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Spatial equilibrium with unemployment and wage bargaining: Theory and estimation ☆

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ABSTRACT

In this paper, we present a spatial equilibrium model where search frictions hinder the immediate reallocation of workers both within and across local labor markets. Because of the frictions, firms and workers find themselves in bilateral monopoly positions when determining wages. Although workers are not at each instant perfectly mobile across cities, in the baseline model we assume that workers flows are sufficient to equate expected utility across markets. We use the model to explore the joint determination of wages, unemployment, house prices and city size (or migration). A key role of the model is to clarify conditions under which this type of spatial equilibrium setup can be estimated. We then use U.S. data over the period 1970–2007 to explore the fit and quantitative properties of the model. Our main goal is to highlight forces that influence spatial equilibria at 10-year intervals.

1. Introduction

In this paper, we embed a search and bargaining model of the labor market into a spatial equilibrium setting in order to provide a simple framework where one can discuss the joint determinants of local wages, unemployment rates, housing prices and migration. While unemployment is typically abstracted from in the canonical spatial equilibrium model,[1] our goal is to explore the insights that can be gained from shifting from a Walrasian approach to one in which wage bargaining and unemployment play a central role.

We begin the paper by presenting a spatial equilibrium model in which search frictions hinder the immediate reallocation of workers within and between local labor markets, which we refer to as cities. The search frictions imply that unemployment arises as an equilibrium phenomenon. Following Pissarides (2000), wages are determined by Nash bargaining between firms and workers. We assume that cities have exogenous differences in terms of productivity, amenities and land availability. Further, we allow cities to be subject to agglomeration externalities and congestion externalities. Much of this (including equating of worker utility across cities, free entry of firms, and differences in productivity and amenities across cities) is the same as in the classic Roback (1982) paper and the literature that has followed. However, as we will see, the shift in the labor market component of the model to include frictions has important implications and allows us to examine issues such as whether worker mobility is more responsive to wage or employment rate changes within a consistent framework.

An important element of the model is the presence of many industries within each city. Unemployed individuals search for a job across these industries and can also randomly receive an option to search in another city of their choice where the industrial mix will be different. Households will move to cities with either higher wages or lower unemployment, implying increases in the demand for land in those cities. Accordingly, in the spatial equilibrium, house prices will adjust to make households indifferent among cities. Differences in industrial mix across cities will play an important role in helping us identify the effects of wages on housing costs and mobility decisions. In particular, we will be able to exam-

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[1] Two recent references include Glaeser and Gottlieb (2009) and Moretti (2011). See Amior (2012) for a recent paper that takes a related but different approach to introducing mobility into a search and bargaining model.

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ine the sensitivity of household mobility decisions with respect to both wages and unemployment.[2]

The paper builds on our previous work, Beaudry et al. (2012, 2013), in which we present a tractable model of search and bargaining with multiple industries and cities. However, in those papers, cities are not assumed to be subject to either agglomeration or congestion externalities. The result is a spatial equilibrium with a particular block recursive system of equations whereby wages and employment rates can be determined independently of house prices and city size, allowing us to focus on wage and employment determination without being explicit about the determination of house prices and city size. In contrast, the basic model of this paper is not block recursive and, accordingly, the simultaneous determination of house prices and migration decisions becomes the central focus.

In order to make the presentation more transparent, we first present a baseline model which abstracts from several features that are then introduced progressively. The baseline model has the advantage of allowing for a clear discussion of the main identification issues.[3] The second main section of the paper focuses on estimating the model using data drawn from the U.S. Census and the ACS over 10 year windows.

