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Research BRIEF

Urban Structure: Role In Urban Growth, Net New Business Formation and Industrial Churn

"Motown Becomes Movietown . . . Workers who used to build cars are learning to build sets."
Wall Street Journal, September 17, 2010

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Cities play a critical role in economic development. Considered engines of growth, cities also are places where people do their best work. Economists recognize the key role of entrepreneurs in driving innovation; the economist Joseph Schumpeter established in the early 1900s that specializing in discovery is the key economic activity. Entrepreneurship involves discovering new products and services as well bringing them to market in new and better ways. At least as important as Schumpeter's contribution is F.A. Hayek's insistence that local knowledge spreads among large numbers of decentralized actors who implement the many important details, including supply chains. The unique spatial arrangements within urban areas can be expected to form in ways that facilitate the flow of ideas and innovation, enabling successful cities to be congenial hosts to innovative and entrepreneurial activities.

Cities change slowly but most do adapt. Different urban forms are associated with different technologies. In particular, dramatically improved mobility by cars and highways has freed various economic activities from locating in the traditional urban center and expanded urban areas to an unprecedented extent in the second half of the last century. Many urban researchers agree that metropolitan spatial structure underwent a "qualitative change" toward more polycentric and/or dispersed forms. But not much empirical research has been done on the relationships between urban form and economic efficiency. Which urban structure is most congenial to creative and entrepreneurial spirits?

This research sought to help bridge the gap between growth economics and urban economics. What we found places a premium on flexible land markets and the open-ended evolution of urban structure. We tested links between urban size, spatial structure and growth by utilizing a unique spatially detailed data set for the 79 largest U.S. metropolitan areas. We found evidence that urban forms evolve to accommodate growth; spatial patterns emerge that accommodate and limit the road and highway congestion that comes with greater urban scale. We found that the links between spatial structure indicators and urban growth vary across metro sizes: more clustering in small metros and more dispersion in large metros were associated with urban growth, after controlling other supply side variables and regional location. "Clustering" refers to the importance of sub-centers; "dispersion" refers to the extent to which activities take place outside the traditional downtown. Our results suggest that Schumpeter's "gales of creative destruction" – in which new ways replace old methods – include a spatial aspect that proves useful in determining which cities grow well and why they are more productive.

Commuting times are less sensitive to increasing metro size if employment is decentralized. Figure 1 shows mean commuting times of workers in different locations increasing with an increase in metropolitan population size. The gain (slope of the estimated regression) is apparently the steepest for Central Business District workers. The increase in average commuting time associated with a doubling metropolitan population size was approximately six minutes for CBD workers, but only about three minutes and two minutes for those workers commuting to subcenters and dispersed workplaces, respectively. This initial finding led us to conjecture that polycentric and dispersed spatial structure has an edge in mitigating congestion in large metropolitan areas. Our initial tests showed that in the 1990s, more dispersed spatial forms helped accommodate faster growth in large metropolitan areas while a metropolitan area with a more clustered spatial structure grew faster, perhaps enjoying agglomeration economies when relatively small.

Employment Growth, Industrial Churn and New Business Formation

These findings prompted further work. We based our empirical regression models on a well known supply-side urban economic growth model. In this model, a city's favorable attributes promote employment growth by boosting production processes, attracting more consumers or facilitating faster technological development.

We modified this supply-side urban growth model to examine the effects of spatial structure variables on (i) industrial churn (ii) net new business formation (NNBF) and (iii) employment growth. In particular, we hypothesized that the relationship between spatial variables and the three growth indicators depends on metropolitan population size rather than assuming just one overall relationship.

The basic empirical model is shown in expression (1) below. Employment growth, industrial churn and NNBF were alternately used as the dependent variables in this model. Explanatory variables included spatial structure variables as well as other control covariates that are found in the literature. We used two spatial structure variables indicating urban dispersion and polycentricity of employment that are estimated in the next section. To test whether or not the coefficients of the spatial variables vary across different metropolitan sizes, we included interaction terms involving the spatial measures and employment size in the statistical estimations.

$$Y = \alpha X + \beta_1 \log N + \beta_2 F + \beta_3 \log NF \qquad (1)$$

Y denotes the dependent variables used in our models, employment growth, industrial churn, and NNBF in the early 2000s; N denotes employment size in the beginning year; X is a vector of metropolitan attributes listed in Table 2 including the constant; F is a vector of spatial structure variables – dispersion and polycentricity.

