**Search, Migration, and Social Connections: Solving the Migration Puzzle to Beijing**

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## Abstract

We provide a plausible explanation for the phenomenon of migration to big cities such as Beijing and Shanghai. This process can be observed particularly among students who migrate to these cities and prefer to look for their first jobs upon completion of their studies, instead of going back to their hometowns. Despite the slightly higher wages offered in big cities, it is unclear why recently graduated students feel attracted to remain in big cities, where the living costs are much higher and the job market is more competitive compared to small cities. We develop a search and matching model in which we consider that the social connections created by the agents during their studies are used as a tool to get jobs. We solve for the optimal investment in social connections, and for the level of social capital that makes agents indifferent between migrating and staying in their current locations. We use a computational model and show that for agents with a sufficiently large social network, the value of social capital is large enough to overcome the value of going back to their hometowns, where they would face lower competition and living expenses, but they would lack the advantages that a social network represents.

*Keywords:* migration, search and matching, social network

*JEL classification:* J61, D83, D85.

## 1. Introduction

The labor migration from rural to urban areas is a significant and common phenomenon in developing economies. Most of the studies that analyze rural–urban migration argue that the flow of migrants to the urban sector reduces the probability of employment in urban areas, and thus the expected payoffs from higher wages paid in the urban areas and from lower wages paid in rural areas will be equalized in equilibrium.[1] These models argue that the public policies that intend to solve the unemployment problem by creating more jobs in urban areas will fail, as the creation of new jobs will be offset by a further inflow of new migrants. A similar explanation can be found in studies that assume a frictional market, such as Mortensen and Pissarides (1999a, 1999b), Molho (2001) and Coulson et al. (2001).

Therefore, it seems natural to ask the following two questions: (1) If wages are increased or more jobs are created in rural areas, through either public policy or modernization, will some agents in urban areas decide to move to the countryside? (2) If that is the case, which agents will decide to do so? Most studies provide an affirmative answer to the first question and mention that any agent would decide to move to a rural area until the marginal payoffs are equalized due to the migration process. However, empirical evidence frequently contradicts this intuition and is not able to provide much evidence to answer the second question. A good example of the inconsistency between theoretical predictions and empirical observations is found in the case of new graduates making decisions about their job searching process in Beijing. Although there is a similarity between starting wages in Beijing and many smaller cities,[2] the living costs in Beijing are much higher. According to statistics by CIIC,[3] the annual salary for a new graduate in Beijing in 2017 was RMB 62,400. In a nearby city, Tianjin, the average annual salary was RMB 61,320. Despite the similarities in income, the living costs are significantly different between these two cities. According to China Statistical Yearbooks, the per capita consumption expenditure in 2017 in Beijing was RMB 40,346, while in Tianjin, it was RMB 30,284—a difference of RMB 10,062.[4] However, about 86.47% of new graduates from universities located in Beijing decide to stay and search for their first jobs there.[5] This tendency of working at their graduated city is a common observation

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[1] Look for example at the classic paper by Harris and Todaro (1970), and at Todaro and Smith (2006)

[2] In this paper, when it is not confusing, we use the terms "urban area" and "big city" as interchangeable; the same applies to the terms "rural area" and "small city."

[3] There is no official statistics for starting salaries of new college graduates in China. However, most of these data are provided by commercial survey companies. China International Intellectech Co. (CIIC) is a Listed Central Company.

[4] According to China Statistical Yearbook (2018), mentions that residents in Beijing face residential cost that are two times higher than those in Tianjin. Similar differences in expenditure levels can be found for clothing, medical care, education, and transportation and communication.

[5] Data source, 90dichan.

not only for cities like Beijing but also for various regions in China. As it is shown in Table 1, most college graduates look for jobs locally, with a proportion of about 80%. This includes the areas with poor economic performances (e.g., North-East China), 63.4% of college graduates in Liaoning Province chose to stay and work in Liaoning, as well as 51% of college graduates in Jilin Province in 2016.[6] Although many college graduates from North-East China choose to move to other areas to seek employment opportunities, most of them still decide to stay in North-East China. This phenomenon contradicts some results from trade theory (the law of one price), migration theories, and spatial searching models (e.g., Calvó-Armengol, A. (2004) and Montgomery, J. D. (1991)).

Table 1. Percentages of College Graduates Working at the Universities Locations 2004-2011 (%)

| College Locations | Beijing/Tianjin /Shanghai | East China | Middle China | West China | Total |
|---|---|---|---|---|---|
| 2004 | 72.4 | 87.0 | 65.3 | 67.2 | 74.5 |
| 2005 | 71.3 | 87.5 | 66.5 | 69.7 | 75.4 |
| 2006 | 70.6 | 88.4 | 67.6 | 70.3 | 75.7 |
| 2007 | 69.1 | 89.0 | 67.7 | 71.9 | 76.3 |
| 2008 | 66.3 | 88.3 | 64.8 | 69.6 | 74.6 |
| 2009 | 95.3 | 90.9 | 80.6 | 82.8 | 86.0 |
| 2010 | 94.2 | 90.1 | 79.1 | 82.6 | 85.0 |
| 2011 | 65.4 | 87.4 | 77.4 | 73.3 | 79.5 |

Source: The National Survey on the Employment of College Graduates 2004-2011.

It might be the case that people migrate to a location by accepting a wage cut or lower starting salary in return of a higher wage profile, i.e. wage grows faster in the new location. Existing literatures, for example Kennan and Walker (2011) use the wage profile to explain the both forward and backward labor force migrations whilst other like Burdett and Coles (2010) use the wage tenure effects to explain the job-to-job transitions. However, in a frictional labor market the expected payoff from a job is not only determined by its wage profile but also by the probability of getting the job offer and move up the wage ladder. Empirically, the new graduates are facing much more severe competitions in cities like Beijing and Shanghai whereas there are large numbers of elite universities in contrast to the second tier cities. As shown in Figure 1, the proportion of

[6] Data source: Employment Quality Report of College Graduates in Liaoning Province 2016; Employment Quality Report of College Graduates in Jilin Province 2016.

employees with junior college, bachelor, and postgraduate degrees in Beijing and Shanghai was much higher than the second tier city, which means that finding a suitable job is more difficult for a graduate in these cities. Therefore, by taking job market competitions into consideration, a higher wage profile seems much less appealing for the new graduates in Beijing to stay.

