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How important are local inventive milieus: The role of birthplace, high school and university education [☆]

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ABSTRACT

Using data on the entire population in combination with data on almost all individuals in Sweden listed as inventors, we study how the probability of being listed on a patent as inventor is influenced by the density of other *future* inventors residing in the same region. In this process, we control for demographic and sector effects along with the educational characteristics of parents. This approach allows us to trace how location history influences individuals' inventive capacity. We focus on three types of influences: (a) future inventors in the municipality around the time of birth, (b) future inventors around the time of graduation from high school and (c) future inventors at graduation from higher education. We find suggestive evidence that co-locating with future inventors may impact the probability of becoming an inventor. The most consistent effect is found for place of higher education; some positive effects are also evident from birthplace, whereas no consistent positive effect can be derived from individuals' high school location. Therefore, the formative influences mainly deriving from family upbringing, birth region and from local milieu effects arising from a conscious choice to attend a higher education affect the choice of becoming an inventor.

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Introduction

To what extent do local milieus influence individuals' abilities to become an inventor? Marshall (1920) famously observed that closely related industries tended to locate in the same district, and he noted several advantages as being critical to their success. One advantage was that knowledge was as if in the 'air'. The question raised in this paper is whether different 'airs' or socio-cultural relations are 'contagious' in the sense that they have a positive impact on an individual's probability of becoming an inventor. We study this by measuring the volume and density of co-located inventors at various stages and estimate whether such socio-cultural imprints are lasting. Moreover, we investigate their relative strength during upbringing and later on through education.

Existing literature on the role of place for inventive activity looks mainly at regional characteristics at the time when the creative act takes place, leaving the background of individuals largely unaccounted for. Even when historical perspectives are brought into

the analysis, the region usually receives attention as opposed to the individuals' backgrounds, i.e. if they migrated from one location to another along with other information on background. Hence, rather than writing another 'history of locations of inventive ideas' in this study, we examine 'the location history of inventors' and focus on an individual's probability of becoming an inventor by studying the eventual impact from the level and density of other nearby future inventors over time. We use the entire population born in 1955–1977 which can be observed in 2007 and study how the probability of being listed on a patent as inventor is influenced by the density of other future inventors residing in the same region. We focus on three such densities: (a) future inventors in the municipality around the time of birth, (b) future inventors around the time of graduation from high school and (c) future inventors at graduation from higher education. We have two objectives. First, we want to get a qualitative understanding of whether certain birth and educational milieus matter more as experiences are accumulated over time. Second, we want to estimate whether exposure to other inventors has a relative impact on the probability of individuals becoming inventors. For this purpose, we employ probit regressions to estimate the extent to which each density impacts on the probability of becoming an inventor.

Our main finding is that a local milieu with a high density of future inventors at an individual's birthplace or at the place of

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higher education indeed has a significant positive effect on the probability that this individual becomes an inventor. However, effects from high school are less consistent with such an interpretation. This suggests that the local inventive milieu within a birth region and/or during higher education is the most promising candidates for future study of the relation between geography and inventiveness.

The paper is structured as follows. In Section 'Literature review', we review the literature examining the location of inventive and innovative activity. In Section 'Data and research design', we describe the data and method used to examine the inventors and describe the distribution of future inventors found at different locations. In Section 'Empirical analysis', a descriptive analysis of the distribution of future inventors is made followed by a regression model investigating the effects of birthplace, high school and university on future inventors. Section 'Interpretation of findings and conclusions' concludes.

Literature review

An abundant selection of literature examines the location of activities related to knowledge creation at the time of its occurrence. Economic geographers and other scholars with interest in regional studies have a long tradition of explaining innovative activity and regional economic development partly as an outcome of socio-cultural variables. The learning region debate in the 1990s (Asheim, 1996; Maskell and Malmberg, 1999; Morgan, 1997) stresses this relation by arguing that on the local level, embedded institutions and both strong as well as weak relations between economic actors can shape a strong innovative environment. Such environments can turn out to be stable over time and provide long periods with continuously innovative activities that help regions stay competitive. These regions can be based on high-tech and research, e.g. Silicon Valley and Grenoble region, or more low-tech production like furniture production in northern Jutland in Denmark. Compared to the local institutional setup the level of technological input is not necessarily decisive in explaining whether an environment turns out to be an innovative and competitive milieu. However, the local institutional setup does not do the job alone; global 'pipelines' are also essential to access and exchange knowledge generated in the greater surroundings (Bathelt et al., 2004).