Expression (2) below defines the industrial churn index, which measures gross employment reallocation across industrial sectors in each metropolitan area. This measures the extent to which cities accommodate new industries.

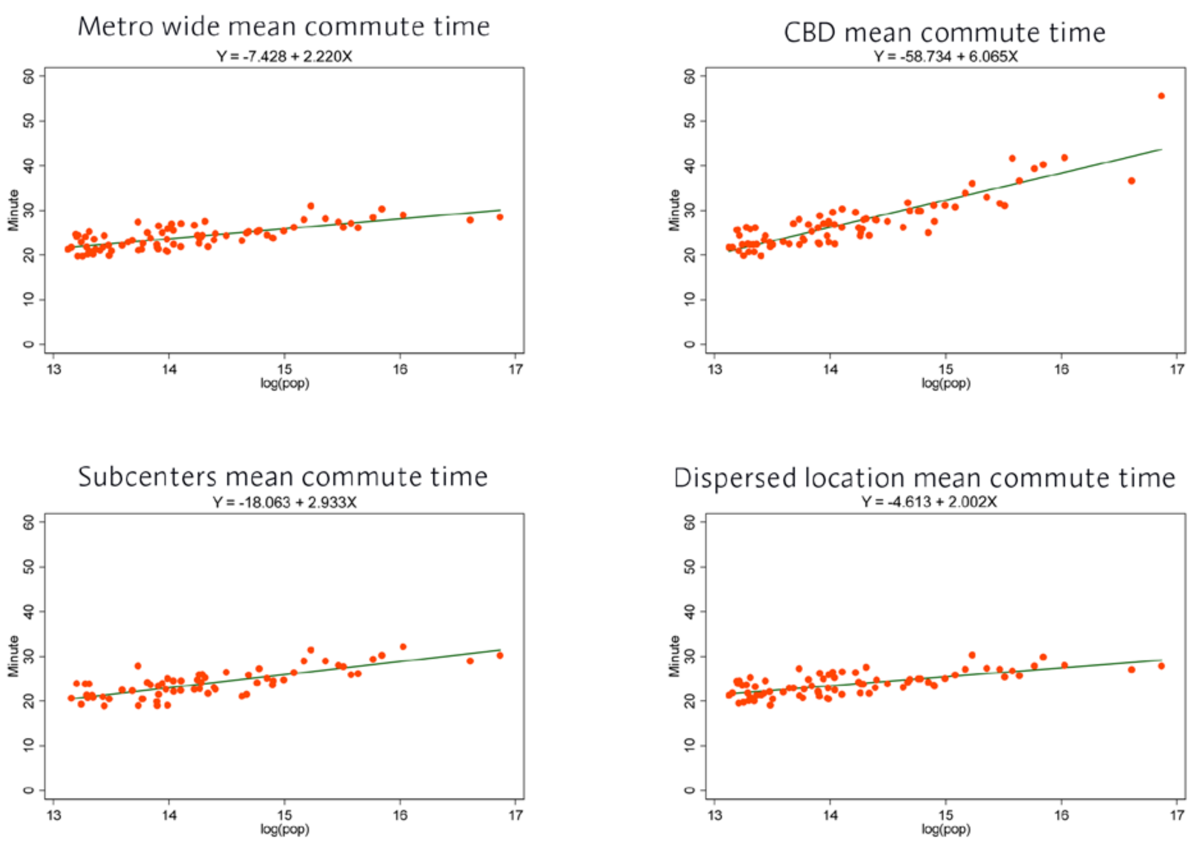
$$Churn_c = \frac{1}{5}\sum_{t=2001}^{2006}\sum_{z=1}^{19}\left|\frac{e_c(z,t+1)-e_c(z,t)}{e_c(t)}\right| \qquad (2)$$

where z = economic sector, t = year, e = employment, and c=MSA.

