Labour Economics 29 (2014) 49–61

Contents lists available at ScienceDirect

Labour Economics

journal homepage: www.elsevier.com/locate/labeco

Free to Move? A Network Analytic Approach for Learning the Limits to Job Mobility

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HIGHLIGHTS

- Applies complex network analysis to describe boundaries to job mobility.
- The network approach improves upon analysis of industry and occupation transitions.
- The labor market has four mobility segments between which mobility is constrained.
- There is evidence of positive assortative matching across segments.
- Workers move more freely when unemployment is low. Boundaries are counter-cyclical.

ARTICLE INFO

Article history:
Received 30 March 2013
Received in revised form 22 April 2014
Accepted 11 May 2014
Available online 23 May 2014

Keywords:
Job Mobility
Complex Networks
Job Matching

ABSTRACT

Job mobility has many overlapping determinants that are hard to characterize solely on the basis of industry or occupation transitions. Workers may match with, and move to, particular jobs on the basis of match quality, preferences, human capital, andmobility costs. This paper implements a novel method based on complex network analysis to describe how workers move from job to job. Using data from the Panel Study of Income Dynamics (PSID), I find first that the labor market is composed of four distinct segments between which job mobility is relatively unlikely. Second, these segments are not well-described on the basis of industry, occupation, demographic characteristics, or education. Third, mobility segments are associated with earnings heterogeneity, and there is evidence of positive assortative matching across segments. Fourth, the boundaries to job mobility are counter-cyclical: workers move more freely when unemployment is low.

1. Introduction

The flexibility with which workers move between different types of employment affects many economic outcomes, including earnings inequality (Autor and Dorn, 2013), the persistence of unemployment (Şahin et al., 2012), and individual earnings growth (Gathmann and Schoenberg, 2010). Recognizing this, economists are devoting renewed attention to models in which workers can not or do not move with between employment opportunities because of mismatch, incomplete portability of skills, imperfect information about job opportunities, or because of institutional barriers. A growing literature suggests the factors constraining mobility are more complex than can be revealed through coarse industry or occupation categories (Neal, 1995, 1999; Pavan, 2011; Yamaguchi, 2010; Sullivan, 2010). However, data limit our ability to use less coarse categories, or to study transitions across combined industry and occupation groups.

This paper introduces a new method, using tools of network analysis, to find the boundaries of labor market mobility using data on observed job transitions. A common implication of models of imperfect mobility is that there are groups of jobs amongst which transitions are relatively likely, and other groups amongst which transitions are relatively unlikely. Sattinger (2006) emphasizes that overlapping labor markets are a common implication of models in which workers and firms match on the basis of productive characteristics. Workers try to match with specific jobs, but because of search frictions, they occasionally move between different markets (Postel-Vinay and Robin, 2002; Shimer, 2005; Şahin et al., 2012). The boundaries to mobility therefore exist, but are porous. The empirical challenge this paper confronts is to find labor market boundaries from data on job mobility in a manner that accounts for the fact that workers can move across those boundaries.

Network analysis provides a solution to this conceptually and computationally challenging problem. I represent job mobility as a network of connections between workers and employers that evolves over time as people move from job to job. This network should be densely connected among jobs between which it is easy to move, and sparsely connected among jobs that lie across labor market boundaries. In

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http://dx.doi.org/10.1016/j.labeco.2014.05.003
0927-5371/

complex network analysis, the need to find densely connected groups of nodes arises in many applications, and is referred to as a problem of "community structure detection". I apply a well-developed method for detecting community structure in a general network, modularity maximization (Girvan and Newman, 2002; Blondel et al., 2008), to find labor market boundaries in the PSID. Fig. 1 illustrates the approach, which is described in detail in Section 2. Nodes in the figure correspond to jobs defined as unique pairs of finely-detailed industry-occupation codes. Whenever a worker has held both jobs, they are connected. I find labor market boundaries around four groups of jobs. I use a similar method to characterize the groups of workers that are matched to these groups of jobs.

To address the key question of how this method compares to the more conventional strategy of analyzing industry and occupation transitions, I define a measure based on the concept of *homophily*. This measure defines how much mobility is observed within groups relative to what would be expected if job matching were random. The analysis generates three main results. First, the boundaries revealed by my network approach are much stronger than boundaries based on industry, occupation, or industry-occupation pairs. Second, there is very little sorting on the basis of observable demographic characteristics across labor market boundaries. Third, the boundaries to mobility are associated with specific types of industry-occupation combinations that are intuitive, but difficult to predict in advance.

