses relatively distant from major metropolitan areas. The geography of venture capital means that ideas emerging from these places often only become commercialized in one of a handful of metros such as San Francisco/San Jose or Boston (Rubin 2010). Urban universities in turn often neglect nascent clusters within their metros, as was the case with UC San Diego vis-à-vis San Diego's telecommunications cluster until the 1990s (Porter 2001). In general, the field of knowledge transfer from universities to the private sector is richly developed and beyond the scope of this document, but there is some space for further inquiry.

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[32] One of the key Supreme Court decisions upholding restrictive municipal land-use regulations, 1974's *Village of Belle Terre v. Boraas,* concerned a group of students at Stony Brook University. In its decision, the court ruled that Belle Terre's ban on more than two unrelated persons in a single-family residence was constitutional.

[33] The most prominent examples of this tension are the wholesale demolition of Chicago's Little Italy for the Chicago Circle Campus of the University of Illinois in the 1950s, and the Columbia University expansion of the late 1960s that precipitated one of the period's most notorious episodes of campus violence.

The Role of Goods Movement

The United States has one of the world's most elaborate internal goods movement networks. The Interstate Highway System connects virtually every metropolitan area in the 48 contiguous states, enabling a truck with a single driver to travel more than 600 miles a day.[34] For long-distance hauls and/or heavier commodities, what has been called the world's best freight rail system serves most of the country's populated areas, doing particularly well at connecting the Pacific coast with hubs in the nation's midsection.[35] An elaborate inland waterway system enables coal, grain, chemicals, gravel, and other bulk commodities to travel thousands of miles along the Mississippi-Missouri-Ohio river system, the Great Lakes, and (via the Intracoastal Waterway) the south Atlantic and Gulf coasts. At the opposite end of the added-value spectrum, an abundance of airports enables the movement of high-value cargo throughout the country and to and from points the world over.

Taken as a whole, the system reduces transportation's portion of the final costs paid by consumers, for both goods and services, relative to what it might be with a less elaborate system. It facilitates relatively economical movement of raw materials and finished goods to and from the nation's seaports and land borders, as well. For better or worse, the impacts on the American economy have been significant.

Swift, highly reliable, and relatively inexpensive trucking facilitated the adoption of just-in-time logistics practices during the 1990s by firms across the economy, in both the manufacturing and service sectors. The freight rail and inland waterway systems enable the export of Midwestern and Pacific Northwest grain, Southwestern cotton, and Appalachian coal to consumers around the world. Trucking and freight rail are vital to the export of American manufactures from the South and Midwest to Canada and Mexico, the United States' largest trading partners, as well as export customers further afield.[36]

On the negative side of the trade balance ledger, intermodal freight rail plays a crucial role in bringing East Asian manufactured goods from the three major West Coast port complexes (and, to a lesser but increasing extent, East Coast ports) to the rest of the country. However, the westward backhaul of empty containers from the Midwest and South to the Pacific ports is an increasingly important conduit for agricultural commodity exports to hungry East Asian countries, and it holds potential to reduce export costs for manufacturers as well (Fuller et al. 2011).

In spite of this elaborate and thorough inland distribution system, the distance to an international gateway—an airport, a land border, or a seaport—is still enormously important for potential exporters (Gries, Naudé, and Matthee 2009). All things being equal, exporting firms that are closer to a gateway

[34] This figure depends crucially on the strictness of hours-of-service (HOS) regulations. A lower daily limit on HOS turns many one-day truck trips into two-day trips, with commensurate effects on costs. Not coincidentally, the most recent Notice of Proposed Rulemaking (NPRM) concerning a change to the Federal Motor Carrier Safety Administration's HOS regulations resulted in over 28,000 public comments; a similarly high-profile DOT NPRM, "Enhancing Airline Passenger Protections," received 2,000.

[35] Including places such as Chicago, Kansas City, Dallas, and Memphis. "High-Speed Railroading," *The Economist,* 22 July 2010.

[36] The recent agreement allowing Mexican trucks into the United States removed a major barrier for American firms exporting to Mexico, which has experienced strong economic growth in recent years in spite of a bloody conflict between public safety agencies and narcotics traffickers. See Damien Cave, "For Mexicans Looking North, a New Calculus Favors Home," *New York Times*, 6 July 2011; and Binyamin Appelbaum, "U.S. and Mexico Sign Cross-Border Trucking Deal," *New York Times,* 7 July 2011.

will have an advantage over those that are more distant. For firms that export high-value products by air, proximity to a major international passenger gateway (e.g., Los Angeles, Miami, Chicago, New York) or cargo hub (e.g., Memphis or Louisville) will provide a distinct advantage over a location from which a lengthy truck trip or additional airborne segment is necessary to reach a major airport. For exporters by sea, there is great advantage in being close enough to a marine terminal (or an "inland port" offering nonstop intermodal rail service to a major seaport) that a drayage truck can, within a single day of service, make a round trip between their loading dock and the port. If manufacturing increases as a share of U.S. exports, metros that host one or more such gateways will have a distinct advantage over those that do not. In turn, the portions of metros that have the greatest access to such gateways will receive the lion's share of growth in the sectors that utilize them most.

