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Bringing space into the equation: Modelling the social and spatial interdependence of neighborhood effects on educational outcomes

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ABSTRACT

While there is an ever-growing body of research on neighborhood effects on various forms of life chances, the suggested social mechanisms still refer to rather ambiguous theoretical concepts. Furthermore, previous research seldom adequately models the suggested social interdependence at the individual level. Instead, researchers largely rely on contextual regression models. This paper addresses both problems by using spatial econometrics to reconstruct neighborhood effects in terms of interdependent social action. To this end, a rational action model of neighborhood effects on educational outcomes is elaborated as a theoretical alternative. Furthermore, using data on the transition to secondary school in Switzerland as an illustration, spatial probit models are estimated to directly test neighborhood effects at the individual level. It can be shown how the interdependence of parental educational motivation within neighborhoods crucially shapes students' transition to the more advantageous school track, thereby revealing an additional path by which educational inequalities are reproduced.

1. Introduction

While an ever increasing body of research suggests that individual life chances in general (e.g., Morenoff, Sampson, & Raudenbush, 2001; Oakes, Andrade, Biyoow, & Cowan, 2015) and educational attainment in particular are crucially shaped by the contexts in which people live (e.g., their neighborhood, city or region: Ainsworth, 2002; Brännström, 2008; Crane, 1991; Garner & Raudenbush, 1991), the social mechanisms explaining such contextual and compositional effects are usually formulated rather vaguely. Instead, researchers often refer to broad theoretical concepts such as collective socialization or the epidemic spread of norms (Galster, 2012; Sampson, Morenoff, & Gannon-Rowley, 2002). Furthermore, the identification of neighborhood effects is impeded by several methodological challenges. These include the proper assessment of the scale of "neighborhood", the separation from other contextual influences (e.g., school effects), unobserved selection processes, or the identification of endogenous effects (Durlauf, 2004; Lupton & Kneale, 2012; Manski, 1993; Oakes, 2004; Sykes & Musterd, 2011). Although researchers are increasingly aware of these issues, another aspect has largely been neglected. While most theoretical approaches to neighborhood effects imply a certain social and spatial interdependence of observational units, the methods used to test these models largely rely on the assumption of independent observations and fail to incorporate any spillover from one unit to another (LeSage & Pace, 2009). Thus, apart from the necessity of elaborating the mediating social mechanisms of neighborhood effects in more detail (Sharkey & Faber, 2014; Wodtke, Elwert, & Harding, 2016), we need to endeavor to match the theoretical and the empirical framework.

The aim of the present contribution is to address both the theoretical as well as the methodological problems. On the one hand, a theoretical model based on interdependent social action is elaborated as a theoretical alternative. To this end, the well-established educational decision-making framework (Boudon, 1974; Breen & Goldthorpe, 1997; Erikson & Jonsson, 1996) is extended by introducing social and spatial dependence among rational actors and their subjective expectations of the costs and benefits of the different alternatives. It is then evaluated to what extent introducing space into the original Breen-Goldthorpe model offers an explanation for the documented neighborhood effects on educational outcomes. This approach enables the direct testing of a particular mechanism through which neighborhoods can be expected to influence educational attainment.

On the other hand, an alternative empirical framework to assess the proposed neighborhood effect at the individual level is introduced. In this regard, the social interdependence of people's actions in a given context, such as the neighborhood in which they live, requires a methodological framework that abandons the assumption of identical and independently distributed observations (Cressie, 2015; LeSage & Pace, 2009). To this end, spatial econometric techniques are used to reconstruct the mutual dependence of people and their choices within the neighborhood context. By doing so, it can be shown how educational decisions and careers are not only the result of individual reasoning but also the choices and actions of others within the

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neighborhood. More generally, the theoretical and notably the methodological frameworks represent a toolkit for a better understanding and modeling of contextual effects and aligned decision making in social research. Finally, understanding the effects of intertwined educational choices in different contexts also bears potential with regard to formulating more adequate policies for reducing educational inequalities (Galster, 2002, 2012; Lupton & Kintrea, 2011). Making use of the multiplying effects of social interdependencies and taking context into account, such policies can promote educational equality beyond the effect of programs that target single individuals.

The remainder of this paper is organized as follows. In the next section, existing research on neighborhood effects is briefly summarized. In the third section, an alternative model of spatial and social interdependence in educational decision making is elaborated. Additional information about the Swiss education system is provided in the fourth section. The data and the methodology are introduced in the fifth section, while the sixth section presents the results. The last section concludes with a critical discussion of the presented evidence and its relevance for explaining persistent social inequalities in education. Furthermore, it discusses the potential value of the presented methodological strategy for sociological research in general.

2. Neighborhood effects on educational outcomes: assessing the evidence

Building on Wilson's (1987) seminal work of the epidemic spread of norms and behavior in areas of concentrated poverty, scholars have reported negative effects of deprived neighborhoods on various types of educational outcomes in children (e.g., Andersson & Malmberg, 2015; Crane, 1991; Garner & Raudenbush, 1991; Harding, 2003; Leventhal & Brooks-Gunn, 2000). Moreover, research concerned with the theory of collective socialization, focusing on the influence of local social networks, peers, and high status neighbors as role models, has found positive impacts of advantaged neighborhood environments on children's and adolescents' educational achievement and attainment (Ainsworth, 2002; Andersson & Subramanian, 2006; Brännström, 2008; Goux & Maurin, 2007; Kauppinen, 2007; Rosenbaum, 1995; Wodtke et al., 2016). However, the suggested mechanisms (i.e., the epidemic spread of norms or forms of social learning from others within the neighborhood) are usually assessed indirectly using aggregated measures, such as the share of high or low-income residents within the neighborhood.

