Central place theory is a descriptive theory of market area in a spatial context. Its definition, history, and relation to modern microeconomic theory are provided. JEL Classification: R12. Keywords: Market Area, City Hierarchy, Hexagonal Structure, Spatial General Equilibrium Theory, Transport Cost, Increasing Returns to Scale

Central Place Theory

Central place theory is a collection of loosely related, informal, descriptive models of city size, city location, and market area based on the trade-off between increasing returns to scale in production and the cost of transport of goods from firm to home. Land markets are often absent. At its core, central place theory is an empirically motivated description of production in Southern Germany. It is a remarkable empirical regularity in search of a formal theory; a better name would be "central place regularity."

The beginnings of the theory are attributed to Christaller (1933) who first made detailed observations of urban hierarchies and then attempted to model them. The basic ideas put forward are that consumer population is distributed uniformly, while firms locate in cities. Cities form a hierarchy, in that cities higher in the hierarchy produce all the goods that cities one level lower in the hierarchy produce, and one more. The ratio of market areas of a commodity produced only at a given level of the hierarchy (and above) to the market area of a commodity produced at the next lower level of the hierarchy (and above) is assumed to be constant, independent of the level in the hierarchy considered. Thus, the cities in a given area form a hierarchy where the size of a city's market area and the variety of commodities it offers are perfectly correlated. In graphical terms, the result is a collection of hierarchically ordered cities with the market areas of cities not at the same level of the hierarchy overlapping, but market areas of cities at the same level disjoint. Commodities characterized by low transport cost but high returns to scale are provided by few cities high in the hierarchy. Commodities characterized by high transport cost but low returns to scale are provided by most cities.

Lösch (1944) expanded on this theory. He postulated a homogeneous agricultural plane with farmers. Some turn to beer production, and face linear, downward sloping demand curves with choke prices. For a given price at the brewery, total delivered price increases with distance from the plant due to transport cost. In the plane with a uniform distribution of inebriated consumers or farmers, demand for a firm's beer is given by the volume of a cone centered at the brewery with height given by the brewery's mill price and the

slope of its sides determined by the demand curve and the cost of beer transport. With a marginal cost curve, equilibrium can be found. Unfortunately, the collection of bases of cones, namely disks, do not partition the plane. So hexagons are used, forming a Teutonic triangulation of hierarchical hexagons. In this theory, the central places are the breweries.[1]

One can view the theory as producing a complex of overlapping, ordered layers of hexagonal partitions of the plane corresponding to the market areas of cities in a hierarchy. Agriculture is the basis for and genesis of this structure.

The theory has developed beyond these basic descriptive models; see McCann (2001, chapter 2.7) for a nice summary and cites. Hartwick (2004) is the culmination of a line of research more in accord with optimizing behavior, pricing, and trade theory that also relates the models to the rank-size rule.

The reader should be cautious in interpreting this entire literature because equilibrium and efficiency are often confused, while the models tend to be mechanistic in nature as opposed to allowing agents to optimize in equilibrium. To the general economist, the theory will appear to be informal and imprecise.

Paul Krugman (1995, pp. 38-41) criticizes central place theory, or "Germanic geometry," for its lack of formal foundations, particularly regarding market structure and firm behavior.[2]

Even if one is willing to overlook these defects, there is one further important flaw. Central place theory generally runs afoul of Starrett's Spatial Impossibility Theorem; see Starrett (1978), Fujita (1986), and Fujita and Thisse (2002, chapter 2.3) for discussion. In essence, the Impossibility Theorem says that in a closed economy with perfect and complete markets at all locations, location independent utility and production functions, and no relocation cost, there is no competitive equilibrium where commodities are transported. Thus, if the assumptions are satisfied, either there is no equilibrium, or in equilibrium agents and commodities are distributed uniformly and locations are autarkic. Central place theory apparently makes these assumptions, though due to its imprecision, perhaps it doesn't. Naturally, although the literature considers consumer migration at times, the assumption of a uniform distribution of consumers could render the theorem inapplicable. I conjecture that it simply makes the existence of an (autarkic) equilibrium more likely. But this is probably not worth pursuing, as location models that fix consumer locations in a uniform distribution can only generate cities without people.

[1] St. Louis is a prime example.

[2] He is also credited with the first alliteration in this literature.

So where does this leave us? The modern theory of agglomeration, and thus the modern theory of central places, begins with the Impossibility Theorem. Its contrapositive tells us that to generate models with non-trivial agglomeration at equilibrium, at least one of the hypotheses must be violated. Even then, equilibrium might not exist, or in equilibrium cities could collapse to a point or have agents spread uniformly. Models of non-trivial cities involve a very delicate balancing act between forces pulling agents together and forces pushing them apart. The New Economic Geography has provided one of several possible types of models capable of producing cities and even hierarchies of cities. Fujita and Mori (1997) and Fujita, Krugman and Mori (1999) generate a form of central place theory in a general equilibrium framework by employing imperfect competition and increasing returns at the firm level. Unfortunately, this type of model has many defects, as detailed in Berliant (2005), including a reliance on specific functional forms and indeterminacy: one equilibrium is selected from a continuum.

Central place theory is not grounded in the analytical tools of modern economics, so it does not have firm foundations. Thus, it is difficult to build on central place theory, either theoretically or empirically.

In my view, the future of central place theory is as a stylized fact to be explained by our models, much like the rank-size rule.

Marcus Berliant

References

[1] Berliant, M. 2005. Well isn't that spatial?! Handbook of Regional and Urban Economics: A view from economic theory. Forthcoming in the Journal of Economic Geography.

[2] Christaller, W. 1933. Die Zentralen Orte in Süddeutschland. Jena: Fischer. Translated by C.W. Baskin. 1966. Central Places in Southern Germany. Englewood Cliffs: Prentice-Hall.

[3] Fujita, M. 1986. Urban land use theory, in Location Theory. Edited by J. Lesourne and H. Sonnenschein. New York: Harwood Academic Publishers.

[4] Fujita, M., Krugman, P. and Mori, T. 1999. On the evolution of hierarchical urban systems. European Economic Review 43, 209-251.

[5] Fujita, M. and Mori, T. 1997. Structural stability and evolution of urban systems. Regional Science and Urban Economics 27, 399-442.

[6] Fujita, M. and Thisse, J.-F. 2002. Economics of Agglomeration. Cambridge: Cambridge University Press.

[7] Hartwick, J.M. 2004. Trade in a Hierarchical System of Cities. Mimeo.

[8] Krugman, P. 1995. Development, Geography, and Economic Theory. Cambridge: MIT Press.

[9] Lösch, A. 1944. Die Raumliche Ordnung der Wirtschaft. Jena: Fischer. Translated by W.H. Woglom. 1954. The Economics of Location. New Haven: Yale University Press.

[10] McCann, P. 2001. Urban and Regional Economics. Oxford: Oxford University Press.

[11] Starrett, D. 1978. Market allocations of location choice in a model with free mobility. Journal of Economic Theory 17, 21-37.