The decentralization of goods movement infrastructure

A development worthy of note is the renewed migration of goods movement infrastructure, and the logistics firms and establishments (warehouses, distribution centers, etc.) that are its user base, to the urban periphery. This shift may have a significant negative impact on the attractiveness of central-city and inner-suburban locations for importers and exporters.

Increasing congestion on Chicago's vital rail-switching network, and delays and cost overruns on the CREATE project meant to relieve this congestion, has led the three principal railroads that carry goods between Pacific ports and the Midwest (Union Pacific, BNSF, and Canadian National) to make significant investments in facilities far from the city.[37] UP and BNSF have built huge intermodal yards at the twin CenterPoint Intermodal Center industrial parks on the site of the former Joliet Arsenal, 45 miles southwest of Chicago in the rural portion of Will County.[38] CN purchased the old Elgin, Joliet & Eastern Railroad—a belt line approximately 35 miles distant from the Chicago Loop—in order to connect its main lines to Vancouver and the new container terminal at Prince Rupert, British Columbia, with its very busy Chicago-Memphis-New Orleans line (the old Illinois Central Railroad).[39] Already, CenterPoint Intermodal is a huge success, attracting major customers including a Wal-Mart distribution center and forest products giant Georgia Pacific. APL, one of the major transpacific shipping firms, has relocated its Chicago terminal from the city to CenterPoint Joliet, with the intention of using it for direct service between the West Coast and Chicago.[40]

This phenomenon is not limited to Chicago. In greater Los Angeles, the proposed Alameda Corridor East-Trade Corridor project would build gigantic intermodal terminals on BNSF's and Union Pacific's respective transcontinental main lines in Barstow and Indio—each well over 100 miles from their twin terminals near downtown Los Angeles, which are essentially at capacity and unable to expand—and connect them to the Los Angeles/Long Beach port complex by grade-separated "rail expressways." Traffic congestion and the search for cheaper labor have resulted in many of the warehouses and

[37] "More Projects, More Funding Still on CREATE's Slate, UP's Payette Says," *Progressive Railroading,* 8 November 2010.

[38] See "CenterPoint Intermodal Center - Elwood, IL," http://www.centerpoint-prop.com/projects/article.aspx?id=151&mode=INFRASTRUCTURE.

[39] "U.S. Court Refuses to Stay CN Rail's EJ&E Purchase," Reuters, 22 January 2009.

[40] "International shipping company to move terminal to CenterPoint facility," *Chicago Tribune,* 07 July 2011.

distribution centers serving the Port of New York and New Jersey to move from the Newark area to the Allentown-Bethlehem-Easton metro, 70 miles west in eastern Pennsylvania.[41]

The net benefit of these changes is unclear. Forgone growth in, or outright loss of, central-city and inner-suburban employment in the logistics sector is problematic: places like Newark and the South Side of Chicago suffered from tremendous unemployment even before the Great Recession. From an environmental perspective, the additional distance of truck trips to peripheral locations will result in increased greenhouse gas emissions.[42] However, the outlying destinations for many of these facilities are equally challenged. Notwithstanding the city's population growth in the 1990s and 2000s, much of Joliet has yet to recover from the loss of the Arsenal and the Joliet Iron and Steel Works in the early 1980s—and the housing-boom-driven exurban areas to its west suffer from the highest foreclosure and vacancy rates in the Chicago metro. The Lehigh Valley reeled from the slow death of Bethlehem Steel, whose flagship mill has now become a casino.[43] The Riverside-San Bernardino metro remains one of the most challenged in the wake of the recession; the High Desert and Coachella Valley portions that would host the Alameda Corridor East's two termini have been particularly hard hit. Overall, **it will be useful for policymakers to know the impact of the movement toward far-flung intermodal terminals and other goods movement infrastructure on the distribution of economic activity within metropolitan areas, particularly with regard to exports.**

Summary

The task of increasing exports will fall on the manufacturing and tradable services sectors. It is therefore important to understand the relationships between these and the built environment of the metropolitan areas that host them. It is also vital that policymakers understand the nation's goods movement system, and the impact of changes to it on urban economies.

Key Research Questions for Policymakers

- Over the course of the 20th century, numerous forces combined to shift manufacturing activity out of central cities and toward the metropolitan fringe. After a prolonged decline in its share of economic output, it is poised to be a key driver of economic recovery, but a return to previous land use patterns would be problematic. **Where should manufacturing be located within metros? Does this play out differently in different industries, and for varying sizes of metros? What are the costs and benefits for the various groups impacted by each potential location?**
- The decentralization of manufacturing contributed to a significant loss in upward mobility for traditionally disadvantaged central-city populations, which have not suburbanized as quickly. This important topic has its own set of well-developed literature. **What can policymakers do to improve**

[41] David Biederman, "Finding the Northeast Tipping Point," *Journal of Commerce,* 26 November 2007.

[42] On the other hand, many of these centrally located intermodal terminals, warehouses, and the like can be described as "diesel death zones," with childhood asthma and adult respiratory ailments vastly more common in their surrounding areas than in their host metros as a whole. So long as trucking remains a major source of emissions of smog-forming compounds and particulate matter, limiting the number of trips to and from centrally located logistics centers will be beneficial to the generally densely populated communities located near them.

[43] Steve Friess, "A Casino Rises in the Place of a Fallen Steel Giant," *New York Times,* 22 May 2009.

the ability of low-income populations to access skill-appropriate employment, particularly in manufacturing?