Shefer and Frenkel (1998) state that innovative milieus should be defined by the rate of innovation in a specific locality in combination with the degree of socio-economic interaction among firms closely located. This is basically what this paper aims to sketch out using register based data on an individual level: The probability of becoming an inventor if you are brought up or educated in a specific milieu.

The innovative milieu concept partly has its origin in the GREMI (the European Research Group into Innovative Milieus) research program, which was underpinned by analyses of factors that made some regions or locations more dynamic than others with respect to innovation. According to Crevoisier (2004), innovative milieus are "a synthetic analytical tool for analysing and understanding current economic change" (p. 369) and consist of three important axes: technological dynamics, change in territories and organisational change. The argument put forward by Crevoisier (2004) is that over time, a milieu stays innovative by "mobilizing the resources constituted by the past that are then adapted to new techniques and markets and are incorporated within new products" (p. 373). Accordingly, to understand innovation, and thus also inventiveness, time and space relations become essential. Also, time-space geography takes into account that creative people, at least partly, are formed by their experiences in the past, and this opens for an attempt to analyse the relation between the past

and the present. According to Törnqvist (2011), a majority of Nobel Prize winners in economics and physics have attended Princeton University, Harvard University and University of Chicago at some point in their careers either as students, visiting researcher or in more permanent positions. Based hereon, Törnqvist argues that some places – or milieus provide more creative or stimulating settings than others. This is an excellent example of the hypothesis that some institutions and organisations that materialise in place have a more dominant role in generating knowledge, creative thinking, etc., compared to others. This view on connecting time, space and human activity demonstrates that prior experiences may give valuable insights to understanding individuals' present creativity. Thus, in the light of the theoretical and empirical work developed within time-space geography, we argue that milieus such as place of birth (childhood), high schools and universities may provide valuable insights to explaining creative and thus inventive behaviour of individual human beings.

Other literature examines to what extent innovation is concentrated in certain regions and to what extent research and development (R&D) as well as education facilities can be linked to inventive outcomes, such as patents (Ejermo and Gräsjö, 2011; Jaffe, 1989). This literature invariably finds that, irrespective of which traditional innovation indicator is used (Acs et al., 2002), innovative activity is geographically concentrated, even after controlling for population size (Ejermo, 2009). Supplementary literature has examined whether knowledge spillovers, typically using patent citations as a proxy, are bounded by geographical space. Jaffe et al. (1993) found strong evidence for geographical boundedness while later contributions moderated the spillover interpretation but improved the understanding of what mechanisms could explain these patterns. These studies focused on labour mobility (Almeida and Kogut, 1999; Møen, 2005; Zucker et al., 1998) and social networks (Singh, 2005). The social networks literature suggests that geography matters for spillovers when inventors are not bound together by prior social links (Agrawal et al., 2006). However, to some extent social networks can also substitute geographical interaction and thus become important for the distribution of knowledge.

This is also one of the major points stressed by Saxenian's (1994) famous study on the IT industry. She argues that some of the more successful examples of knowledge circulation across regions can be linked to the mobility of creative, innovative and entrepreneurial individuals and are largely dependent on the social relations in which these individuals engage. This suggests that entrepreneurial or inventive behaviour may be a part of the socio-cultural setting that is inherited through the experiences obtained in one region and then transferred through individual mobility to other regions.

Entrepreneurship studies address the location of creative acts through the study of new firms. This literature highlights other aspects than those obtained by innovation indicators. While new firms are undoubtedly concentrated, similar to innovations, they are not always found in urban centres. For instance, based on studies from the small Gnosjö region, Sweden, Johannisson (1986) argues that some regions have a socio-cultural milieu that facilitates entrepreneurship in a way not found in surrounding regions. This demonstrates that the contextual setting of a place can be of great importance for the regions' ability to prosper and also for how individuals act. By the same token, Vogelius and Sørensen (1987) study uneven geographies of entrepreneurship and labour culture in Denmark, revealing that areas dominated by large enterprises tend to develop a worker-based culture that lacks entrepreneurial spirit. In contrast regions based on small firms and agriculture tend to have a larger proportion of people willing to engage in entrepreneurial activities such as own start-ups.

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