

Essays in Economic Geography

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Abstract

This dissertation focuses on the geographic nature of entrepreneurial activity, on understanding the location decisions of firms and the economic consequences of these decisions. The first chapter builds a theoretical framework for understanding the location decisions of single entrepreneurs and how geographic forces like market access, supply linkages, and spillovers are both shaped by and determine these choices. The second evaluates the long-run effects of growth on subjective well-being and finds a strong relationship between the two. The third models and describes the geographic patterns behind the expansion of firms.

Category: Entrepreneurship, economic geography, urban economics

Keywords: Geography, international trade, agglomeration, location decisions, multiple-equilibria

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Executive Summary

This dissertation builds a new set of tools to understand the effects of the location decisions of entrepreneurs and firms and explores the effects of entrepreneurial location decisions on the growth and well-being of cities. I find:

- Establishment density acts as a sufficient statistic for the desirability of a location and can predict firm quality.
- Sorting of more productive entrepreneurs explains some but not all of the density-productivity relationship.
- Cities that have low long-run growth rates decrease the subjective well-being of citizens relative to those which have experienced economic growth.
- Firms tend to grow outwards from their initial location in radii.
- Larger, more productive firms tend to cluster less, spreading their operations over larger distances.

In the first chapter, I build a theoretical framework to model the entry of entrepreneurs into locations with geographic linkages in order to understand the effects of entry into a network or ecosystem of firms. This theoretical framework solves a difficult problem arising when location decisions and geographic interconnections interact to make such models intractable. The theoretical framework gives rise to a new set of empirical tools.

I use establishment-level US Census data to show how this framework reveals strong patterns in the data and that ignoring firm-to-firm geographic linkages biases results and reduces our empirical power.

The second paper uses CDC data to show how growth is associated with higher levels of subjective well-being, finding city-level effects that are strongly correlated with long-run growth even when accounting for a large list of individual-level controls.

The third paper explores the poorly-understood patterns of firm expansions and reconciles these patterns with current understanding of urban growth, highlighting two new agglomerative forces: within-firm distance costs and demand cannibalization which may seriously affect the concentration of economic activity across space.

Chapter 1: Describing the location decision

The quantity and quality of economic activity varies dramatically across space. Larger, more productive firms are clustered in larger, denser cities.¹ Economists have sought to explain these consistent patterns by hypothesizing centripetal forces – transportation costs and other pecuniary and non-pecuniary spillovers – that drive both the spatial differences in density and the ubiquitous relationships between firm and location characteristics.² However, spatial models which fully account for these forces by directly modeling geographic linkages do not yield predictions that enable reduced-form tests for the presence of these forces, while models that do so have only been able to do so at the cost of abstracting from most of the geographic pathways in which these forces may be active.

Economic geographers embed these forces in models in which firms and workers choose from a network of interconnected locations. In these models, locations differ based on their proximity to other firms and workers, while that proximity is itself endogenous to the decisions of those agents. Technical limitations arising out of this complex interaction of location choice and geographic linkages – in particular, multiplicity and lack of a closed-form solution – had in the past limited these models to being stylized analogies.³ A recent set of papers have developed methods to structurally estimate these forces in real urban spaces.⁴ These estimates conclude that geographic linkages are important.

¹This stylized fact has been validated in multiple periods and across multiple continents. Ciccone & Hall (1996) were the first to differentiate between density and city size with respect to productivity. Recently work by Maré et al. (2006) and Combes et al. (2010) confirm the relationship using data from New Zealand and France, respectively.

²For an overview of such models in urban economics, see Rosenthal & Strange (2004a, 2001).

³The domain of models earlier “New Economic Geography” work is largely restricted to one dimension. For classic examples see Rossi-Hansberg 2005; Fujita et al. 1999.

⁴See Allen & Arkolakis (2013) and Ahlfelt et al. (2012) for recent examples.