- Dramatic increases in freight flows, traffic congestion at key hubs for goods movement, and an large-scale shift from trucking to intermodal rail have driven the construction of large-scale transportation and warehousing facilities at the fringes of metropolitan areas, far from traditional logistics districts. **How will the decentralization of goods movement infrastructure impact the distribution of economic activity within metropolitan areas, particularly with regards to exporting firms?**

Urban Form and Innovation

Innovation and cities go hand in hand. To be sure, there have been instances of incredibly innovative places in rural settings, such as the Bletchley Park cryptography center in the English countryside that broke the codes used by Germany to communicate with its submarines—an effort that also resulted in the first digital computer (Komninos 2011). Nevertheless, these tend to be temporary and narrowly focused. Much more commonly, new centers of innovation have emerged from existing urban centers with abundant resources at hand, as occurred with automobiles in Detroit and Stuttgart, and a century later with interactive entertainment in Seattle and Los Angeles.

Alternatively, development of a new node for innovation can lead to rapid urbanization of the surrounding area, as occurred in previously sleepy, agriculture-dominated regions like the southern shore of the San Francisco Bay with the microelectronics industry and central North Carolina with Research Triangle Park. The urbanization invigorated these areas by making them appealing to knowledge workers whose demand for urban amenities could not have been met in these regions in previous decades. Indeed, both the productivity-boosting proximity of other highly skilled workers and the presence of urban amenities have accounted for the continued high productivity in recent decades of cold-weather metros. In prior decades, these Northeast and Midwest places (e.g., New York, Chicago, Philadelphia, and Boston) seemed to be on their way to eclipse by “Sun belt” metros whose chief appeal has been cheap housing (Glaeser and Gottlieb 2009).

In the next American economy, it will be necessary to harness the innovative capabilities of cities to achieve lasting and sustainable (in every sense) prosperity. In that light, it is critical to understand the clusters of innovation that have produced so much of the prosperity of the past and will be the sources of future economic growth. In turn, it is also important to know about the capability of innovation in information and communications technology (ICT) to increase the prosperity and quality of life in American cities.

The Geography of Innovative Clusters

From at least Alfred Marshall onward, economists have observed the tendency toward geographic concentration of firms by sector, in low- and high-tech industries alike. Advances in telecommunications technology have failed to eliminate this tendency, and may well have heightened it by dramatically increasing the relative value of information that requires face-to-face interaction to exchange (Lee and Mokhtarian 2008).

Clusters, defined as geographically concentrated groups of interconnected firms and supporting institutions (e.g., universities and colleges) within a general industry sector, are characterized by labor market pooling, supplier specialization, and knowledge spillovers facilitated by high interactivity among firms (Muro and Katz 2010). Geographic clustering of the firms in a sector—whether due to customer-sharing or to a larger pool of labor with skills matched to the demands of that particular industry—increases the productivity of all firms within that cluster, as well as the likelihood that new establishments will form and multi-establishment firms will add new locations in that geographic area (Delgado, Porter, and Stern 2010). In turn, the presence of a cluster for a given sector in a metro increases the likelihood of a new cluster forming in a related sector, creating a virtuous cycle of innovation that can form the basis for lasting prosperity in that metro.

By identifying the forces that result in self-sustaining clusters, business researcher Michael Porter created what was for a time a thriving cottage industry for economic development practitioners seeking either to nurture nascent clusters in their metros or, through tax incentives and elaborate construction projects, create them from scratch. Efforts in the former category generally fared far better than those in the latter (Fromhold-Eisebith and Eisebith 2005). While Porter's theory failed to acknowledge the forces that also drive firms apart, it remains influential nonetheless (Funderburg and Boarnet 2008). **What is not well understood, however, is the relationship between clusters and urban form.**

As creatures of agglomeration economies, clusters are subject to the same forces that impact agglomeration. Chief among these is the cost of transportation, both monetary and temporal. Congestion is the primary constraint on growth of agglomeration economies, as it inhibits labor accessibility (Matsuo 2011). It is not a coincidence that many prominent industry clusters exist either at the pedestrian scale in highly accessible central business districts (e.g., fashion in Manhattan, financial engineering in the Chicago Loop) , or at the automobile scale along major regional highway corridors and at their intersections (e.g., information management along the Dulles Toll Road in the western Washington suburbs, biotechnology along I-5 north of downtown San Diego and I-270 in the northern Washington suburbs). Given the failure of so many "black box" attempts to form clusters through the provision of physical space in highly accessible locations, though, cheap office space near a freeway interchange clearly does not provide a sufficient precondition for a sustainable cluster to form (Muro and Katz 2010).