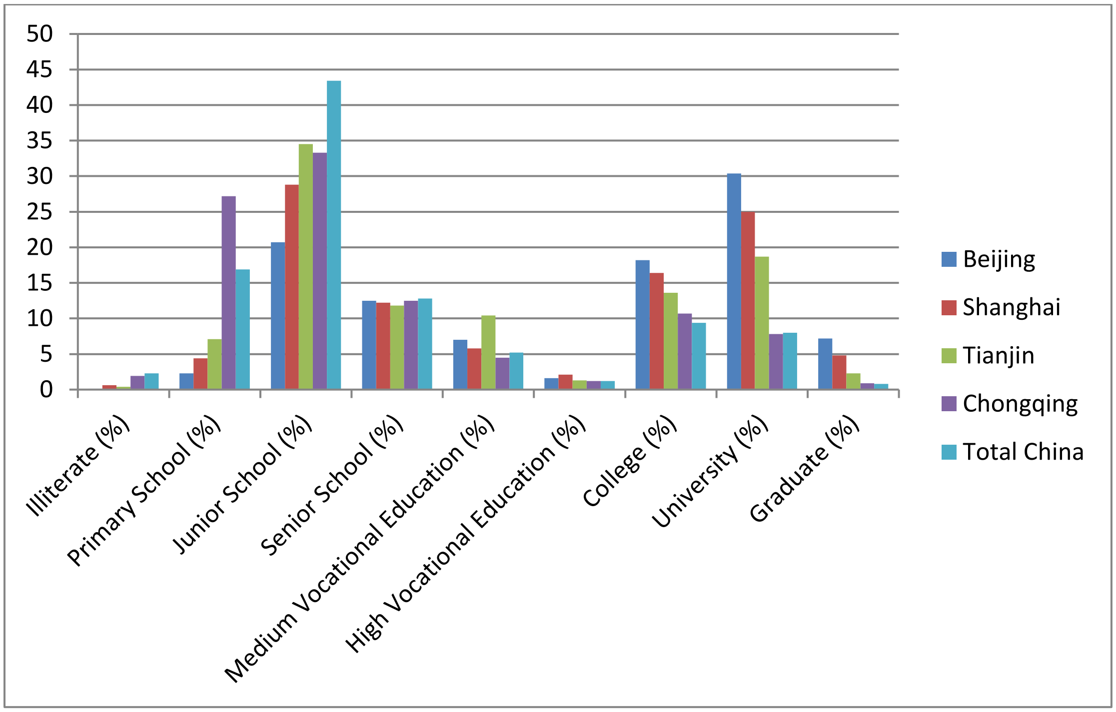


Fig.1. Educational Attainment Composition of Employment by Region 2017

Different from many empirical studies that focus on city size (Chen et al., 2018), wage distribution (Kennan and Walker, 2011), rural landholding (Meng & Zhao, 2018), or the role of culture, settlement barrier, and language diversity (Su et al., 2018), we argue that social networks and personal connections are part of the answer to the puzzle explained above. Wang et al. (2015) provided some empirical evidence on the social network effect using Chinese data. There exist extensive empirical and theoretical works that examine the use of personal contacts by job seekers. These works try to analyze the extent to which workers rely on personal sources of information to learn about available vacancies and to obtain jobs. Studies such as the one by Myers and Schultz (1951) mention that more than 60% of the workers surveyed obtained their first jobs by using personal connections. Similarly, Granovetter (1973) found that 50% of the agents that participated in his study obtained their current jobs by using social networks. Still, other studies, such as those by Blau and Robins (1990) and Holzer (1988), show that a higher proportion of jobs found via personal contacts are likely to be accepted.[7] Indeed, the

[7] For a detailed review of the empirical evidence and of the main theoretical models developed look at Goyal (2007).

social connection plays an important role in job market in China as well. This can be seen in Table 2, which shows that the proportion of unemployed workers who choose to ask their friends and relatives to help them find a job was around 50% in recent years.[8]

Table 2. Job Seeking Methods for Urban Unemployed Workers (2011-2017) (%)

| Year | Register in Employment Agency Office | Ask Friends Relatives about Job | Contact the Employer Directly | Answer or Advertise | Scan Job Ads | Take Part in Employment Advertise Meeting | Prepare for Own Business | Other | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | 8.9 | 51.3 | N/A | 1.2 | 7.9 | 9.2 | 7.1 | 14.5 | 100.0 |
| 2012 | 7.0 | 52.4 | N/A | 1.0 | 9.7 | 7.3 | 7.2 | 15.4 | 100.0 |
| 2013 | 7.7 | 50.2 | N/A | 0.9 | 11.4 | 7.7 | 6.9 | 15.2 | 100.0 |
| 2014 | 7.3 | 52.9 | N/A | 1.1 | 12.6 | 6.2 | 6.8 | 13.0 | 100.0 |
| 2015 | 7.1 | 43.4 | 7.4 | 0.9 | 12.1 | 7.7 | 5.8 | 15.6 | 100.0 |
| 2016 | 5.8 | 46.7 | 6.8 | 0.6 | 13.5 | 7.3 | 5.8 | 13.5 | 100.0 |
| 2017 | 5.3 | 46.4 | 7.7 | 0.8 | 15.0 | 6.9 | 6.2 | 11.7 | 100.0 |

Source: China Labor Statistical Yearbook 2012-2018

In a nutshell, the data reported above show that social connections play an important role in the job seeking.

