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ABSTRACT

Density, Social Networks and Job Search Methods: Theory and Application to Egypt*

The aim of this Paper is to study the impact of the size and the quality of social networks on the probability of finding a job. We first develop a theoretical model in which individuals are embedded within a network of social relationships. Workers can obtain information about jobs either directly, or indirectly, via an employed friend belonging to their social network. We show that, conditional on being employed, the probability of finding a job through social networks ? relative to other search methods ? increases and is concave with the size of the network. There is, however, a critical size of the network above which this probability decreases. We also show that the probability of finding a job through friends and relatives decreases with the local unemployment rate. We test empirically these theoretical findings for Egypt using the 1998 Labor Market Survey. The empirical evidence supports the predictions of our theoretical model.

JEL Classification: J23 and O12
Keywords: density, networks, search methods and weak ties

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1 Introduction

It is commonly observed that job seekers use their friends and relatives to find a job. The empirical evidence suggests that about half of all jobs are filled through personal contacts (Granovetter, 1974, Holzer, 1988, Corcoran *et al.,* 1980, Topa, 2001). One reason put forward is that it is the most efficient and the least costly job search method (Holzer, 1988). Another explanation is that it allows firms, which are unable to identify the characteristics of applicants because of adverse selection problem, to screen them (Montgomery, 1991, Mortensen and Vishwanath, 1994). The focus of this paper is different. We analyze the acquisition and transmission of job information by job seekers through their friends and relatives, and in particular the effect of the size and quality of social networks on the probability to find a job.

Calvó-Armengol (2003) and Calvó-Armengol and Zenou (2003) were the first to study the effect of the size of social network in a theoretical context. They use a job-matching model in which workers find jobs through social contacts. They show that more social contacts increase the probability to find a job, a standard result in the social network literature, especially in sociology (see e.g. Wasserman and Faust, 1994).

In this paper, however, we only focus on the transmission of job information through social network rather than on the matching process between firms and workers. Thus, we do not model the matching process, but examine the transmission of job information by comparing the success of using "friends and relatives" versus other search methods.

Furthermore, we focus on a network of friends that have only *weak ties* with each other. Following Granovetter (1973, 1974, 1983), the strength of a social tie corresponds to the duration of a relationship and thus we define a weak tie (as opposed to a strong tie in which the relationship is repeated over time, for example members of the same family or very close friends) when social interaction between two persons is transitory (e.g. random encounters).[1] Granovetter argued that, because they provide bridges between densely knit clusters of social structure, weak ties are crucial whenever information is diffused through social interaction. In particular, he found that weak ties play an important role in the labor market, where they provide job seekers with information from personal contacts in distant parts of the social structure.

By developing a theoretical model in which individuals are embedded within

[1] See in particular Montgomery (1994) and Calvo-Armengol *et al.* (2003) for models on weak and strong ties in the labor market.

a network of social relationship (weak ties), we show that, conditional on being employed, the probability to find a job through social networks, relative to other search methods, is increasing and concave for reasonable size of networks, but becomes decreasing when the network is too dense. We also show that the probability to find a job through friends and relatives decreases with local unemployment rate. The intuition runs as follows. In denser areas, the size of the network increases, therefore each worker has more information and/or can be more recommended about jobs through these friends, implying that the probability to find a job using this method increases. The concavity stems from the fact that, if each worker has more friends, each of his/her friends has also more friends to transmit information, which creates congestion. When the size of the network is too dense, then the congestion effects are so important that the probability to find a job decreases. Finally, the unemployment rate is a measure of the quality of the network. If unemployment rate increases, workers are more likely to have friends that are unemployed and so less chance to get a job through friends and relatives.

To test this model we use population density as a proxy for the transmission of job information between weak ties belonging to the same network of relationships. Our conjecture is that in denser areas, the network of social relationships is larger so that the size of the network can reasonably be approximated by the population density of the area. This should be particularly true for social networks consisting exclusively of *weak ties* since it is more likely to encounter more random acquaintance in denser areas (such as cities) than in less dense areas (such as rural areas). It should be clear that we do not conjecture here that the quality and the intensity of social relationships, especially among strong ties, are better in denser areas. What we believe is that, controlling for strong ties (there is no reason to have a higher number of strong ties in denser areas), bigger cities (i.e. more densely populated areas) expose people to more contacts, which increases the number of their random acquaintance and, as a result, provide them with more information about jobs. Observe that our conjecture is not in contradiction with the *social capital* literature developed by sociologists (see in particular Coleman, 1988, and Putman, 1993, 2001). In the latter, it has been argued that social capital declines with density and urbanization. But, social capital mainly refers to strong ties. Indeed, in urban areas, the individual feels stronger in that he or she belongs to much *wider* although more *unstable* networks. Contrary to less dense areas (such as rural areas), social pressure to belong to these networks is practically nil. As

a result, in cities, social networks of individuals with regard to the intimacy, time, and proximity of physical relationships (strong ties) are weaker. On the other hand, they are more dense in number (weak ties). Since, as stressed by Granovetter (1973), the strength of weak ties is to involve a secondary ring of acquaintances who have contacts with networks outside ego's network and thus offer new sources of information about job opportunities, we believe that population density is a reasonable proxy for the size of a network of weak-tie relationships and of the transmission of job information between them.