The spatial characteristics of industry clusters vary by sector. In manufacturing, the need for plants with large floor area and loading docks capable of accommodating combination trucks dampens the strength of agglomeration economies (Glaeser and Kahn 2001), but clustering by sector still occurs regularly. A study of manufacturing in the five-county greater Los Angeles region found that most manufacturing sectors had distinct clusters, with more than half of related employment within 5 to 7.5 miles of a geographically defined center.[44] High-tech sectors such as electronic components and pharmaceuticals had particularly tight clusters (Funderburg and Boarnet 2008). Interestingly, the most tightly concentrated cluster was the garment manufacturing center southeast of the Los Angeles CBD, reflecting both the incredible concentration of garment wholesalers and importers in the Fashion District and the ring of densely populated, largely immigrant Latino neighborhoods surrounding downtown Los Angeles that provide the bulk of the cluster's workforce. While hardly a conventionally attractive space for innovation, it has nonetheless become the center of a major industry characterized

[44] The region there defined includes the Los Angeles-Long Beach-Santa Ana, Riverside-San Bernardino-Ontario, and Oxnard-Thousand Oaks-Ventura metros. See Funderburg and Boarnet (2008).

by incredibly rapid product turnaround—embodied by Fashion District–spawned "fast fashion" retailer Forever 21 (Williams and Currid-Halkett 2011).

Knowing that certain industries tend to agglomerate does not imply that they form innovative clusters, however. Aggressive zoning could force particularly polluting sectors into a single municipality or district, but their constituent firms might not be any more productive for having competitors next door than if they were 10 miles away instead. **It would be a useful research task to determine the factors that, at the metropolitan level, lead to the formation of clusters characterized by high interactivity among firms.**

Since some of the most productive industries in recent decades display significant agglomeration economies and have highly educated workforces that skew young, cities that offer high accessibility and urban amenities have attempted to capitalize on these characteristics by redeveloping moribund areas as *innovation districts.* These are neighborhood- or district-level portions of cities that attempt to create the conditions necessary to allow high-tech clusters—consisting of small, agile firms characterized by a high ratio of intellectual to physical capital—to form.[45]

Prominent examples of innovation districts include 22@ in Barcelona, a former textile manufacturing campus transformed into a thriving center for high-tech and creative industries; the Knowledge Precincts of Melbourne, areas surrounding university campuses in which land-use regulations encourage interaction between private businesses and academics; and the Boston Innovation District (Komninos 2011). Barcelona has attracted particular attention because of its superb urban design and innovative infrastructure (including often neglected systems such as lighting and waste disposal), but also because of its laser-like focus on five specific sectors: media, medical technologies, information and communications technology (ICT), energy, and design. This focus enabled targeted outreach efforts that reaped strong dividends (Battaglia and Tremblay 2011). **One key question for policy researchers is whether a success like 22@ can be replicated in an American context, especially in the era of sharply constrained eminent domain and opposition to using public resources to assist private firms.**

Smart Cities

Another proposition to stimulate economic growth and dramatically change how people live, companies operate, and communities function goes beyond the individual consumer to the collective—the "smart city." Major infrastructure and information technology firms, having wired people throughout the world, are now on a mission to connect cities through the integrated application of advanced technologies to achieve dramatic increases in the efficiency of service provision, the performance of infrastructure, and the energy efficiency of buildings.[46]

Motivating these efforts are two factors: first, breathtakingly fast urbanization in the developing world; and second, the continuing decline of infrastructure in developed countries. Each market phenomenon offers enormous potential for firms that can supply infrastructure components, link them together with networking equipment, and manage the enormous volumes of data that would flow out of such a system. Cities so equipped would have the ability to monitor the performance of their infrastructure at

[45] Julie Wagner and Mark Muro, "How Colleges Can Foster Development Zones," Atlantic Cities, 14 February 2012.

[46] While the terms "smart city" and "intelligent city" have been applied to a variety of concepts, we use them here to describe cities characterized by large-scale deployment of ICT infrastructure for service management.

highly granular levels, targeting maintenance efforts for maximum effectiveness and enabling rapid reconfiguration in the event of component failure. Perhaps more important, citizens and businesses would have unprecedented communications capability, with concomitant increases in quality of life.

Most of the projects thus far have been small—intelligent electricity metering here, dynamically optimizing traffic control systems there—but a few smart city projects have taken place at a large scale, in terms of both their geographic reach and the range of urban systems they encompass.

Masdar in the United Arab Emirates, New Songdo City in South Korea, and Tianjin Eco-City in China are the best-known examples of smart city projects built *ex nihilo,* with every necessary infrastructure component in place to maximize the productivity of service delivery and minimize energy use. The various players in the smart cities sector also plan to use their technology to retrofit existing cities, although some components will be easier than others to install. (It is difficult to imagine installing a common utility duct into an existing city street, particularly in densely developed areas.)

Hollands (2008) notes that most of the discourse surrounding the concept has concerned economic efficiency driven by private capital and entrepreneurship; concerns of democratic legitimacy, social justice, and the like are ignored or minimized. Notably, Masdar and Tianjin Eco-City are in authoritarian countries with little democratic accountability at the local level; South Korea has a strong democracy, but a considerably more centralized system of government than most Western countries. The paramount role of private capital in the development of these cities—dozens of which are planned in China alone—is somewhat incongruent with other styles of urban growth accustomed to strong state control of urban development. In response, Caragliu, Del Bo, and Nijkamp (2009) propose a new definition:

> We believe a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.

The addition of the participatory governance component considerably strengthens the smart cities concept, while also transforming it. Paskaleva (2011) imagines “public-private-people partnerships” in service provision, whereby ICT enables citizens not only to provide detailed feedback on city services, but to act as full participants in the entire service development process of goal-setting, decision, design, delivery, and evaluation—enabling truly open innovation in governance.