I go on in Section 5 to show how the network-based approach fares in two applications for which good measures of labor market boundaries are essential. First, I consider mismatch unemployment, and show that workers are less likely to cross labor market boundaries when unemployment is high. Next, I develop a complementary analysis of assortative matching – who matches with whom. I show that the groups of jobs and workers revealed on the basis of mobility patterns are distinguished by a significant amount of earnings heterogeneity. Workers who earn more on average tend to be employed in jobs that pay more on average, a fact that has become rather controversial in the literature using matched employer-employee data (Abowd et al., 1999). Altogether the results suggest that network-based measures of job mobility are a useful addition to the toolbox of applied labor economics. I conclude the paper with a discussion of other areas of labor economics that could benefit from this approach.

2. The labor market as a network

Fig. 2 illustrates the formation of a realized mobility network from panel data collected over three time periods in a labor market where the set of workers is $W = \{1,2,3,4,5,6,7,8\}$, and the set of employers is $J = \{A,B,C,D\}$. Workers and employers are nodes in the network, and an edge connects a worker and employer whenever there is an employment relationship between them. The example shows that while the structure of employer-employee links is sparsely connected at any point in time, the realized mobility network may, and indeed does, become densely connected very quickly. In this section, I introduce the concepts of network analysis and their application to labor market data.

2.1. Preliminaries

A *graph* or *network*, G, is defined by a set of *nodes* or *vertices*, $V(G) = \{1,\ldots,N\}$, and a set of *edges* that connect them, $E(G) \subset V(G) \times V(G)$. The edges are undirected $(i,j) \in E(G)$ whenever $(j,i) \in E(G)$.

This paper considers networks in which multiple edges can form between two nodes, represented by including an edge multiple times in $E(G)$. An alternative is to characterize an edge as a triple: $(i,j,\omega) \in E(G) \equiv V(G) \times V(G) \times \Omega$, where Ω is the set of whole numbers.

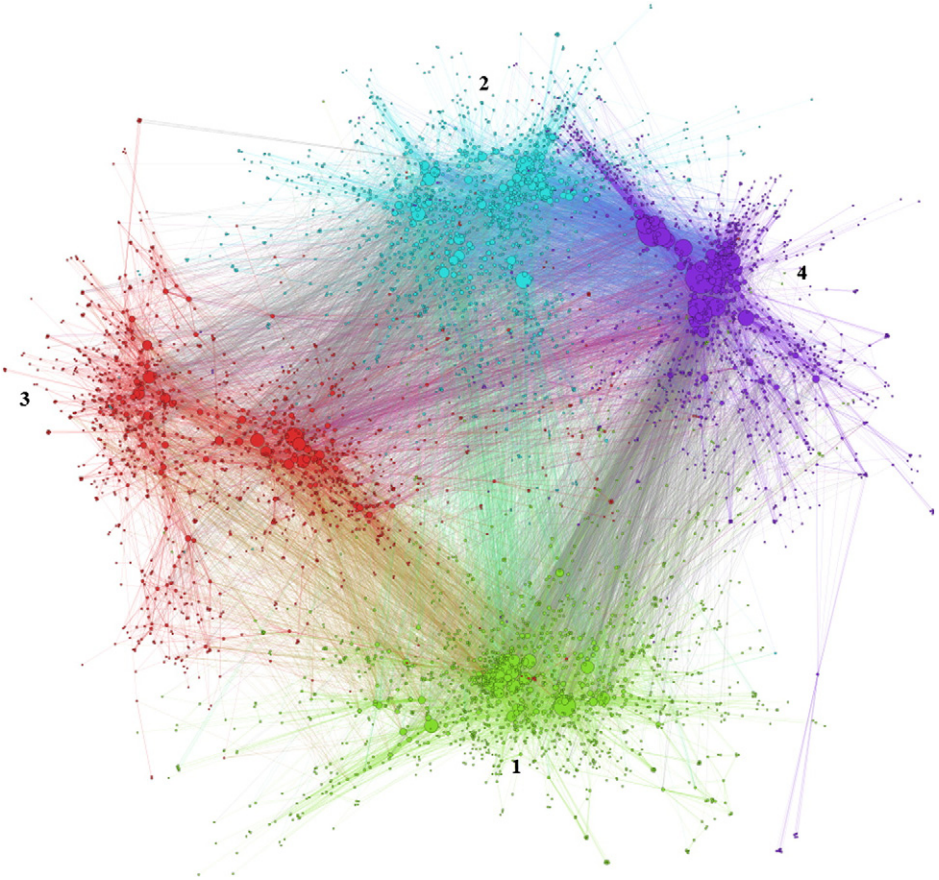

Fig. 1. Projection of the realized mobility network in the PSID onto industry-occupation pairs. The figure displays the four largest partition classes, which are labeled in bold.