Our estimations allow us to address a set of issues central to the intersection of urban and labor economics. These include: (i) the relative importance of wages versus unemployment in affecting migration decisions, (ii) the strength of the housing-cost-wage interaction, (iii) the relevance of agglomeration effects over the medium run and (iv) the nature of the spatial equilibrium process. We find that migration decisions are much more responsive to changes in local employment opportunities than to wages: a one percent increase in a city's employment rate causes an inflow of worker three times greater than a one percent increase in real wages. We also find that the effect of wages on the determination of housing cost is much stronger that the effect of higher house prices on the determination of wages. For these relationships, we find that a 1% increase in housing cost has the direct effect of increasing wages by approximately 0.25%, while an increase in the average city wage generates higher housing cost in an approximately 1-to-1 fashion. With respect to the importance of agglomeration effects on productivity, we do not find any significant evidence of such forces over the 10-year periods we focus upon. In fact, our estimates of the wage and employment processes suggest that migration neither increases nor decreases marginal productivity over the medium run. In addition to finding that variation in city size has very little direct effect on wages and employment rates, we also find that for most cities, house prices appear quasi-invariant to migration. More specifically, house prices are invariant to migration in all cities except those with very limited available land, where house prices respond strongly to migration flows. For the land elastic cities, our estimates put into question the role of house prices in equating utility across localities. We offer two alternative interpretations of this observation. The first being that some form of congestion externality affects the desirability of different cities, and this acts as the key equilibrium force insuring that agents receive equal utility across locations. The second interpretation is that migration frictions are sufficiently prevalent to hinder the equalization of utility over 10 year periods.

The paper is structured as follows. In the next section we present our spatial equilibrium model with multiple industries and wage bargaining. We use the model to derive four estimating equations and to discuss how the parameters of these relationships can be identified. In Section 3 we present the data we use for estimation. In Section 4 we report our estimates for the four equation model and discuss their implications for urban-labor issues.

2. Theoretical framework

In this section, we set out to extend a standard search and bargaining model to include multiple sectors, multiple cities, endogenous migration decisions and endogenous housing costs. Our goal is to derive an empirically tractable spatial equilibrium model with unemployment and wage bargaining. Given that goal, our model is highly stylized, but we will show that this simple model provides a reasonable fit to the data.[4]

Consider an environment where there are C cities and a mass 1 of households, with each household having 1 unit of labor. As we will specify more precisely later, households will have the opportunity to move between cities, and we will be aiming to characterize both the stationary equilibrium, where households are indifferent between living in different cities, and changes in the stationary equilibrium induced by changes in exogenous factors. The mass of households located in city c at time t is denoted by L_{ct}, and we will also refer to L_{ct} as the city size. Households have preferences defined over the consumption of a final good, X, the consumption of housing, H, and the consumption of city specific amenities, A_{ct}. The final good is an aggregate of output from I industries. The price of the final good, X, is normalized to 1 and the price of intermediate/industrial good i is given by p_{it}. The $i \in \{1, \ldots, I\}$ industrial goods can be produced in each of the C cities, and employers in a city take the prices, p_{it}, as given.[5]

For now, we will consider all households to be ex-ante identical. Later we will discuss how household skill heterogeneity can be introduced into the model. Cities, in contrast, are heterogeneous ex-ante and ex-post, as they will differ in terms of their productivities, their amenities and the available land. As will be made clear, city-level productivity terms and amenities will have an exogenously given component and an endogenous component which reflects agglomeration and congestion externalities.

2.1. Search

We assume that search frictions characterize the labor markets in all cities. Each local economy unfolds in continuous time. Note that to simplify notation, and since we are searching for the stationary equilibrium, we will suppress the dependence of variables on time until we focus on changes in stationary equilibria. At each point in time, cities are populated by risk-neutral firms that maximize discounted profits and by worker-households who have per-period indirect utility functions given by: $y - \gamma_1 p_c^h + \gamma_2 A_c$, where y is the income received by the worker, p_c^h is the price of housing in city c, A_c is the public amenity in city c, and γ_1 and γ_2 are parameters. Households take the value of amenities as given, but these can affected by congestion externalities such that:

$$A_c = \epsilon_{1c} - \gamma_3 L_c,$$

[2] The basic model gives rise to a system of $3 + 2N$ equations where N in the number of industries. The system determines wages for each industry-city pair, the share of employment in each industry in each city, the employment rate in the city, city house prices and the city size (the labor force). However, for most of the analysis, we can focus on a reduced system of 4 equations which determines average city wage, the employment rate, house prices and city size.

[3] As we are working with observational data, identification will rely on restrictions on unobservables. Given the model is over-identified, the joint validity of the model and the implied restrictions can be evaluated using standard tests.

[4] Our model exposition shares much with that in Beaudry et al. (2012).

[5] We can model the endogenous determination of prices, but for our purposes this is not necessary. All that is needed is that prices, p_{it}, be subject to an exogenous shifter which can reflect changes in technology or tastes.