In the United States, interest in smart cities is just now emerging. This may owe to the extreme fragmentation of local government: even in populous and spatially expansive cities such as New York and Chicago, a host of public, semi-public, and private entities dictates land use, service provision, and infrastructure policy—let alone in their broader metropolitan areas. **It would be a useful endeavor to determine how best to adapt the smart city concept to an American context.**

Summary

The tight relationship between cities and technological innovation has endured for centuries, but scholars have only recently begun to understand the mechanisms by which it functions. Sharpening this understanding is a crucial task for policymakers seeking to ensure the economic vitality of cities and

metropolitan areas. Researchers also should apply their efforts to adapting innovative urban applications of information technology that originated abroad to a U.S. context.

Key Research Questions for Policymakers

- Providing the conditions under which networks of interconnected firms can achieve greater output and innovation than otherwise possible is an essential task for contemporary metros and their leaders. What these conditions are, however, is less well known. **What factors influence cluster formation at the metropolitan level? What is the relationship between clustering and urban form?**
- The innovation district is an exciting new model of urban development that offers the possibility of reusing productive land in a way that fosters the development of innovative clusters. **In what contexts could the innovation district model work in the United States? What are the barriers to its implementation?**
- Smart cities efforts hold out the promises of dramatic increases in the efficiency of service provision, the performance of infrastructure, and the energy efficiency of buildings. As a new and emerging field, research and deep understanding of these efforts is still largely anecdotal. **What have international experiences been with respect to smart cities, and how should the concept be adapted in an American context?**
- The provision of large-scale information infrastructure at the metropolitan level offers great potential benefits to governments, firms, and individuals in these places. **How can U.S. metros and their constituent municipalities use information technology to improve not only economic performance but also government responsiveness and quality of life?**

Urban Form and the Low Carbon Economy

While the United States has yet to enact a comprehensive policy to limit the carbon dioxide emissions that are the primary cause of global climate change, the "green economy" continues to be the subject of considerable attention. Part of the reason is that the discussion has shifted from one framed as an environmental imperative to one framed as a market imperative and a strategy to produce jobs (Muro, Rothwell, and Saha 2011).

Therefore, despite the challenges of cap-and-trade other efforts at the state and federal level are still putting the country on the path toward a low-carbon future. For example, negotiations among automakers, the United Auto Workers, environmental groups, and federal regulators recently resulted in a new corporate average fuel economy standard of 54.5 miles per gallon by 2025, as well as the first-ever federal fuel economy regulations on medium and heavy trucks.[47] While there is plenty of evidence that greater fuel efficiency makes driving cheaper—thereby inducing more of it over the timeframe in which individuals and firms make location decisions—such a dramatic increase in fuel economy standards should still result in a large net reduction in carbon dioxide emissions (Downs 2004).

[47] Bill Vlasic "Carmakers Back Strict New Rules for Gas Mileage," *New York Times,* 28 July 2011; and "White House Announces First Ever Oil Savings Standards for Heavy Duty Trucks, Buses," National Highway Traffic Safety Administration press release, 09 August 2011.

The Environmental Protection Agency recently finalized a rule sharply limiting power plants' emissions of sulfur dioxide and nitrogen oxides that cross state lines, and another setting tight limits on the amount of mercury and other toxic substances emitted by power plants.[48] Once fully implemented, these two rules likely will result in substantial reductions in the use of coal for electric power generation, replaced by low- (primarily natural gas) or zero-carbon (wind, solar, and perhaps nuclear) generation methods.

With regard to urban form, though, these changes are of only limited relevance. As mentioned above, tighter fuel economy rules on cars without any real increase in fuel prices will likely spur more driving and thus end up adding to urban sprawl.[49] Meanwhile, barring revolutionary technological breakthroughs that would lead to electricity becoming the dominant source of automotive propulsion, the relevance of electricity prices to urban form is limited: it is possible, after all, to build highly energy-efficient buildings that, by virtue of location, end up with larger carbon footprints than more conventional structures in more efficient locations. A superb example of this is the LEED Platinum-certified headquarters of Twin Cities–area electricity wholesaler Great River Energy, which sits in a distant suburb of Minneapolis essentially inaccessible by transit.[50] Even the Environmental Protection Agency can fail to appreciate the importance of location efficiency in carbon dioxide emissions reductions, as demonstrated by its plan to move its Kansas City–area regional headquarters from downtown Kansas City, Kansas, to an LEED Gold building in outer suburban Lenexa, Kansas.[51]

Ultimately, transportation is the strongest lever for reducing the carbon emissions of metropolitan areas (Williams et al. 2011). There are two principal methods to reduce the quantity of travel in urban areas. The first is to use pricing to internalize the externalities resulting from travel, resulting in a market-clearing (or at least more efficient) level of travel consumption. The second is to shift the travel demand curve to the left, either by realigning land uses to enable individuals and households to make shorter trips, or by eliminating the need for travel altogether in certain circumstances.

Congestion Pricing

Conventionally powered cars, trucks, and buses produce carbon dioxide whenever their engines are running.[52] Of course, the emissions produced at various speeds differ drastically. Most cars reach peak fuel economy at 45–55 miles per hour—which happens to be the speed at which most urban freeways

[48] 76 FR 48208, 08 August 2011; final rule, "National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units," pending publication in *Federal Register.*

[49] It would be useful to determine whether a more fuel-efficient vehicle fleet would make carbon pricing more acceptable to the public.