Furthermore, results differ greatly by the methodological frameworks used and are dependent on the wider (urban and national) context. While studies using (quasi-)experimental data usually find weak effects, or even no effects (e.g., Kling, Liebman, & Katz, 2007; Ludwig et al., 2008; Rosenbaum, 1995), research using survey data reports persistent and sometimes strong evidence for neighborhood effects on educational outcomes (e.g., Ainsworth, 2002; Goux & Maurin, 2007; Leventhal & Brooks-Gunn, 2000; Sharkey & Faber, 2014). Although this discrepancy partly reflects the difficulties of conducting large scale, long-term social experiments (Clampet-Lundquist & Massey, 2008; Sampson, 2008), it especially demonstrates the methodological problems faced when researching contextual and compositional effects (Durlauf, 2004; Manski, 1993). However, given that levels of segregation and welfare policies differ considerably between countries and namely between Europe and United States (Musterd, 2005), neighborhood effects are often less pronounced or even absent in the European context (Andersson & Malmberg, 2015; Kauppinen, 2008; Zangger, 2015).

Similarly, existing evidence also shows that the effects of neighborhoods on educational outcomes are heterogeneous across individual social background, gender, and developmental period (e.g., Andersson & Malmberg, 2015; Chetty, Hendren, & Katz, 2016; Sharkey & Faber, 2014; Wodtke et al., 2016; Zangger, 2015). Thus, the exposure to a common neighborhood can be associated with distinct outcomes for different social groups. In the following, we will therefore take a closer look at how such neighborhood effects in the particular case of educational attainment might be explained in terms of individual choices and the interaction with others.

3. From the ground up: putting individual decision making into context

Although neighborhood effects do make a difference for children's educational attainment, they have often been neglected in explanations for persistent inequality in education. Instead, scholars have proposed different theoretical frameworks for explaining educational inequalities spanning from the role of individual aspirations (e.g., Duncan, Haller, & Portes, 1968; Page, Levy Garboua, & Montmarquette, 2007; Sewell, Haller, & Portes, 1969) to compositional effects in different types of schools (e.g., Coleman, Hoffer, & Kilgore, 1982; Morgan, 2001). However, when it comes to explaining persistent social inequalities in education (Becker, 2003; Breen & Jonsson, 2005; Breen, Luijkx, Muller, & Pollak, 2010), one particular model of educational decision-making has received special attention in the literature. Building on Boudon's (1974) distinction of primary and secondary effects of social origin, Breen and Goldthorpe (1997) developed a theory of educational inequalities in terms of a rational action framework. Ever since, scholars have refined and extensively tested the validity of this framework (e.g., Breen & Jonsson, 2005; Stocké, 2007).

However, the Breen-Goldthorpe model as well as its extensions assume that the evaluation of the explanatory parameters (e.g., the costs and benefits) is a purely individual cognitive and motivational process. This view of independent actors, however, is challenged by the above reported evidence on both neighborhood and peer effects in other contexts, such as classrooms and schools (Hanushek, Kain, Markman, & Rivkin, 2003; Sacerdote, 2011). Thus, the question is, how to incorporate this interdependence into a model of individual action and if in turn this interdependence explains the documented neighborhood effects.

To this end, let us first consider a generalized version of the original model, as depicted in Eq. (1). An alternative k is chosen if its utility U_k exceeds that of all other alternatives U_l. Furthermore, $\pi_{k,l}$, $p_{k,l} \in (0,1)$ denote the probability of success and the propensity of status decline, respectively. $-SD$ reflects the importance of status maintenance, $C_{k,l}$ the costs, and $B_{k,l}$ the subjective expected benefits for alternatives k and l. While $\pi_{k,l}$, $C_{k,l}$, $p_{k,l}$, and (as a consequence) $U_{k,l}$ in Eq. (1) differ with individual social origin (Breen & Goldthorpe, 1997), we can think of two—at first sight seemingly contradictory—paths through which interdependence could be introduced into the original educational decision-making model.

$$U_k = \pi_k B_k + [(1-\pi_k)p_k(-SD) - C_k] > \pi_l B_l + [(1-\pi_l)p_l(-SD) - C_l] = U_l \quad (1)$$

Following the overall assumption, individual i is confronted with the decision on entering a higher educational track k versus a lower one l. Either of the two tracks is associated with different educational credentials and, therewith, likelihoods of gaining distinct social positions. In return, the implied hierarchy of different social positions (Breen and Goldthorpe's (1997) 'societal consensus') shapes people's aspirations for different educational alternatives. However, such aspirations are not directly included in the above outlined model. In a rational action framework, we can think of aspirations A_{ik}, A_{il} as an individual i's motivation for the alternatives k and l. As others have pointed out (Becker, 2003; Esser, 1999; Stocké, 2007), the individual educational motivation for alternatives k and l is given as the sum of the subjectively expected benefits and their instrumentality for status maintenance:

$$A_k = B_k + p_k \times (-SD) \quad \text{and} \quad B_l + p_l \times (-SD) = A_l \quad (2)$$

Furthermore, such aspirations, and their role in the reproduction of educational inequalities, have been demonstrated to be interdependent

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