Using the 1998 Egyptian Labor Market Survey, which is a nationally represented individual level data covering more than 20,000 individuals, we find that the probability to find a job through friends and relatives indeed increases and is concave with population density. We also find that *the predicted probability to find a job can even decrease when the area becomes very dense*, confirming one of the most surprising and controversial results of our theoretical model. We then show that this probability is negatively affected by the local unemployment rate.

Most of the empirical literature on social networks is largely confined to U.S. and British studies - except for Addison and Portugal (2002) who analyze job search methods and outcomes in Portugal - and has mainly studied the relative efficiency of one search method versus the others. For example, Holzer (1987, 1988) has shown that, in the U.S., for workers aged 16 to 23 years, friends and relatives, and direct applications without referral are not only the most frequently used search methods, but also the most productive in generating offers and acceptances. In a similar way, Blau and Robins (1990) in an analysis of Equal Opportunity Pilot Project data for 1980 have shown that friends and relatives generate the most offers and acceptances per contact, while having the highest acceptance rate per offer. For the U.K., Gregg and Wadsworth (1996) find similar results.

As stated above, our focus is different in that we study the impact of population density (as measured by the population per inhabited square Kilometer) on the probability to find a job using social networks in Egypt. This country is a particularly well adapted case study since it has extremely large variations in terms of population densities. For example, Cairo has around $27,000$ inhabitants per square Kilometer whereas, for the least dense, Suez, it is only 46. There are very few countries that have such extreme differences. For instance, in the United States, the highest dense MSAs are: Jersey City, New York and Chicago which have respectively 4577, 2875 and 1243 inhabitants per square

Kilometer.[2] To the best of our knowledge, this is the first paper that studies the relation between network size (as captured by population density) and the probability to find a job.

There is also an important empirical literature on social networks in less developed countries. However, the focus is essentially on migration and on how migrants obtain information about jobs through friends and relatives (see for example Banerjee, 1981, 1983 or more generally Munshi, 2003; Mazumdar, 1987). In fact, very few studies have analyzed the importance of social networks in finding a job in less developed countries (without migration).[3] A notable exception is Assaad (1997) who found that, in Egypt, among construction workers, kinship ties and social networks matter less than their regional background in finding a job. In another paper, Assaad (1993) found that, in the informal sector, employers prefer to hire craftsmen to whom they have previous personal ties.

The paper is organized as follows. In the next section, we develop the theoretical model. Section 3 presents the data while the econometric model is presented in section 4. In section 5, we discuss the econometric results. Finally, section 6 concludes.

2 The theoretical model

As stated above, our focus is on the impact of network size (weak ties) on the job acquisition rate of workers. For that, we propose a model in which firms only advertize their jobs using informal methods. For example, they can post help-wanted signs on their windows (or any equivalent cheap methods) and hire the first worker who is aware of this job[4] (all workers are assumed to be identical). What is then crucial for individuals is to obtain information about these jobs. To simplify and to be more specific about the Egyptian case,[5] we focus on the main search methods used by the unemployed. Either workers use their "friends and relatives" to obtain information about jobs or find by themselves this information (for example, a worker can find a job directly by

[2]Source: U.S. Bureau of Census for the 1990 Census.

[3]A recent paper by Fafchamps and Lund (2003) find strong evidence that social networks play a key role in the provision of mutual insurance in Rural Philippines.

[4]In this paper, it is assumed that a contact leads automatically to a job.

[5]Around 85% of private jobs are informal ones which implies that most private jobs are not covered by any formal contract so that hiring and firing costs are very low, and that informal job search methods are commonly used.

passing by a firm, discovers the help-wanted-sign and applies at the gate or fills in a form). The latter job search method is referred to as "job application or at the gate". Table 1 shows that the main search methods used by the unemployed are "friends and relatives" (52.1%) and "job application or at the gate" (51.5%).[6] In Table 2, one can see that 32.5% of jobs are found through friends and relatives and 8% through job application or at the gate (5.5% through job applications and 2.5% at the gate). In our data base, the latter (at the gate) means that workers asked if there is a job available at the work place and the former (job application) means that workers have filled in a form.