[50] David Levinson, "Great River Energy HQ LEED Platinum," *The Transportationist.org,* 19 July 2009, http://blog.lib.umn.edu/levin031/transportationist/2009/07/great-river-energy-hq-leed-pla.html.

[51] Gabriel Nelson, "A City Feels Spurned as EPA Heads to the Suburbs," *E&E Greenwire,* 19 April 2011.

[52] Hybrid powertrains usually include regenerative braking and frequently do not run their combustion engine at low speeds—meaning that they can achieve their greatest fuel economy in stop-and-go traffic. At a sufficiently large portion of market penetration for hybrids, congestion mitigation strategies would actually lead to *more* carbon dioxide emissions. This might also apply to battery- or hydrogen fuel cell-powered electric cars, as well.

reach peak traffic flow.[53] Therefore, maintaining traffic at this speed or close to it, while minimizing travel distances, should do much to reduce carbon emissions from automobile travel. Of course, it is possible to eliminate traffic congestion by making development densities so low that the vehicle flow rate on any given road will never approach its design capacity, but that would effectively eliminate the entire concept of an urban area.

The ultimate futility of both highway and transit capacity provision for long- and even medium-term congestion reduction leaves congestion pricing as a potentially effective way of achieving long-term congestion mitigation at a given level of demand for personal travel (Duranton and Turner 2009). To be sure, comprehensive congestion pricing of even a second-best variety (i.e., not charging the full marginal cost of congestion at any given place and time) arguably rivals nuclear fusion power for the length of time that it has been ten or twenty years away from ubiquity—due, in no small part, to the many technological, political, and institutional barriers that such a policy would need to surmount (Levinson 2010). In particular, the distributional impact of pricing can be problematic, harming low-income and working-class households living in the large portions of many metros in which the private automobile is the sole means of reliable access to employment, shopping, and other services. While these impacts arguably have been significantly overstated, especially compared with alternate transportation finance methods such as sales taxes (Schweitzer & Taylor, 2008), it is critical that any implementation of pricing include measures to offset the mobility losses incurred by lower-income households. **In recent years, though, the research agenda of developing strategies to overcome the fierce political barriers to pricing has yielded some creative results and is worthy of continued effort (e.g., King, Manville, and Shoup 2007).**

The widespread adoption of congestion pricing would have varying results. Those unwilling to pay out of pocket the marginal cost of the congestion they impose (or a second-order approximation thereof) for a trip on a congested roadway would face several options. They could change the time of day at which they travel; the route they use to a less congested one; the mode by which they reached their destination (e.g., switching from the private car to ridesharing, transit, or nonmotorized modes); or choosing another destination.

Over time, a metropolitan-wide congestion pricing policy should result in a more compact distribution of both population and economic activity (Anas and Xu 1999). Whether this would take a monocentric or polycentric form likely depends on regional context, but both spatial distributions would result in reductions in travel distances for both commuting and non-commuting travel. Depending on available infrastructure and land-use patterns, it might also trigger a mode shift toward transit and/or non-motorized modes.

Realigning Land Use for Spatial Efficiency

More broadly, the relationship between the built environment and travel behavior has been one of the most active areas of inquiry for transportation and urban planning scholars since the mid-1990s (Muro and Puentes 2004; Ewing and Cervero 2010). Attention has recently returned to the potential usefulness of urban planning and design in reducing greenhouse gas emissions by reducing the necessity of automobile usage (e.g., Boarnet et al. 2011).

[53] This is not the same as "free flow" speed, which the widely used Texas Transportation Institute *Urban Mobility Report* uses as the baseline for measuring congestion, and which has been criticized for privileging high vehicle speeds above all other urban transportation metrics (e.g., Cortright 2010.)

Increasing the overall density of an urban area clearly results in shorter vehicle trips, but density in and of itself is no guarantee of spatial efficiency (Gordon and Richardson 1997). Los Angeles is by some measures the nation's most densely populated metro, due to the lack of significant difference in population density between the central city and its suburbs, as well as a dearth of open space within urbanized portions of the metropolitan area. It provides an excellent and cautionary example of a densely developed yet automobile-dependent region, with prevailing land-use patterns (long blocks, wide arterial roads, strict functional separation of primary land uses) that discourage walking and consequently inhibit the development of transit ridership outside the lowest socioeconomic strata (Eidlin 2005).

Careful urban planning, with a particular eye to factors that impact residents' willingness and ability to use alternatives to the automobile for many trips—or at least minimize the length of car trips—can be a powerful tool for reducing transportation's contributions to carbon emissions. Even in suburbs where the vast majority of commuting occurs by automobile, individuals who live near pedestrian-oriented shopping districts are more likely to walk to shopping than those who live in automobile-oriented areas (Boarnet et al. 2011). While the collocation of housing and shopping can reduce vehicle travel significantly, the collocation of housing and employment yields even greater reductions in driving (Cervero and Duncan 2006).[54]

One key strategy for reducing carbon emissions in established suburbs is to develop plans for creating walkable urban places—mixing offices, retail space, and residences at a pedestrian scale—at highly accessible locations (Leinberger 2010). The downtowns of older streetcar and commuter rail suburbs like Naperville, Illinois, and Bethesda, Maryland, have been the primary sites of such development. However, the success of many "town center" projects, which have transformed numerous moribund indoor shopping malls into pedestrian-oriented outdoor shopping centers with offices and apartments next door—effectively providing downtowns to suburbs often devoid of them—demonstrates the potential for developing walkable places in locations with no previous history of pedestrian orientation.

