Roads and Economy: Location Theory, Cost-Benefit Analysis, New Economic Geography, Market Access and Graphs

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Abstract

This paper examines the relevant literatures regarding roads and the economy. This is an early draft which will cover: early economic thinkers on the subject like Cantillon, Condillac and Steuart, Adam Smith, von Thunan, Marshall, Weber, Hotelling, Losch, Alonso, Hoover, Ohlin, Sathail, Moore and Tesch; the cost-benefit approach and how roads are valued; the production function approach; empirical strategies; modern urban economics including Fujita and Baum-Snow; the new economic geography including Krugman, Fujita, Venables, Redding and Turner; the market access literature including gravity trade models and modern GIS data implementation; as well as the representation of roads using graph theory.

Keywords: transportation, new economic geography, market access

JEL Codes: would go here

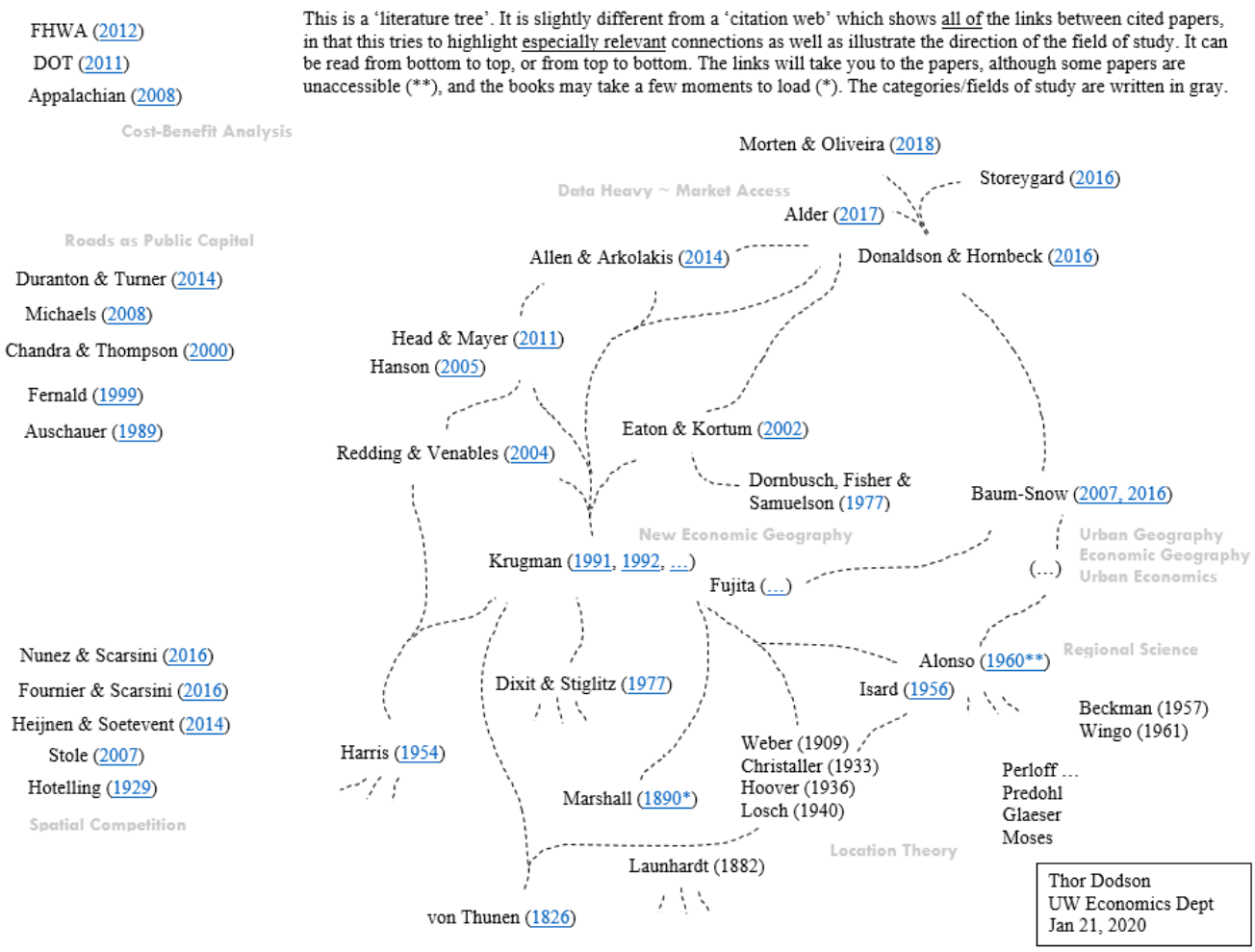

Figure 1: A Bid-Rent Curve

1 Introduction

A number of papers and literatures have considered the effect of roads on the economy. Without oversimplifying too much, they may be grouped together as: location theory, regional science, new economic geography, spatial competition, and public capital.