[*Insert Tables* 1 *and* 2]

Observe that our aim is not to explain the existence and stability of networks[7], but to take a network as given and to investigate, for each case above, how the size and the quality of the network affects the probability to obtain a job. Before stating the formal model, let us give the basic intuition of the theoretical results.

In the model, the main problem for each worker is to obtain information about jobs. Firms are assumed not to advertize jobs through newspapers (because it is assumed to be too costly), but rather using informal methods such as, for example, help-wanted signs on their windows (this has obviously no costs). Each worker is embedded in a network of social relationships, exclusively weak ties, so that he/she can find a job either *directly* (if by chance he/she sees the job advertisement) or *indirectly* because one of their friends who belongs to their social network is employed, knows about this job and transmits the information to the worker. Observe that the probability to hear directly about a job is the same for someone who is employed and for someone who is unemployed.

In particular, if an employed friend j of a worker i hears about a job, he/she will transmit this information to all his/her friends that are unemployed so that the probability to find a job for i is just 1 over the number of unemployed friends of j (in this case, i can be informed about a job and still do not obtain it). In this context, by assuming that density does not affect the "job application or at the gate" method (i.e. living in a denser area does not

[6] In Table 1, the unemployed are allowed more than one job search method. Also, observe that this paper does not deal with the optimal search methods used by firms (for this issue, see Pissarides, 1979). We just assume different search methods by firms and see how this affects workers' chance to find a job.

[7] This is what Calvó-Armengol (2002) has done.

improve your chance to get a job by this method, since even if on average you are more likely to pop in a firm with ads at its gate, there are more workers that will do the same thing), we show that, conditional on being employed, the probability to find a job through friends and relatives increases and is concave with the network size. We also show that for very dense networks, i.e. large number of weak-tie friends, this probability can even decrease and that it always decreases with local unemployment rate. The intuition runs as follows. Denser areas expose people to more contacts (the size of the network of weak ties increases) so that each worker has more direct friends and therefore has more job information through these friends. As a result, since the probability to find a job directly (i.e. "job application or at the gate" method) does not increase with density, the probability to find a job using friends and relatives increases. The concavity stems from the fact that, if each worker has more friends, each of his/her friends has also more friends to transmit information to, which creates congestion. For very dense networks, this congestion can be so important that it outweighs the benefits of large networks so that the probability to find a job decreases. Finally, the unemployment rate is a measure of the quality of the network. If unemployment rate increases, workers are more likely to have friends that are unemployed and so have less chance to get a job through their friends and relatives.

Let us be more specific about the model and describe first how individuals are connected to each other in a given social network. Denote by n the number of individuals in this given network, with $n = U + E$ (U and E are respectively the unemployment and the employment levels). We assume that networks are *symmetric*. This means that each individual $i = 1, ..., n$, who can be either employed or unemployed, has exactly the same number of direct neighbors $s < n$ and that if i is connected to j, then also j is connected to i. We also assume that the *quality* of the network is the same for everybody (*uniform mix*), i.e. the number of unemployed and employed directly connected to each worker is the same for all workers and equal respectively to $(1 - u)\, s$ and us (the unemployment rate $u = U/n$).

Figures 1a and 1b illustrate two cases of symmetric networks. In figure 1a, there are $n = 6$ workers and they are all connected to each other. Each worker has exactly 5 direct neighbors and thus communicate with all the other workers. In figure 1b, the size of the network is still $n = 6$ and the network is still symmetric, but incomplete.[8] Some workers have no relations with others

[8] To be complete, a symmetric network must be such that $s = n - 1$.

since each individual only has now 3 direct neighbors. For example, worker 1 directly communicates with individuals 3, 4 and 5, but not with 2 and 6. Observe that Figure 1a represents a complete and symmetric network which is not uniform mixed unless all workers have the same employment status (they are either all employed or all unemployed). Figures 2a, 2b and 2c give examples of incomplete symmetric networks with uniform mix. Figure 2a describes an incomplete symmetric network with uniform mix since each worker (employed or unemployed) has two direct neighbors, one being unemployed and the other employed. Figures 2b and 2c display the same incomplete network ($n = 6$, $s = 3$), but with different uniform mix. Indeed, the network in figure 2b is of better quality than that in figure 2c since in the former each worker has three direct neighbors, one being unemployed and the other two employed, whereas in the latter, only one of the direct neighbors is employed while the other two are unemployed.