Boarnet and colleagues (2011) point out that even in one of the nation's most densely developed suburban regions, the South Bay region of southern Los Angeles County, most of the existing pedestrian-oriented retail nodes cannot be sustained by the relatively low-density residential areas surrounding them. Instead, most visitors arrive by automobile, often leading to conflict between business districts and their surrounding residential areas over parking and through traffic. While the existing suburban downtowns have some scope for densification (e.g., by replacing single-story retail structures with multistory mixed-use buildings), many suburban retail clusters have street plans and surrounding land-use patterns that make accommodating denser development difficult. Any plan to redistribute commercial activity to these nodes, in the name of minimizing vehicle travel, will need the accompaniment of a new accessibility strategy encompassing pedestrian and bicycle facilities and local circulator transit—especially critical given the tendency of walkable centers to increase property values nearby, and thus reduce affordability for low-income populations. Perhaps more important, it will be necessary to develop strategies to overcome the extreme hostility of many suburbanites to residential structures other than single-family houses and garden-style apartment and townhouse complexes (Levine 2006). This line of inquiry is well traveled, with conclusions too lengthy to summarize here, but the slow pace of change in most metros implies a need for further work.

[54] This likely owes a great deal to changes in shopping preferences that have caused the pedestrian-oriented retail components of many neotraditional residential developments to struggle (Grant and Perrott 2011).

Telecommuting and Electronic Retail

Another frequently recommended strategy for travel demand reduction is the promotion of telecommuting. Virtually every advance in information and communications technology from the telegraph onward has inspired pundits to proclaim that it will lead to "the end of the city." Instead, by allowing individuals and firms to maintain relationships with a greater number of parties in the same amount of time, telecommunications has *increased* the demand for face-to-face interaction, both within metros and over long distances (Lee and Mokhtarian 2008). Being able to work without going to an office, however, is a very different thing from simply being able to exchange information over a greater distance. A society-wide shift toward telecommuting could result in significant reductions in travel demand.

The one problem with this narrative is that it runs into the same problem of triple convergence (also known as the Fundamental Law of Traffic Congestion) that renders capacity increases futile over the long term (Downs 2004). Even without a growing metropolitan population, every former peak period automobile commuter now working from home would be replaced by someone who, previously, had either driven an alternate route, traveled at a different time, or used a different mode (probably rideshare or transit). Most metros have enough latent demand for peak-period automobile travel for triple convergence to swamp any reduction resulting from the adoption of telecommuting (Mokhtarian 2009). The duration of the peak period may be shorter, but the level of congestion faced by travelers during the period will be the same.

Of course, there *are* limits to triple convergence: if enough users permanently leave the roads, there will not be enough latent demand for peak period travel to produce the same level of congestion. Given the longstanding existence of economies of both geographic and temporal agglomeration—not to mention the fact that the adoption of telecommuting is more likely to be a reaction to a relocation decision by a household or firm than an actively sought work arrangement—it seems unlikely that such a drastic shift toward telework would ever occur (Mokhtarian 2009; Lake 2008).

One intriguing possibility for reducing travel demand lies in the switch from physical to electronic retail commerce. Whether e-commerce will lead to reductions in carbon dioxide emissions, however, is much less clear. Since so much shopping is done as part of mixed-purpose tours (e.g. home → day care/school → work → day care → shopping → home) or multi-store shopping tours, the marginal CO_2 impact of switching one purchase from in-person to online may be minimal. Additionally, since a significant portion of shopping is for items not well-suited to online purchase (i.e., perishable food, certain clothing items), the ability of e-commerce to eliminate dedicated shopping tours is limited—and if it does eliminate a shopping tour that took place on transit or a non-motorized mode, replacing it with additional home delivery truck trips, there may be a net emissions *increase* from an offline-to-online purchasing switch. Research in this area is relatively new (Edwards et al. 2010; Kawamura and Miodonski 2012). **Continuing study of the carbon impacts of electronic retail is well worth pursuing.**

Summary

Whether or not a comprehensive carbon pricing regime comes into existence any time soon, metros have a dual imperative to both reduce their carbon emissions and to adapt to an environment in which carbon-intensive activity is much more expensive. This will necessitate a multi-pronged approach to reducing automobile travel, in particular. Road pricing, travel demand–reducing land-use strategies, and electronic work and shopping arrangements are the most likely means by which this can take place. It is

essential that researchers and policymakers develop a greater understanding of the issues and implications of these policies.