In this study, we build a dynamic equilibrium model to answer the two questions proposed above. We analyze the process of migration between two cities of different sizes. We consider that heterogeneous unemployed workers can build social connections and link with employed workers in the same city, who then become a source of job opportunities. The ex-ante uncertainty in the job matching market makes these social connections valuable for unemployed workers. Hence, the potential loss that results from moving to an alternative location and abandoning the already established social connections makes it unattractive for workers to move to a new city. That is, agents value the social capital they have built in the city where they are currently located. The increase in the expected payoffs that may result from migration should be large enough to

[8] There is no empirical data on college graduates' job seeking methods, so the results of our study can be useful to provide initial data on this issue.

compensate for the welfare losses that result from abandoning the existing social capital and the cost of building a new one.

Our contributions are two-fold. First, we embed the concept of migration equilibrium into a search and matching framework. This integration is critical as the decisions of labor mobility are essentially determined by the differences in returns in different labor markets. Hence, it is natural to model these expected returns.

Second, we separate the search equilibrium from the migration equilibrium, considering that in the first case, workers choose the optimal level of social connections that maximize their present value of expected lifetime utility. In the second case, there is a specific investment level in social connections that make an agent indifferent between staying in the current city or moving to another one, and any deviation from this level would result in migration. Our framework shows that agents will not necessarily migrate from urban areas to rural areas even if they take into account the similarity in wages and the differential in competition and living expenses. We also find that if there is any migration, only those agents that have a low social capital stock will decide to move.

The rest of the paper is organized as follows. Section 2 describes the model, and Section 3 and 4 present the equilibrium properties. Section 5 presents a numerical example that simulates the migration behavior of agents based on the model. Section 6 discusses empirical evidence and policy implications. Finally, Section 7 concludes.

## 2. Model

We construct a discrete-time model with an infinite horizon. Consider a two-city economy. One city, denoted by $B$, is bigger than the other one, denoted by $S$. The population in each city is endogenously determined through the migration decisions of rational economic agents. Without losing generosity, we assume that jobs in a big city are paying a higher wage than their small city counterparts, that is, $w^B > w^S$.[9] However, the living cost in a big city $c^B$ is greater than the small one $c^S$.

The number of vacant jobs in each city is represented by $V^i$, and hence $V^B > V^S$. In each period, any job may be destroyed, and thus a worker would be laid off. The destruction of jobs results from idiosyncratic shocks that follow an independent identical (i.i.d.) process with arrival rate $\delta$. In each period, the number of new jobs created is such that the total number of jobs is maintained.

[9] We can endogenize wage setting process. However, this will unnecessarily complicate the analysis. For further references in wage setting process in a stock-flow matching see Coles, M. G., & Muthoo, A. (1998), Coles (2003), Albrecht et al. (2006) and Ebrahimy and Shimer (2010).

Following the literature, we assume that there is a measure $L$ of infinitely-lived and risk-neutral laborers.[10] All laborers have a common reservation value of zero for home production and a discount rate $r$. Laborers are distributed across two cities and are free to choose in which city to live following individual rationality. They are heterogeneous in the stock of social capital in the form of social connections. Specifically, let $N$ denotes the degree of social connections that the laborer has in his/her current city. Hence, $N = 0$ represents a laborer who has no social connections with anyone in the city.

Following Coles and Smith (1998), we assume that workers and firms can contact one other through a central marketplace without cost, a job center, or a talent center. The marketplace provides unemployed workers with complete information regarding each employer's job offer, just as it happens in many real-life marketplaces where workers could interact directly with companies that are offering jobs in a marketplace. The market operates over an infinite sequence of discrete periods.

As jobs under consideration are different, workers may find that they are suitable for some of them but not for others. We assume that the productivity of a worker-job match is an independent draw from a Bernoulli distribution. Specifically, a match between a work and a job vacancy will result in productivity $\pi > 0$ with probability $\lambda$, in which case a worker is productive in a specific job offered by an employer, and the productivity is zero; hence, the worker is not productive in this job, with a probability $1 - \lambda$. Workers are either employed or unemployed at any moment. Let $E_i$ and $U_i$ denote the number of employed and unemployed workers, then $L = \sum_{i \in \{B,S\}} E^i + \sum_{i \in \{B,S\}} U^i$.

Two different channels exist through which the unemployed seek job offers: the matching marketplace and their social connections. Through his/her social connections, the employed worker could disseminate information to his/her unemployed contact regarding a job vacancy in which the job seeker is productive. In contrast to the marketplace, the unemployed will immediately accept job offers disseminated from social connections. We assume that there is no on-the-job search; hence, the information about vacancies is disseminated in only one direction: from the employed to the unemployed.

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[10] The preferences concerning risk are unessential. If we were to allow risk-averse preferences, this would only change the threshold values, for example, higher thresholds, but not the decision mechanism, as the market equilibria (i.e., search equilibrium and migration equilibrium) are defined in the same manner.

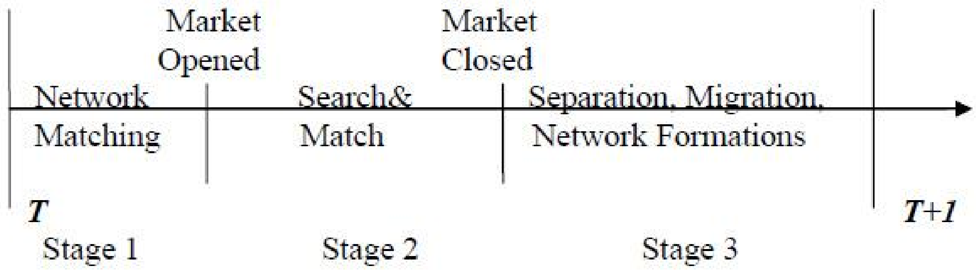


**Fig. 2.** Time and events

Each period comprises three sequential stages (see Fig. 2). The economic decisions are taken and the interactions among agents occur in the order stated below:

*Stage 1.* There are $V^i$ numbers of vacancies being created in city $i \in B, S$. In the first round, vacancies are assigned through networks. Before the matching market is opened, any job seeker may be informed of a potential offer from one of his/her connections. If the job seeker receives the information and accepts the offer, he/she becomes employed and starts to work in the next period. If more than one job opportunity arises during the same stage, the job seeker randomly picks one of the offers.

