Impacts of transit and walking amenities on robust local knowledge economy

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ABSTRACT

As of 2013, knowledge economy has held more than 10% of U.S. employment, generated nearly 20% of national GDP and expect to increase to 25% during the next 20 years. Likewise, Eurostat 2020 aims to increase investment in Knowledge Intensive Business Services (KIBS) to bypass the competitors, Japan and the U.S. As the result, investigating the determinants of robust knowledge economy is a continuing concern between city scholars, planners and leaders. To date, several locational and non-locational factors have been found to be influential. For instance, transit service, walkable street networks and dense neighborhoods that provide walkable access to urban amenities are the location preferences for the creative class. Creative class, in turn, attracts KIBS, and produces innovation which are all contributive to the knowldge-based economic vitality. While such trend is widely supported by the theoretical efforts, there is little empirical evidence on these complex multidimensional relationships and hence this study seeks to investigate both direct and indirect impacts of transit and walking amenities on the robust local knowledge economy. Using Structural Equation Modeling (SEM), we developed a comprehensive model that accounts for KIBS, creative economy and innovation productivity and investigates their locational and non-locational determinants with the particular focus on walking and transit amenities. Our results generally echo the findings of previous studies about the key role of industry clustering, place quality amenities, diversity and tolerance on the three drivers of robust local knowledge economy. We found that among all exogenous variables racial diversity and industry clustering have the most significant direct effect on innovation productivity. We also found that transit service quality and walkability contribute to a robust local knowledge economy through KIBS and creative class, but they have an adverse relationship to the innovation production of the STEM small firms. This might be due to the fact that walkability and transit access increase the property values and, therefore, make them unaffordable for small innovative firms. Our findings on the impacts of walkability and transit access on innovation productivity in vulnerable small firms call for attention to the equity aspects of innovation-supportive urban developments.

1. Introduction

Knowledge Intensive Business Services (KIBS) contribution to the U.S. Gross Domestic Product (GDP) is above-average productivity. As of 2013, KIBS employed almost 10% of the U.S. employment and generated nearly 20% of national GDP which will increase to nearly 25% during the next two decades (Muro, Rothwell, Andes, Fikri, & Kulkarni, 2015). KIBS share in European Union (EU) labor force has also increased and Research and Development (R&D) alone held over 1.2% of 2015 EU labor force (Europe 2020 indicators - R&D and innovation, 2010). Eurostat 2020 goal is to increase investment in KIBS to 3% of their GDP in order to bypass their competitors, Japan and the U.S. (Uppenberg, 2010). KIBS and creative enterprises also facilitate innovative activities in other sectors through which they let their

significance go far beyond themselves (Bakhshi, McVittie, & Simmie, 2008; Cooke & Leydesdorff, 2006).

A considerable amount of literature on the determinants of robust local *(neighborhood-level)* knowledge economy point out to non-locational factors including racial diversity, sexual diversity and share of bohemian residents which establish the social trust for further face-to-face contacts and attract creative class (Bereitschaft & Cammack, 2015a, 2015b; Florida, 2002a; Knudsen, Florida, Stolarick, & Gates, 2008; Rao & Dai, 2017). Share of educated population also is an indicator of access to skilled labor force which attracts KIBS and boosts the innovation productivity (Joseph, Mullen, & Spake, 2012; Müller, Rammer, & Trüby, 2009; Shearmur, 2010, 2012) and so do the university and private R&D expenditures (Acs, Audretsch, & Feldman, 1994; Black, 2005; Crescenzi, Rodriguez-Pose, & Storper, 2007;

Furman, Porter, & Stern, 2002).

In addition, previous studies shed light on several locational determinants of innovation such as spatial clustering which attracts KIBS through agglomeration externalities (Audretsch & Feldman, 2004; Wallsten, 2001), proximity to Central Business Districts (CBDs) (Shearmur, 2010) and place quality amenities which attract creative class, talents and KIBS, and thus, boost innovation productivity (Florida, 2014; Shearmur, 2010). Furthermore, density and land-use diversity found to enhance the face-to-face contacts and embed an urban buzz which leads to increase of innovation productivity (Storper & Venables, 2004; Wood & Dovey, 2015).

In addition to these factors and according to the theoretical frameworks such as agglomeration theory and the theory of amenity richness, transportation infrastructure (more specifically walking and public transit) could contribute to a robust local knowledge economy. Theory of amenity richness emphasizes on the role of transit and walking amenities as the place quality preferences of the skillful millennials responding to their car-free life style, strong desire for urban social life and living in mixed-use and compact urban areas (Shearmur, 2012). The agglomeration theory discusses the role of transportation infrastructure in expanding access to the suppliers as well as widening firms' customer and labor market areas (Van der Panne, 2004).