Finding reduced-form evidence for the geographic forces they model continues to only be systematically possible in urban economic models, which, as they generate reduced-form relationships, lend themselves to such testing. However these reduced-form relationships arise in settings with restricted or no geographic linkages between locations.⁵⁶ Tests based in the urban framework have found evidence of productivity spillovers and limited evidence for the importance of market access and firm sorting.⁷ But because urban models abstract from most of the pathways through which these geographic forces may operate, these tests potentially misidentify these forces or their magnitudes.⁸

This paper presents a new solution method for geography models that generates testable, reduced-form predictions despite multiplicity and without closed-form solutions for the general equilibrium. In doing so, it offers a bridge between the recent developments in economic geography and urban economics and uncovers new evidence for the spatial forces described by both fields.

I build a geography model where heterogeneous firms choose locations in a continuous, multi-dimensional space with a broad set of geographic forces affecting those location decisions. I use the firms' location decision to construct an index that ranks locations according to the way these geographic forces affect firm revenues. I then reinterpret all agents' decisions as choices among index values, and show how this delivers a set of predictions

⁵In general, new geography models which can be estimated in arbitrary geographies can only yield analytic solutions when returning to restricted geographies. Allen & Arkolakis (2013), obtain closed-form solutions when applying the model to line segments and the model in the follow-up paper, Allen Arkolakis 2015, equilibrium conditions have analytic expressions on a circle-geography.

⁶The workhouse models of urban economics abstract from spatial networks. In the Rosen-Roback (1979; 1982) inter-city framework, the endogenous and exogenous characteristics of New York – but never its proximity to Boston and Philadelphia – dictate its economic outcomes. In the Alonso-Muth-Mills (1964; 1969; 1967) (AMM) intra-city framework, each location's proximity is modeled as distance to a central business district (CBD), and is always an exogenous characteristic. For a

⁷See Rosenthal & Strange (2004b) for an overview of urban evidence on the sources of spatial agglomeration, and Greenstone et al. (2010) and Ellison et al. (2007) for classic examples of measurements of productivity spillovers and the relative strength of other agglomeration sources including market access, respectively.

⁸Monte et al. (2015) in particular find that estimates of the effects of place-based policies and local productivity shocks are significantly more variable than reduced-form estimates imply, and using local controls significantly bias estimates. They offer a correction based on their structural estimates that accounts for geographic linkages that specifically correct for bias resulting from commuting between U.S. counties.

that relate firm and location characteristics. These reduced-form predictions hold in any equilibrium and therefore characterize the full set of equilibria.

Moreover, the model yields a set of observable sufficient statistics for the unobserved index values: establishment density, employment density, and land prices. Using these variables as a proxy for the underlying geography-based index means that geographic forces can be taken into account without being directly (structurally) estimated; ordering locations according to establishment or employment density reveals the order of index values, which includes the combined value of all geographic forces including access to markets, inputs, and productivity spillovers from nearby firms.

I present two applications of this new strategy for reduced-form spatial empirics. The first application demonstrates the empirical advantage of incorporating geographic linkages to reduced-form work. Accounting for geographic forces using density as a sufficient statistic significantly improves upon traditional urban reduced-form empirics that are based on the monocentric model and provides a method for empirical work in non-monocentric cities. The new method strengthens known empirical relationships and find others which are entirely missed by geography-free urban models. In the second application, I show how this empirical approach can identify the sorting of firms with higher ex-ante productivity into denser locations within cities and differentiate sorting from productivity spillovers. I provides evidence that part of the density-productivity gradients in cities is due to firm sorting.