*Stage 2.* The matching market is opened at the beginning of this stage, with unmatched workers and unfilled jobs searching for trade partners in the market. During the same period, employed workers produce one unit of consumable goods and get paid at the wage rate. Those job seekers that are recruited during this stage leave the marketplace and start producing in the next period. At the end of the stage, the matching market is closed again. Then the unfilled vacancies are destroyed and the unmatched workers who remain unemployed proceed to the next stage.

*Stage 3.* At the beginning of this stage, the idiosyncratic separation shocks result in the layoff of some employed workers. Finally, all the unemployed workers decide whether to stay in the same city or migrate to another one. Those who choose to migrate to another city abandon the existing social connections and need to invest to build a new social network.

As employed workers are subject to layoff shocks, some of the unemployed workers may lose their connections in each period. The unemployed could pay a cost to build new connections to replace the lost ones. The cost of building $n$ new connections is captured by a convex cost function $I(n)$ such that $I'(\cdot) > 0$ and $I''(\cdot) > 0$.

## 3. Market dynamics

As there is personal contact between agents, the information will correspond to a position in which a job seeker will be productive given his specific characteristics; that is, the information provided to a job seeker corresponds to a secure match. A job seeker will be informed of a potential offer by one of his connections with independent probability $\alpha$. Therefore, in stage one, an unemployed agent with links to $N$ employed workers will get a job using networks with probability $p = 1 - (1 - \alpha)^N$. Any job offered at this stage will be immediately accepted. Accordingly, there are $F_{1t} = pU_t$ total vacancies filled through this 'network hiring process', where the first subscript stands for the current stage and the second for the current period. The unemployed workers that fail to get a job during stage one will participate in the matching market and search for the potential vacancies to fill.

At the beginning of stage two, there are $V_{2t}^i = V^i - pU_t^i$ unemployed workers who will participate in the matching process. Hence, the probability that there is at least one job vacancy that suits the job seeker is $1 - (1 - \lambda)^{V_{2t}^i}$. Now, consider the probability that a particular unemployed worker in the market matches up with a vacancy during this stage. There are measures of $U_{2t}^i = (1 - p)U^i$ total unemployed in the marketplace when it opens. Then the job-finding rate for any unemployed worker at the marketplace in city $i$ is determined by

$$\frac{1}{U_{2t}^i}[1 - (1 - \lambda)^{V_{2t}^i}].$$

As noted by Coles and Smith (1998), although this stock-flow matching function is not homogeneous, it has increased to a scale that fits the empirical observations in labor market matching. It implies that in a marketplace that favors the job seekers due to either less competition among the unemployed, namely a lower $U_i$, or more job opportunities, namely a higher $V_i$, the job-finding probability is higher.

The workers who got a job through either networks or the matching market start producing in the next period, and all the unmatched workers remain unemployed after the market is closed at the end of stage two.

At stage three, a proportion $\delta E_t^i$ of employed agents are laid off. All those unemployed workers decide whether to migrate to another city. Therefore, the change in the level of unemployment at the end of this period follows the difference equation shown below:

$$\varDelta U_t^i = \delta E_t^i - F_{1t}^i - F_{2t}^i + M_t^i,$$

where $F_{2t}^i$ represents the number of matches during stage two, and $M_t^i$ is the number of migrants, such that, if $M_t^i < 0$, there is an outflow from the local labor market, and if $M_t^i > 0$, the local city accommodates migrants from another city.

## 4. Market equilibria

Given that the model is capable to track the full dynamic adjustments of the economy, we only focus on the steady-state equilibrium of the model. In a steady-state, the state variables of the labor market must be such that $\varDelta U_t^i = M_t^i = 0$. Hence, the steady-state allows us to eliminate the time subscript $t$ as in $U_{t-1} = U_t = U$. Now, substitute $E^i = L^i - U^i$, $F_{1t}^i$, and $F_{2t}^i$. Thus,

$$\delta(L^i - U^i) = pU^i + (V^i - pU^i)[1 - (1-\lambda)^{(1-p)U^i}]. \tag{1}$$

Given that a fixed number of jobs $V^i$ are created in each city, the above equation uniquely pins down the size of a city's unemployment $U^i$.

### *4.1. Search equilibrium*

The equilibrium is characterized by the Bellman equations that define the worker's present discounted lifetime utility. Let $Z_i$ denote the present discounted lifetime utility of an unemployed worker in city $i$ as defined by

$$Z^i(N) = b - c^i - eN - I(n) + \beta[f(N^i, V^i, U^i)W^i(N) + (1 - f(N^i, V^i, U^i))Z^i(N)] + \dot{Z}^i(N), \tag{2}$$

where $f(N^i, V^i, U^i) = [1-(1-\alpha)^{N^i}] + \frac{1}{U_{2t}^i}[1-(1-\lambda)^{V_{2t}^i}]$ is the job-finding rate for a worker with $N$ social connections, $e$ is the unit cost of maintaining $N$ social connections, $I(n)$ is the adjustment cost of building new $n$ degree of connections, $\beta$ is the discount factor, and $b$ is the unemployment benefit. Finally, $W^i(N)$ is the present discounted value for an employed worker, which is characterized by the following equation:

$$W^i(N) = w^i - c^i - eN + \beta\big[(1-\delta)W^i(N) + \delta\max\{Z^i(N), Z^j(0)\}\big] + \dot{W}^i(N), \tag{3}$$

where $w$ is the wage income paid to an employee, and $Z_j(0)$ is the present discounted lifetime utility for a migrant who moves from city $j$ to city $i$, and hence abandons all his/her social connections in city $j$.[11] This is given by

$$Z^j(0) = b - c^j - I(n) + \beta\left[f\left(0, V^j, U^j\right)W^j(n) + \left(1 - f\left(0, V^j, U^j\right)\right)Z^j(n)\right]. \tag{4}$$

In the search equilibrium, people are building their social connections, $N^i$, such that their present value of being unemployed is maximized. Thus,

$$N^* = \underset{N}{\operatorname{argmax}}\, Z^i(N). \tag{5}$$

The resulting $N^*$ will determine the steady-state unemployment level in city $i$ as defined by (2).