The key question with regard to these theories is whether the mechanism to which transportation infrastructure could affect innovation is similar for creative industries versus knowledge industries? How does it compare to other locational and non-locations drivers of innovation? While several studies have stated these relationships theoretically (Boschma, 2005; Cooke, 2001; Furman et al., 2002), there is little empirical evidence into such mechanism of impacts.

To fill this gap in the literature, this research seeks to find whether and to what extent transit and walking amenities impact knowledge industries, creative enterprises and innovation productivity. By using Structural Equation Modeling (SEM), this study controls for both direct and indirect impacts of transit and walking amenities on these three drivers of the knowledge-based economic vitality. We hypothesize two mediating (intermediate) variables, KIBS and creative firms, between transit, walking and innovation productivity and report direct, indirect and total effects.

Using ESRI Business Data Source (EBDS) and Small Business Innovation Database (SBIDB), this study is one of the first attempts at the national level to combine disaggregated address-level datasets on the location of knowledge-based and creative firms in tendam with innovations in the U.S. Moreover, our empirical analysis controls for other locational and non-locational factors that are theorized in the literature to be the key determinants of robust knowledge economy at the neighborhood level. We draw upon an international literature in order to echo or provide updates for the previous theoretical predictions. Several locational and non-location drivers of innovation, supported by these theories, are observed to be significant in the US, Australia, Beijing, Austria, Norway as well as other counties (Knudsen et al., 2008; Müller et al., 2009; Rao & Dai, 2017; Wood & Dovey, 2015). Observation of such mutual findings in different countries would suggest that since there is little understanding on the impacts of transit and walking amenities on the three aforementioned drivers robust knowledge economy internationally, the U.S. experience may be generalizable.

2. Literature review

2.1. Creative industries, KIBS, and innovation productivity

This research focuses on the impacts of transportation infrastructure on the three factors of knowledge-based economic vitality including KIBS, creative industries and innovation productivity while controlling for the inter-relationships between them. This section reviews the existing literature about the definition of KIBS, creative industries and

innovation productivity as well as their interactions.

2.2. Creative industries

Since the creative industries contribute to the today's economic growth, the main question revolves around those belonging to this category. To answer this, scholars have addressed the nature of occupations.

Florida (2002a) classifies the creative occupations in two ways: the "super-creative core" and the "creative professionals". The "super-creative core" directly generates new products and ideas while "creative professionals" apply knowledge to solve problems. Florida's "super-creative core" includes the industry categories defined by the U.S. government and "creative professionals" are working in management operations and consultations (Florida, 2002a). Situating Florida's creative occupations as the common agenda has been debatable in the literature. For instance, Rausch and Negrey (2006) raise two major points regarding Florida's creative industries. First, this determination is not inclusive enough, and second, this classification is not homogenous enough to independently dominate the economic performance (Rausch & Negrey, 2006).

Addressing these shortcomings, Markusen, Wassall, DeNatale, and Cohen (2008) introduced the cultural occupations representing the creative industries. Cultural industries are those establishments—for profit, nonprofit, and public—that develop cultural goods and social services. The cultural occupation classification excludes Science, Technology, Engineering, and Mathematics (STEM). Markusen et al. (2008) prioritize these rubrics for their sector selection over the U.S. governmental definition used by Florida (2002a). The U.S. governmental definition is largely based on educational attainment and credentials resulting in the exclusion of all creative workers without degrees (Markusen et al., 2008).

2.3. KIBS

The other category of businesses that contributes to the local and regional knowledge-based economic vitality is KIBS. KIBS have been attracting the attention of academics and policy makers due to their fast and consistent growth since 1970 (Shearmur, 2012). KIBS are characterized by their deep investment and reliance on technology R&D and STEM workers. KIBS are classified into two groups including the technology-based services (T-KIBS) (IT related services, engineering, and R &D consulting firms) and the management-related or professional services (M-KIBS/P-KIBS) (business consultancy, advertising, marketing, and media).

A national assessment of advanced industries prepared by Brookings Institution introduces KIBS sectors which correspond to the determinations in the U.S and non-U.S. prominent studies (Shearmur, 2010). Brookings' criteria for identifying the U.S. KIBS are geared mostly toward STEM and high-tech R&D activities. We adopted Brookings' criteria in our study which are as follows:

1. The R&D expenditure per worker must be in the 80th percentile of industries or higher and exceed $450 per worker.
2. KIBS occupations require a high degree of STEM knowledge which should be above the national average, or 21% of all workers.

Applying these criteria, Brookings identified 50 industries in developing, diffusing, and applying new productivity-enhancing technologies as KIBS occupations (Muro et al., 2015).

Having defined creative industries and KIBS, the major question is how they contribute to the innovation productivity. According to an empirical study from the UK, industries that trade more with creative occupations perform stronger on various innovation measures (Bakhshi et al., 2008) while it depends on the type of creative occupation. For instance, Austrian ICT industries show significantly more support for