The other dependent variable used in our analysis, NNBF, presents the extent of entrepreneurial activities in metropolitan areas. This index can be defined in a fairly straightforward way as in equation (3).

NNBF = (business births – business deaths) / total businesses * 100 (3)

Figure1: Mean commute time by workplace type vs. metro population size



Note: Mean commuting time was calculated only for the drive-alone mode.

The available literature suggests that metropolitan areas with more entrepreneurial activities and more new business formation would be more adept at successful churning of the industrial base and ultimately experience greater economic growth. Thus, we expect that metropolitan growth, NNBF and measures of industrial churn to be highly correlated. Table 1 presents a correlation matrix of the three metropolitan performance indicators and two attributes of metropolitan areas. Both NNBF and the industrial churn index were highly correlated with employment growth, with correlation coefficients 0.754 and 0.573, respectively. Only industry turnover was statistically significantly correlated with metropolitan area employment size and population density. Larger and denser metros were less adept at industrial turnover in the early 2000s. We will revisit these variables' coefficients after controlling for other covariates in the next section on regression results.

Quantifying Spatial Structure

The spatial structure of metropolitan areas is multidimensional and cannot be described by a single measure. We chose to quantify two dimensions of metropolitan level spatial structure, dispersion and polycentricity. Dispersion measures the extent to which economic activities are spread out throughout the urban space outside major employment centers. Polycentricity represents the degree to which center functions are shared among multiple activity centers rather than being centralized in a single urban core, CBD. Modern metropolitan areas have transformed from monocentric to polycentric structures, often with a considerable amount of dispersion.

We quantified our two spatial variables based on how metropolitan jobs are distributed among three different location types: the center, identifiable subcenters, and locations outside these employment centers. The dispersion variable is defined as a non-center location's share of metropolitan employment that is dispersed outside identifiable employment (sub)centers. Polycentricity is measured by comparing the relative strengths of a metro's core central business district (CBD) and multiple employment subcenters. More specifically, the polycentricity variable in this paper is defined as the ratio of employment in all subcenters combined for all centers' (CBD and subcenters) employment. Identifying all employment centers in the sample of metropolitan areas is an essential step in constructing the two spatial variables.

Estimation Results

Our results show a better fit for explaining employment growth than for the other two growth indicators. Table 2 shows a high explanatory power of the employment growth model with most of the control variables being significant with the expected signs. Employment size was positive and significant while average population density in the core urbanized area had a negative sign, which is consistent with a long term deconcentration trend. It may be that congestion costs dominated positive externalities associated with density in the early 2000s. The coefficients of the other control variables, except for the percentage college graduates, are consistent with the results of our previous paper using the data for the 1990s. Large manufacturing's share and large older population had negative impacts on employment growth while percentage immigrants had positive impacts. Consistent with the previous literature cited, warmer and drier weather contributed to employment growth. However, none of our spatial variables were significant in initial (Ordinary Least Squares) estimations.

We found plausible results when applying locally-weighted regression (LOESS) tests. This involved estimating coefficients at each data point; we fit the base regression model to only half of the sample that are similar in employment size with the estimation points and give more weights to closer data points in the dimension of employment size. We used a 50-percent window size and the tricube weight function. The estimation results of the LOESS show how the influence of spatial structure varies across different urban sizes.

Table 1: Correlation matrix of key variables

	Log emp growth	Industrial churn	NNBF	Log emp size	Log pop density
Log emp growth	1.000				
Industrial churn	0.573	1.000			
	(<.0001)				
NNBF	0.754	0.502	1.000		
	(<.0001)	(<.0001)			
Log emp size	-0.162	-0.424	0.072	1.000	
	(0.154)	(<.0001)	(0.529)		
Log pop density1	-0.112	-0.244	0.183	0.551	1.000
	(0.324)	(0.031)	(0.107)	(<.0001)	

1. Population density is measured for the core urbanized area of each metropolitan area.

* P-value in parentheses.