[11] An agent migrating to another city does not necessarily need to start making social connections from scratch. Instead, she/he might have already some social connections as in the case in which she/he moves back from college to her/his hometown. This will increase the value of $Zj$ as the agent will benefit from existing social connections in the local job market. However, this fact only changes the threshold level of N in the migration equilibrium but not its general properties.

*4.2. Migration equilibrium*

The search equilibrium implies that after the separation, these newly unemployed workers compare payoffs from job searches in two different locations to decide which city to settle.[12] Following equation (3), there is a threshold level of $N$, let it be $\overline{N}_i$, such that

$$\overline{N}_i = \{N | Z_i(N) = Z_j(0)\}. \tag{6}$$

As $c(.)$ is an exponential function of $N$, so is $Z(.)$. Hence, $\overline{N}_i$ is the smallest positive solution to $Z_i(N) = Z_j(0)$.

In search equilibrium, workers in city $i$ will invest in his/her social connections up to $N_i^*$. However, it is not necessarily the case such that $N_i^* = \overline{N}_i$. In other words, free-market search equilibrium *is not* necessarily identical to the migration equilibrium. Contrasting to the neoclassical models, for example, Harris and Todaro (1970), where the two equilibria are identical, our model explicitly differentiates the two choices. By doing so, our model generates interesting dynamics in the labor market in a two-city model. The migration equilibrium of our model is summarized as follows:

**Claim 1.** *The equilibrium in a two-city migration model depends on the equilibria values* $N_i^*$ *and* $\overline{N}_i$*, defined by (5) and (6), respectively. Three different cases may arise:*

(1) If $N_i^* > \overline{N}_i$, unemployed workers with social connections below $\overline{N}_i$ will move from a big to a small city and invest in the creation of new links until they reach $N_i^*$; however, unemployed workers with social connections above $\overline{N}_i$ will stay in a big city and accumulate $N$ up to $N^*$.

(2) If $N_i^* \leq \overline{N}_i$, migration equilibrium and search equilibrium coincide, and all unemployed agents with connections below the equilibrium level will migrate to a small city and create new links up to $N_i^* = \overline{N}_i$.

[12] Note that in our model the total size of labor force is fixed, hence in equilibrium only those whose labor market statures changed make decisions of migration. The model is easy to extent by allowing new entrants of labors (e.g., new graduates).

(3) If $N_i^* < \overline{N}_i$, only the highest of the solutions to $Z_i(N) = Z_j(0)$ is positive; hence, for the relevant interval $Z_i(N) > Z_j(0)$, and every job seeker will decide to remain in a big city.

In case 1, the search equilibrium implies that workers living in a big city will invest in social connections up to $N^{B*}$, which is greater than the threshold level of migration equilibrium $\overline{N}_B$. As it pays off to invest in the social network above the migration equilibrium threshold, those whose network degrees are below $\overline{N}_B$ are less well off living in a big city. Once separated from the current job, the value of migration is greater than the value of searching in the current city, thereby resulting in migration.

In case 2, the migration equilibrium is identical to the search equilibrium. As it is not worthwhile to invest in social connection above the optimal level in the search equilibrium, in this case, the benefits of an optimal degree of social connection cannot cover the cost of living in the current city; hence, it is optimal for an agent to move to a new city to restart investing in new connections. This implies that all unemployed workers will migrate to another city until $Z(N^{i*}) = Z(\overline{N}_i)$. To demonstrate the properties of equilibria, we simulated the model in a series of numerical experiments in the next section.

## 5. Numerical example

As the degree of agents in equilibrium appears as an exponent in relevant equations, it is not easy to obtain analytical results for our model. However, we use computational methods to illustrate the matching and migration equilibria of the model.

The annual discount factor is 0.96, which implies that the interest rate is 4%. We choose a wage rate for both big and small cities that roughly equals a quarter of the average monthly salaries in Beijing and Tianjin.[13] We set the living costs for the two cities such that the net incomes are the same. The unemployment benefit equals to 50% of the income of the small city. The remaining parameters in the model are difficult to calibrate, as the probability of a worker-job pair is a productive pair and the probability that job offers arrive through a network is not directly measurable. Instead of estimating these values empirically, we choose these parameters such that the values of the rest of the parameters are reasonable and the model generates predictions consistent with

[13] In 2011, the average monthly salary in Beijing was 6319.58 yuan and in Tianjin 4636.33 yuan (State Information Center 2012).

empirical observation. Following this principle, we chose the parameter values for calibration as listed in Table 3.

**Table 3** Parameter values.

| Parameter | Value | Parameter | Value |
|---|---|---|---|
| $\beta$ | 0.96 | $\lambda$ | 0.4 |
| $w_B$ | 1600 | $\delta$ | 0.2 |
| $w_S$ | 1200 | $c(N)$ | $1/2N^2$ |
| $c_B$ | 1100 | $b$ | 600 |
| $c_S$ | 700 | $V_S$ | 400 |
| $V_B$ | 890 | $\alpha$ | 0.04 |
| $U_B$ | 900 | $U_S$ | 377 |

Based on these values, Fig. 3 shows the lifetime discounted expected utility for agents who are either employed or unemployed and who is either living in a big city or a small city, conditional on their stock of social connections. We can see that each value function is concave in $N$. As shown in the graph, the search equilibrium is such that the workers in a small city invest in social network up to $N^{S*} = 19$, while workers in a big city invest in $N$ up to $B^{B*} = 21$. Workers in a small city invest less in their social networks than their big city counterparts. This is because the job market in a small city is relatively less competitive, for example, the vacancy-unemployment ratio is relatively higher in a small city. In the search equilibrium, workers enjoy the highest present payoff value for being employed, followed by the value of being unemployed in a small city. However, living in a big city always provides a lower value being either employed or unemployed. As mentioned in Section 1, this result comes from the higher living costs faced by agents living in a big city and the similarity in wages and unemployment benefits between the two cities. This is combined with less competition in a small city's labor market since the market tightness is higher ($V_S/U_S = 0.989$) in a small city compared to that in the big city ($V_B/U_B = 0.943$). Therefore, in principle, it is surprising that most agents decide to remain in a big city even when they face better prospects in a small city independent of their employment status. However, once we consider the value of the stock of social connections that would be lost in the case of migration, the logic may become clearer.