Location theory has its roots in von Thunen's (1826) theories on land use and industrial agglomeration*[footnote Fujita], as well as contributions from a broad suite of thinkers such as Launhardt (1882), Weber (1909), Christaller (1933), Hoover (1936), and Lösch (1940). From this strand emerged ideas on how cities' economic activities are spatially distributed and factors influencing agglomeration and dispersion. The primary agglomeration forces summarized by Marshall (1890) are (i) linkages, (ii) thick markets, (iii) knowledge spillovers.

From location theory emerged the interdisciplinary regional science, in large part due to

the efforts of Walter Isard (1956). This literature extended the ideas from location theory while incorporating insights from social science and especially economics. Prominent contributions include Alonso's (1960) work on bid-rent theory as well as works by Beckman (1957) and Wingo (1961).

Regional science has many branches and specialized studies, including urban geography*, economic geography, urban economics, and related fields that have overlapping focus and techniques. While the questions these fields consider are diverse, roads are often a significant factor as in Baum-Snow (2007, et al 2016).

While the key ideas about agglomeration existed for more than 150 years, it wasn't until Krugman (1991) and Fujita (1989, ...) that they enter the economics mainstream. Their work started the so-called 'new economic geography', a literature studying the effects of space and particularly transportation costs on economic agglomeration and performance. Fujita's early work has a slightly different approach that is more in line with regional science, but since Krugman (1991) the new economic geography models typically involve Dixit-Stiglitz monopolistic competition and iceberg trading costs. The specification combines the love of variety, economies of scale, and costly transportation to create a tractable setting where agglomeration can occur, primarily due to the "forward and backward linkages" associated with large local markets (Fujita and Krugman, 2004). This literature entails varying factors of production and degrees of mobility, but as quippingly put in Fujita et al (1999) the core modeling tricks remain "Dixit-Stiglitz, Icebergs, Evolution, and the Computer".

The new economic geography literature has become quite rich, including papers by Redding and Venables (2004), Hanson (2005), Head and Mayer (2011). Of special note is Eaton and Kortum (2002), who utilize a similar framework but with the addition of exogenous differences in regional productivity (similar to Dornbusch et al, 1977). This doesn't change the key outcome of the Krugman models, while adding an additional force for agglomeration from comparative advantage and specialization [**think more about the changes that results from this specification]. Crucially, both models are able to derive a market access term*[footnote Krugman (1992)]. This notion of accessibility based on market size and distance was explicitly described first by Harris (1954) as 'market potential', and the equivalent 'market access' has become a key term since the 90's. Market access depends on a region's competitiveness and desirability in relation to every other region, simultaneously capturing the proximity effects of suppliers and buyers. Recently, work is being done utilizing GIS and pathing algorithms to gather data on how market access changes after transportation infrastructure is developed, which is used to explore the economic impacts. Relevant papers include Allen and Arkolakis (2014), Donaldson and Hornbeck (2016), Alder (2017), Storeygard (2016), Morten and Oliveira (2018) [include?]. Ideologically, the market access models

are similar to gravity trade equations. [*need to look into the gravity literature]

Although this paper focuses on the market access approach, it is worthwhile to mention the related strand of literature viewing roads as public capital. Beginning with Auschauer (1989), a significant volume of research viewed roads and other forms of public infrastructure as an input to a Cobb-Douglas production function along with labor and capital. This facilitated a log linear regression to estimate the marginal benefit of roads as an investment. Notable papers include Fernald (1999), Chandra Thompson (2000), Michaels (2008), Duranton and Turner (2014)*[also include a distance measure], and Pereira (1999). Typically, the measure representing the road system is total lane miles or spending, both of which do not shed light on where to build the roads, which is what inspired the data generated for this paper.

Another strand of literature that naturally applies itself to roads is cost-benefit analysis. As outlined by FHWA and DOT, typically best practice involves calculating the benefits stemming from three sources 1) the value of time savings, 2) the reduction in cost of operations, and 3) improvements in safety. This literature is careful to distinguish economic impacts from benefits on the basis of what can clearly and distinctly be calculated, without dismissing important concepts such as market access (as seen in Appalachian (2008)).