The LOESS estimations yielded results that are more consistent with the growth pattern observed in our work with 1990s data. We found varying coefficients of spatial variables, dispersion and polycentricity, against log employment size. The coefficients of polycentricity were close to zero across different metropolitan size in all three models. Subcenters' share of clustered employment was not a significant factor affecting employment growth and related indicators. It was the coefficients of employment dispersion that showed considerable variation across employment size. Consistent with our initial results for the 1990s employment dispersion had negative or zero effects on metropolitan performance for small metropolitan areas while it positively affected growth indicators in large metropolitan areas. These patterns are observed in all three models – for employment growth, NNBF, and industrial churn.

Conclusions

We found evidence that links between metropolitan spatial structure and economic growth depend on metropolitan size. A metropolitan area with a more clustered spatial form grew faster, perhaps enjoying agglomeration economies in small metropolitan areas; whereas more dispersion was associated with higher growth rates in large metropolitan areas in the 1990s. Our follow-up study attempted to find similar patterns in entrepreneurial activities and industry turnover using the data for the early 2000s.

Spatial structure variables were not statistically significant in OLS estimations perhaps due to the choice of an inappropriate or too short study period. However, the coefficients of spatial variables estimated by the LOESS procedure showed similar patterns as in the previous study. The coefficients of employment dispersion were negative or close to zero for small metropolitan areas, but were positive in large metropolitan areas consistently in explaining employment growth, NNBF, and industrial churn. The variation in dispersion coefficients was statistically significant in the NNBF model. However, the coefficients of polycentriciy were close to zero across the board in all three models.

Cities grow and change and take on an increasingly important role as economies develop. Presumably, there is economic rhyme and reason to all this that can be uncovered by researchers. But there is also a large and growing literature that suggests that modern cities are a market failure. "Urban sprawl" is often used as a pejorative and "livable cities" summarizes a policy agenda geared to moderating long-standing suburbanization trends. While urban economists and others have discussed and tested the economic significance of metropolitan area average densities, one single summary average over large metropolitan areas obscures important variations. We tested more detailed measures of urban structure because there is much to be learned about urban forms, how and why they evolve and how and why they are important. We have taken some small steps in this direction and there is much more can be done.

Table 2: OLS estimation results for employment growth

	Employment growth model			NNBF model			Industrial churn model		
	Beta	t		Beta	t		Beta	t	
Dispersion	0.0002	0.18		-0.0059	-0.37		-0.0180	-1.02	
Polycentric	-0.0003	-1.19		-0.0027	-0.62		-0.0052	-1.07	
Dispersion * log emp.	0.0009	0.77		0.0237	1.07		0.0129	0.52	
Polycentric * log emp.	-0.0001	-0.46		0.0014	0.24		0.0004	0.06	
log employment	0.0177	2.04	**	0.0846	0.52		-0.3824	-2.12	**
log pop. Density	-0.1090	-5.18	***	-0.2521	-0.64		-0.6220	-1.42	
% manufacturing	-0.0050	-3.84	***	-0.0636	-2.61	**	-0.0160	-0.59	
% nonwhite	-0.0012	-1.64		-0.0391	-2.97	***	-0.0137	-0.93	
% immigrants	0.0018	2.03	**	0.0061	0.37		0.0226	1.22	
% pop over 64	-0.0040	-2.32	**	-0.0569	-1.80	*	0.0272	0.77	
% pop college	-0.0022	-2.14	**	0.0227	1.19		0.0149	0.70	
mean Jan. temperature	0.0022	4.03	***	0.0468	4.64	***	0.0444	3.94	***
annual precipitation	-0.0017	-4.20	***	-0.0188	-2.55	**	0.0001	0.02	
violent crime rate	0.0000	-0.12		0.0004	0.78		0.0000	0.06	
Constant	1.0866	6.06	***	3.6008	1.08		6.5702	1.76	*
R sq.	0.697			0.606			0.562		
Adj. R sq.	0.630			0.520			0.467		

2. The number of observations of all models is 79.
3. t at 10%; ** significant at 5%; *** significant at 1%.

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