Key Research Questions

- Longstanding scholarly consensus among transportation economists holds that charging drivers the marginal cost of the congestion they impose on other drivers is the only truly long-term solution to congestion—and is a necessary component of any strategy to reduce carbon dioxide emissions from transportation. However, academic consensus rarely produces action; outside a handful of cities with cordons around their central business districts, the only congestion-priced roads at present are parallel adjuncts to "free" facilities. **What circumstances, policies, and institutional arrangements would be necessary to make congestion pricing feasible at a metropolitan scale?**
- Congestion pricing would likely have a dramatic effect on the mobility decisions of commuters and motor carriers—leading, depending on context, to shifts in the time of day of trip-making, the routes and modes used to make trips, and the choices of destinations. **How would metro-scale congestion pricing impact the distribution of economic activity within metros? Would a metro with comprehensive pricing lose firms and/or residents to other metros?**
- Realigning land-use policy to reduce the length and number of automobile trips is another task essential for reducing the carbon footprints of metropolitan areas. To a significant extent, this involves more intensive development in portions of metros that have heretofore resisted it fiercely. **In what circumstances can denser development take place in suburban municipalities and low-density portions of central cities? How can policymakers overcome the barriers to mixed-use and multifamily residential development, in particular?**
- As the share of consumer purchases conducted online increases, there may be significant impacts on land use and travel demand, but these are still largely unknown. **What are the travel behavior impacts of electronic retail? What impact will an increase in the share of retail conducted online have on the demand for retail space?**

Key Questions for Policymakers

The preceding sections of this document established the state of knowledge in three areas of interest regarding metropolitan economies: first, the relationship between urban form and the production of tradable goods and services in a globalized context; second, the role of technological innovation in metropolitan development; and third, strategies by which metros can reduce their carbon emissions and adapt to a low-carbon environment.

A research agenda that addresses these broad issues should impact federal policymaking, and the implementation thereof, in three principal ways.

First, in light of the nation's economic and demographic restructuring it will **redefine the role and rationale of spatially relevant federal policies and stimulate new thinking about the physical landscape of the nation.** Questions from the preceding sections addressing these issues are as follows:

- How will the retirement of the baby boom generation impact housing markets, travel demand, and urban form?

- What will be the effects of the dramatic shift in racial/ethnic composition on urban form? Are there clear preferences based on these shifts? Will majority-minority metros develop differently from white-majority ones?
- What are the impacts on metropolitan economic performance and fiscal strength from a move to more compact and production-oriented growth patterns?
- Where should modern manufacturing be located within metros? Does this play out differently in large metros, small metros, and nonmetropolitan areas? What are the costs and benefits for the various groups impacted by each potential location?
- Where do large-scale importers and exporters locate within metros? How does this impact urban form?
- How will the decentralization of goods movement infrastructure impact the distribution of economic activity within metropolitan areas, particularly with regards to exporting firms?
- What factors influence cluster formation at the metropolitan level?
- How would road pricing impact the distribution of economic activity within metros? Would a metro with comprehensive pricing lose firms and/or residents to other metros?
- What are the travel behavior impacts of electronic retail? What impact will an increase in the share of retail conducted online have on the demand for retail space?

Second, it will **inform federal programs that impact metropolitan areas' physical form, including support for government-sponsored enterprises, tax expenditures for homeownership, sustainability initiatives, environmental goals, and transportation policies—drawing in agencies such as Treasury, Transportation, and the Environmental Protection Agency**. Questions from the paper to this end are as follows:

- In what contexts can the innovation district model work in the United States? What are the barriers to its implementation?
- How can American cities use information technology to improve not only economic performance but also government responsiveness and quality of life?
- What circumstances, policies, and institutional arrangements would be necessary to make road pricing feasible at a regional scale?
- In what circumstances can denser development take place in suburban municipalities and low-density portions of central cities? How can policymakers overcome the barriers to mixed-use and multifamily residential development, in particular?

Third, it will **describe how these spatially oriented policies can more effectively complement those focused on other inputs for economic growth, such as workforce and economic development, energy, and basic research—drawing in agencies such as Labor, Commerce, and Energy.** Questions from the paper in this vein are as follows:

- How can policymakers use land-use and transportation tools to enhance opportunities for traditionally disadvantaged populations that have suburbanized?

- What can policymakers do to improve the ability of low-income populations to access skill-appropriate employment, particularly in manufacturing?
- How can the federal government facilitate regional cooperation on economic competitiveness, particularly with regards to exporting sectors?

By pursuing this research agenda, HUD will provide policymakers, practitioners, and scholars with enormously valuable information necessary to understanding the complicated interactions between urban economies and the built environment.

Conclusion

In 2008, for the first time in human history, the majority of the world's inhabitants lived in urban and metropolitan areas. This represents a fundamental and dramatic shift and is only expected to intensify. The impacts on the global economy, our social networks, and the built environment will be dramatic and are likely to transform the very fabric of human life.

In the United States, this conversation is affected by several factors.

Our national economy is in the midst of broad and intensive restructuring. This is partially unintentional and precipitated by the most severe economic crisis in more than a generation. The reverberations from the Great Recession are still strongly felt. In response, major attention is being given to moving away from the over-leveraged, debt-driven economy that preceded the recession to one focused on globalization, technological innovation, and production, rather than consumption.

At the same time, the United States is undergoing the most remarkable socio-demographic changes it has seen in nearly a century. From a booming senior population, to large increases in racial and ethnic minorities, to rapid growth overall, these demographic changes are also radically reshaping of the American landscape.

The federal government, for its part, needs to understand the role of these transformations as well as the spatial impact of economically oriented policies on U.S. cities and metros. Yet the realities of the 21st century mean we need not just new policies, but a different approach to building and strengthening the next American metropolis.

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