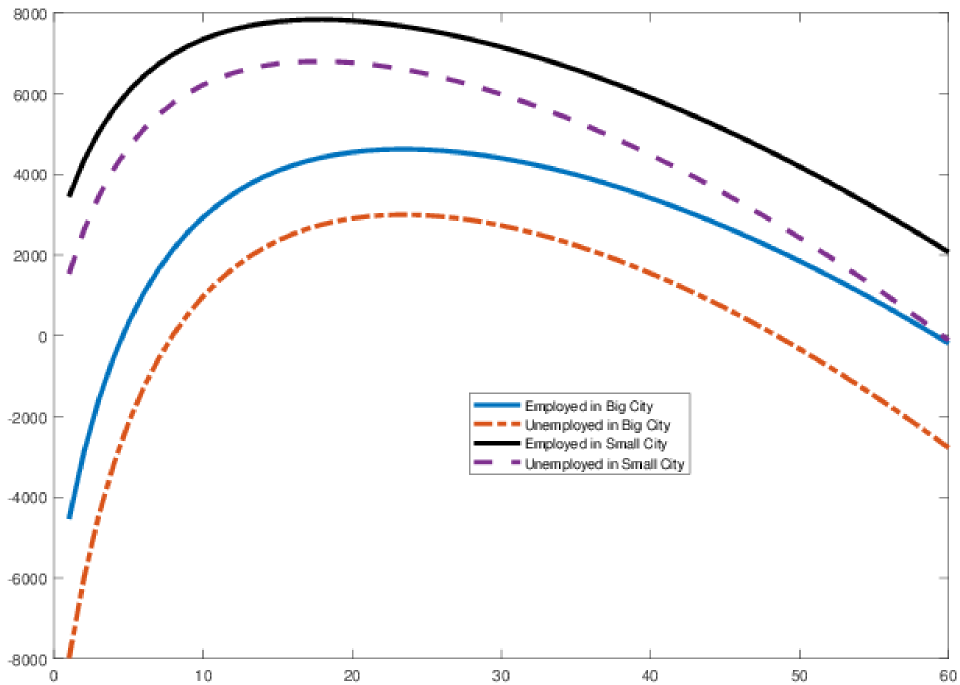


Fig. 3. Search equilibrium.

Fig. 4 presents our main result. For those who decide to migrate from the small city, instead of enjoying the payoff of search in the small city $Z^S(N^*)$ they only obtain a payoff up to $Z^S(0)$, the value of moving to a new city and restart accumulating the network connections. Given these selected parameters, the unemployed agents with $N > 4$ will decide to stay in a big city, where they face the highest expected discounted lifetime utility. It is too costly for them to migrate to a small city, as they would lose their social connections and need to start building a new social network. However, the agents with $N < 4$ will decide to migrate to a small city as their social network is not large and valuable enough to compensate for the lower expected lifetime utility that they face if they remain in a big city. The rational decision for them is to migrate, sacrifice a small number of links, and create a new social network.

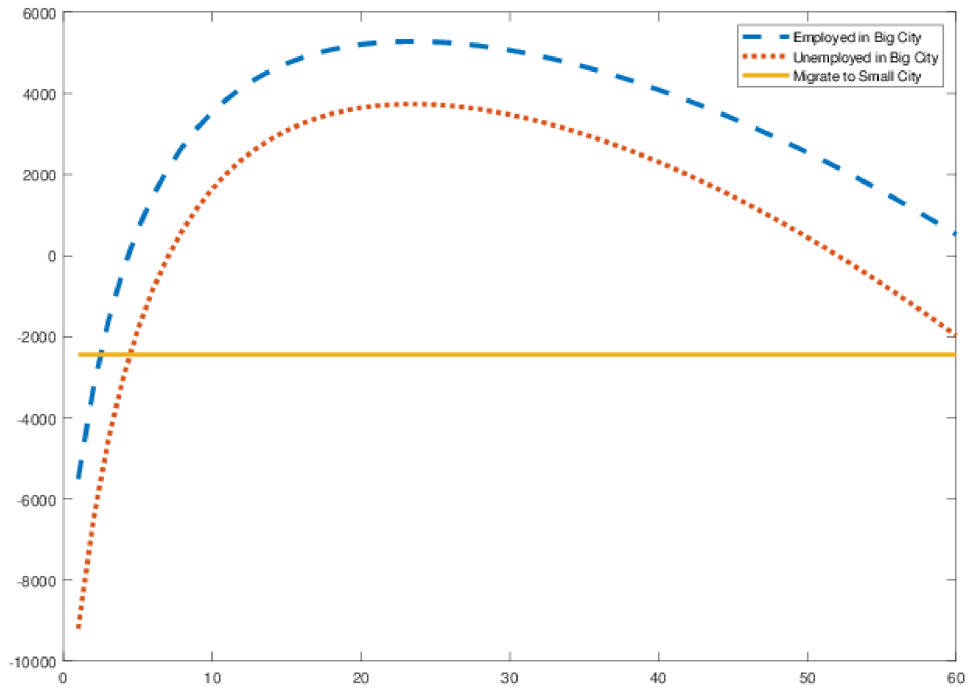


Fig. 4. Migration Equilibrium.