Section two introduces the model and the solution method. Like the framework of Allen and Arkolakis (2013), the model is defined over a continuous space in R^n with arbitrary geographic linkages which define transport costs and spillover decay rates. This approach allows predictions to be directly tested against geographic data. The model nests the Allen and Arkolakis model, allowing in addition for a wider set of geographic forces including geographically-based spillovers from nearby firms, and allows heterogeneous firms to choose locations. This framework can be considered a Rosen Roback(1979; 1982) model

generalized to include geographic linkages and firm sorting between locations, as well as a bridge between the Rosen Roback model and the Alonso Muth Mills (1964; 1969; 1967) framework.⁹

In the model, a set of entrepreneurs that are differentiated by their productivities, choose locations for the production of differentiated goods that will be sold to all other agents in the space with trade costs. This is a Melitz (2003) framework in which firms and workers choose their locations. Entrepreneurs pay rent to land owners, who decide on the optimal amount of floor space to build. Larger firms attract more workers and, in equilibrium, differences in local productivity and access to markets arise endogenously. More productive firms outbid less productive firms for locations which endogenously become central, and landowners at those locations provide more floor space to more firms.

This setting replicates the city-size productivity relationship in the urban theory literature as a density-productivity relationship, but here the relationship is an endogenous feature rather than assumed, and the geographic approach overturns two key results of that literature: in this setting, which accounts for between and within-city sorting, higher productivity cutoffs need not be observed in larger cities, and sorting and spillovers need not be complements.¹⁰

To solve the model, I first construct the index, which takes account of how the various geographic forces affect revenues at each location. Each firm will be indifferent to two locations with the same index value, as their revenues and variable profit will be identical at the two locations, and all firms, all else equal, prefer locations with higher index values. Likewise, land owners at two locations with the same index value will face the same floor space provision decision. It is therefore possible to express and solve all decisions with

⁹In an appendix section I show how the precise AMM framework can be recovered by assuming specific functional form for trade costs which restrict geographic linkages.

¹⁰These results appear in Combes et al. (2012) and Gaubert (2014) respectively. Productivity cutoffs may be absent in the continuous-space model when large cities contain distance or disadvantageous locations which can only compete for low-productivity firms. In addition, when multiple geographic forces are present, sorting may occur on one dimension and not another. For example, when market access is important, firms may choose higher market access locations over locations with productivity spillovers, creating negative assortative matching between firm productivity and location productivity.

respect to the location index. In effect, this reduces a multi-dimensional problem into an assignment problem.

Because index values take into account the location decisions of all agents, they are endogenous and to solve for a general equilibrium, I must solve for a mapping of locations to index values. Here, in this second step, I encounter the traditional issues associated with geography models: there are multiple potential mappings and the no closed-form solution to the mapping. However, because all firm characteristics and location characteristics can be expressed with respect to the endogenous index before the general equilibrium is solved for, firm and location characteristics can be expressed with respect to each other, and so the first step yields predictions between the two that hold in every equilibrium.

The introduction of an index may resemble the approach of Davis and Dingel (2013), which also makes use of an index variable to solve a system of cities model. Davis and Dingel assign an exogenous amenity (that might be thought of as distance to CBD or something else) to all locations in each city. The amenity interacts with city size. In that they abstract from the problem of networked geography, Davis and Dingel (2013) is firmly within the traditional urban framework. By contrast, here, the index is endogenous and derived specifically in order to take geographic linkages into account and simplify their expression as a point of departure from the urban framework.

Section three shows how the model can be used to derive predictions and how establishment density, employment density, and land prices can be used as sufficient statistics for the unobserved index, and therefore for the full effect of all geographic forces on all other location and firm characteristics.

Section four presents two applications to intra-city empirical work. The model offers density gradients, plots of firm characteristics against location density. Using establishment-level restricted-access census data, I compare the density gradients predicted by the model to the distance gradients predicted by a monocentric model in which firms choose locations based on distance to CBD and firm qualities are predicted by the firm's distance to the CBD.

As opposed to distance gradients, density gradients impose no geographic structure on the city and the predictions of the model apply equally in cities with one center and cities with multiple city centers.