One can analyze the effects of these policy parameters on the migration decisions by adjusting them. In these experiments, we first increase the wage level paid in a small city by increasing $w_B$ to 1600, which equals the wage in a big city. In the second experiment, we decrease the number of unemployed job seekers in the small city by reducing $U_S$ to 100. The results of the experiments are shown in Fig. 5. By either increasing the wage or reduce the competition in the small city, we increase the expected payoffs of migration; the threshold levels of social connections increase from 4 to 6 and 7, respectively. It implies that the policies that boost the payoff of moving to a small city will increase the threshold level of the migration equilibrium and encourage some laborers to move to small cities. However, the effects of these policies may be limited as they only encourage marginally attached workers to move.

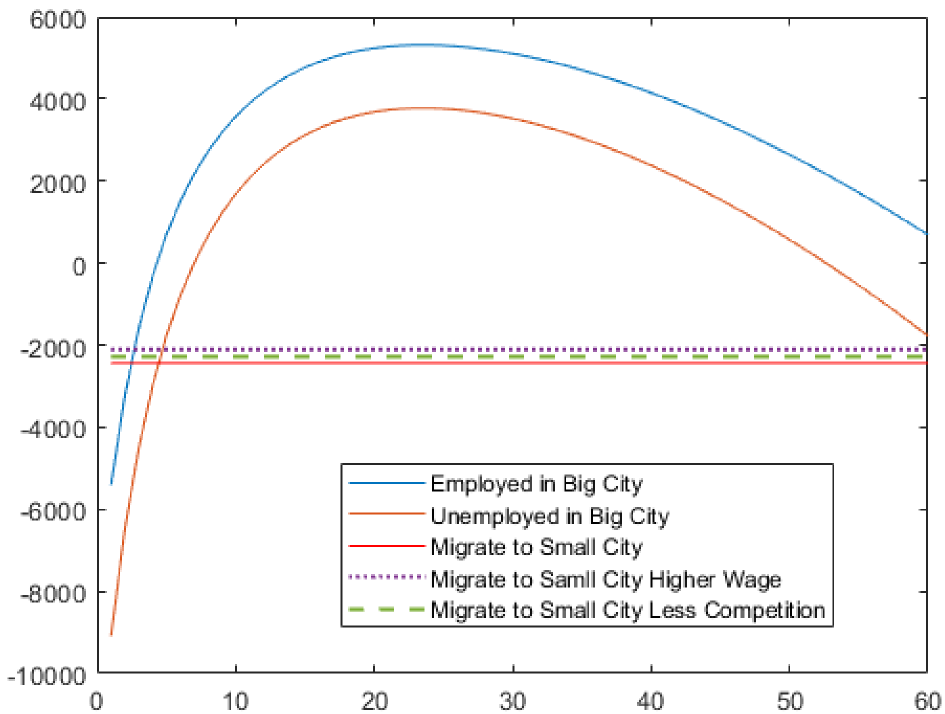


Fig. 5. Comparative Statics.

## 6. Empirical evidence and policy implications

Our model implies that given the significant payoffs from the existence of job matching networks, migrating to another city and abandoning the existing social connections incurs welfare losses. Hence, even if the net gains of living in a big city is smaller than living in a smaller one, it is still difficult for economic agents to choose to migrate.

Our model could explain the migration puzzle in Beijing. As one of China's megacities, Beijing is facing many pressures on transportation, the housing market, natural resources, and pollution. Despite higher living costs, longer commute, and severe competition, new college graduates are still prone to stay in Beijing and start their careers. As stated in the beginning, 86% of them want to stay in the city where they graduate. This is due to the social capital they accumulate over the years of study. After finishing their degrees, their job market values are relatively lower than their counterparts in smaller cities. However, given the social connections they build, the value of migration is even lower than job search in a big city, and thus they choose to stay.

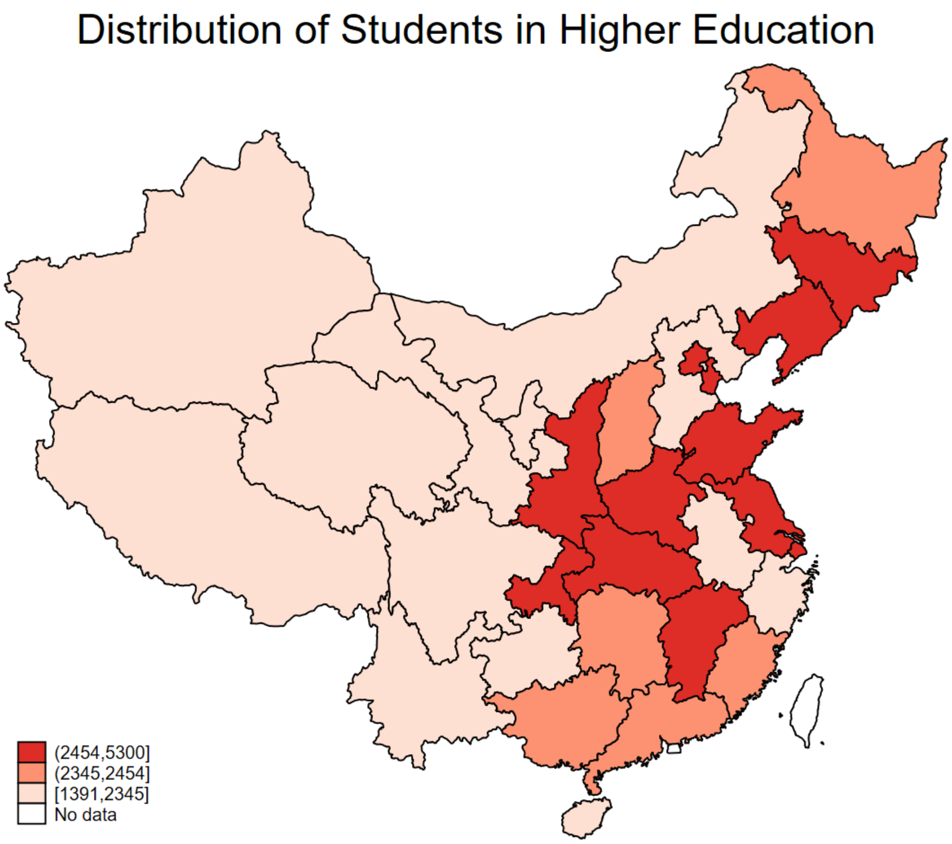

Fig. 6. Distribution of students in higher education.