Density gradients are consistently more powerful than distance gradients, and some density gradients cannot be reproduced as distance gradients. From the perspective of the monocentric model, it appears as if manufacturing firms gain no productive advantage and do not sort on proximity. However, the new approach demonstrates that manufacturing firms are responsive to geographic forces. When combined in a horse-race, distance gradients lose explanatory power while density gradients are only marginally affected. These results are consistent with the hypothesis that density is a richer measure of centrality, containing more information and better accounting for the location of economic activity within cities.

The second application uses the ordering of locations within cities to test for the existence of firm sorting. The model predicts that small deviations in the amount of space available to firms in a given location will attract firms that would have otherwise gone to other locations. If firms sort into locations based on ex-ante productivity, then the attracted firms would be the least productive firms from higher-indexed locations as well as the most productive from lower-indexed locations. The model therefore predicts additional floor space in one location affects the productivity of entrants at other locations differentially based on the locations' relative ranks, with higher-ranked tracks experiencing increases in entrant productivity and lower-ranked tracks experiencing entrant productivity decreases. As these changes occur via the changing firm composition at each location, I call these "composition effects". Importantly, these differential effects are incompatible with any model in which there are no ex-ante differences in firm productivity.

Using establishment-level census data as well as census data on the construction of new commercial real estate, I test for and find evidence of the existence of these composition effects. Crucially, the same exercise fails when tracts are ordered according to their

distance to the CBD: the distance metric is too coarse a proxy to pick up on these fine, geographically-based predictions.

I instrument for construction expenditures using data from the Census of Finance and Insurance on the geography of real estate development firms. Because commercial real estate development requires liquid collateral, such firms are exposed to real estate shocks in multiple cities, and price shocks in one city can both affect firm-level collateral and transfer resources away from projects in relatively lower-shocked cities. Both these channels appear to be in effect in the data. Instrumenting for the construction expenditures of a firm in one city using the sales of non-linked firms in linked cities, I find larger composition effects with similar differential signs.

Chapter 2: Growth and Subjective Well-being

The second chapter in this thesis finds persistent differences in self-reported subjective well-being (SWB) across U.S. metropolitan areas and uses historical data to show that cities that are now declining were also unhappy in their more prosperous past. Residents of declining cities appear less happy than other Americans. Newer residents of these cities appear to be as unhappy as longer term residents, and yet some people continue to move to these areas.

Growth, which is associated with entrepreneurial activity, appears positively correlated with city-level SWB while past growth is negatively correlated. While the historical data on happiness are limited, the available facts suggest that cities that are now declining were also unhappy in their more prosperous past.

One interpretation of these facts is that individuals do not aim to maximize self-reported well-being, or happiness, as measured in surveys, and they willingly endure less happiness in exchange for higher incomes or lower housing costs. In this view, subjective well-being is better viewed as one of many arguments of the utility function, rather than the utility function itself, and individuals make trade-offs among competing objectives, including but not limited to happiness.

Chapter 3: The geographic growth of firms and its effects

The third chapter in this thesis considers the spatial location decisions of multi-unit firms and highlights two previously understudied potential agglomeration and dispersion forces: intra-firm distance costs and market cannibalization.

The geographies of multi-unit plants exhibit a series of unique spatial patterns. For example, firms with multiple establishments cluster, but larger, more productive firms tend to cluster less, spreading their operations over larger distances. These patterns and the forces shaping them have a potentially large impact on the distribution of economic activity; the potential for market cannibalization may decrease the density gradient by inducing firms to disperse their plants, while intra-firm management costs of distance have the opposite effect, inducing firms to centralize plants around the firm's center.

However, we lack a theoretical framework that allows us to model and evaluate how the decisions of multi-unit establishments create and respond to these forces in general equilibrium. This paper proposes such a framework by adapting a new trade model of export platforms to a domestic context.

Firms choose locations for multiple plants and products, trading off proximity to markets, suppliers, and local advantages for the cannibalization of sales and profits from other plants and the effects of distance on establishment management. These tradeoffs become complex in a spatial setting, where sales and spillovers are possible between any two locations.

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