Beijing's development and natural resources suffer the most from the migration puzzle. This is because Beijing is the city with the most concentrated education resources. According to the China Statistical Yearbook 2018, Beijing alone has 92 higher education colleges and universities, whereas Tianjin, Shanghai, and Chongqing have 57, 64, and 65, respectively. If we measure higher education resources by the number of students in the section per 10,000 people, Beijing again has the largest number—equal to 5,300. Fig. 6 plots the distribution of students across the country. It can be seen that the distribution of students, mirroring the distributions of higher education colleges and universities, is concentrated in limited areas in China. Logically, the unequal distribution of education resources leads to the migration of youth to these large cities to seek degrees. Through the years of education, they accumulate social capital that is too valuable to abandon. By choosing to stay, the supply of abundant graduates encourages job creation, which makes moving back to small cities seem less appealing.

Some indirect empirical evidence is consistent with our predictions. Although it is difficult to estimate empirically the effect of social network on people's migration decisions, our theory implies that, among other factors (including wage differences, job opportunities, and living cost), the regions with richer education resources should expect a larger number of locally graduated college employees in their labor market. We collected data on the number of employees with a university degree or above in China in 2017; the results are shown in Fig. 7. Compared to Fig. 6, the regions with a higher number of higher education institutions also show a larger number of employees with a degree of higher education. This association is particularly strong for regions such as Beijing, Jiangsu, and Shanghai, where most of China's elite universities (985 and 211 project universities) are located.[14]

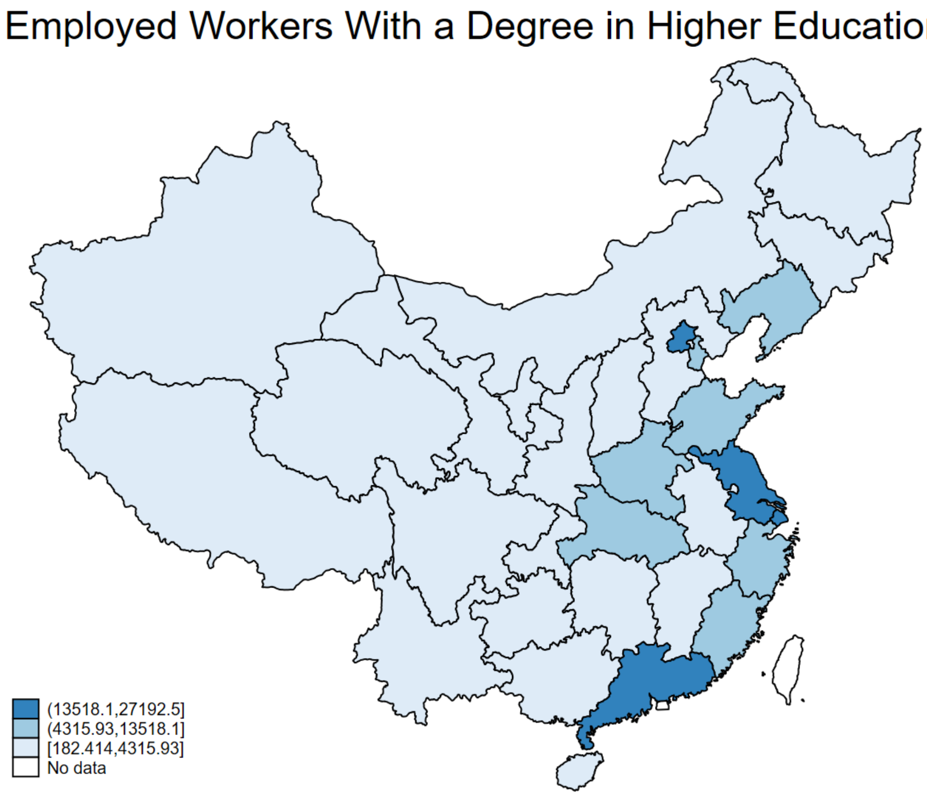


Fig. 7. The number of employed workers with a university degree or above. Unit: 10,000 people. Data source: China Labor Statistical Yearbook 2018

As mentioned above, economic policies that encourage job creation in second-tier cities, which will increase the expected payoffs to migrants, have limited influence on the marginally attached laborers. However, given the positive returns from the social network, the distribution of educational resources is the major driving force of migration in Beijing. Policies that promote the equal distribution of education resources are also recommended.

[14] The total number of 985 and 211 project universities in Beijing, Shanghai, and Nanjing are 32, 14, and 13, respectively, which is a significantly higher number than the other cities and provinces.

## 7. Conclusions

In this study, we provide a possible explanation for the phenomenon of migration to big cities in China. It has been observed that many students who graduate from universities in big cities decide to stay there to look for their first job instead of returning to their hometowns. This occurs although living costs are much higher in big cities, competition for jobs is fiercer, and that recent graduates would be able to obtain similar starting wages in a smaller city.

We argue that part of the explanation rests in the use of social networks as a tool to obtain first jobs. We set up a model with two cities of different sizes where workers are heterogeneous in their idiosyncratic matching productivity. Because of the ex-ante uncertainty involved in job searching in the market, job seekers make use of social connections with employed agents that may provide them with useful information about vacancies that would be a good match given their specific characteristics. The agents who are unable to get a job by using social networks have to participate in the matching market. All agents have to decide their optimal investment in social connections, whether to stay in a big city and use social connections they already have or to migrate to a small city and invest in creating a new network. We argue that the search equilibrium is not necessarily the same as the migration equilibrium. Hence, we claim that for migration to take place, the welfare gains from moving to a new city have to compensate for the value of the social network that an agent would abandon. We provide a numerical example in which we show that our arguments can be supported by a reasonable calibration.

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