[*Insert Figures* 1 *and* 2 *here*]

Let us now focus on the model. Firms only advertize their jobs using informal methods (e.g. help-wanted signs on their windows). So basically, the main problem for workers is to obtain information about jobs and since most of these jobs are advertized informally, friends and relatives (captured by the social network) and gate applications are the main methods used to obtain a job. Therefore, we would like now to calculate the probability to find a job through social networks, given that the job information is not equally available to everybody.

Assume that there are V vacancies in the economy (all jobs and workers are assumed to be identical) and U unemployed workers. Since there are n workers in the economy, the probability that a worker (employed or unemployed) directly hears of a vacancy is equal to $v = V/n < 1$ (v is thus the vacancy rate).[9] In other words, v is the probability to obtain job information without using friends and relatives. This is what was referred to as "job application or at the gate" search method. Two cases may then arise. If the worker is unemployed, then he/she takes this information and obtains the job. If he/she is already employed, he/she transmits this information to all his/her direct (unemployed) neighbors. We assume that all unemployed neighbors are treated on equal footing, meaning that the employed worker who has the job information does not favor any of his/her direct neighbors. As a result, the probability that an unemployed worker i is selected among the $k + 1$ unemployed direct

[9] We assume that $V < n$ always holds.

neighbors of an employed worker j is given by:

$$\frac{1}{k+1}\,(1-u)^{s-k-1}\,u^k$$

This probability is quite easy to understand. Indeed, the probability that a given worker j has $k+1$ unemployed direct neighbors is equal to $(1-u)^{s-k-1}\,u^k$ (i.e. this employed worker has k unemployed direct neighbors plus worker i) and thus the probability that the worker i is selected among all the $k+1$ unemployed is $\frac{1}{k+1}\,(1-u)^{s-k-1}\,u^k$. Now, since the employed worker j has s direct neighbors (including worker i), the probability that j passes the job information onto him/her is equal to:

$$\begin{aligned} p(s) &= \sum_{k=0}^{k=s-1} \begin{pmatrix} s-1 \\ k \end{pmatrix} \frac{1}{k+1}\,(1-u)^{s-k-1}\,u^k \qquad (1) \\ &= \frac{1-(1-u)^s}{s\,u} \end{aligned}$$

This implies that $v(1-u)p(s)$ is the probability that a worker j is informed about a job (probability v), does not need it (probability $(1-u)$) and transmits this information to worker i. Observe that formula (1) is quite general since it only assumes that the network is symmetric (its size is given by s) and that it is uniform mixed (the quality of the social network is the same for each worker). However, it assumes nothing on the quality of the social network (i.e. how many unemployed and employed workers are directly connected to each worker) so that $k+1$ is unknown, nothing on n, the number of workers connected to each other (it can address small as well as big network), and nothing on how workers are located in the network (this is why one must take into account the different combinations between $s-1$ and k).

Consider figure 1b for example. We only know that $s=3$ and $n=6$ and we have no information on the quality of the social network and how workers are located in this network. As a result, the probability that one of the direct friends of any unemployed worker transmits a job information is $p(3)=\frac{1-(1-u)^3}{3\,u}$. Indeed, take for example worker 2. What is the probability that worker 3 (assuming that he/she is employed and has heard about a job vacancy) will give him/her this job information? Since worker 3 has $k+1$ neighbors (with $k=2$, and, apart of 1, the two direct neighbors are 5 and 6), three cases can arise. (i) Either his/her two neighbors are employed ($k=0$), which occurs with probability $(1-u)^2$, and in this case, worker 1 automatically gets the job so that $p_{k=0}(3)=(1-u)^2$ (it is just the probability that the two direct neighbors of 3 are employed and thus do not need the job). (ii) Or only

one of his/her neighbors is employed ($k = 1$), which occurs with probability $(1-u)u$, and worker 1 obtains the job with probability 1/2. However, since we do not know the employment status of each worker, there are two possible combinations: either 5 is employed and 6 unemployed or the reverse. This implies that $p_{k=1}(3) = 2(1/2)(1-u)u = (1-u)u$. (iii) Or the two direct neighbors of 3 are unemployed ($k = 2$), which occurs with probability u^2, and worker 1 obtains the job with probability 1/3. Since there is only one combination (5 and 6 are unemployed), $p_{k=2}(3) = (1/3)u^2$. Now, by summing these three probabilities $(p_{k=0}(3) + p_{k=1}(3) + p_{k=2}(3))$, we obtain our result.

If we now take figure 2c, then we have much more information since we know exactly the employment status of each worker. In this case, what is the probability that 1 obtains job information from his/her direct neighbor 5, who is employed (and is assumed to be informed about a job)? If this is the case, then since worker 5 has also 3 neighbors, two of whom are unemployed (workers 1 and 6), the probability that 5 transmits information to 1 is obviously 1/2. Compared to figure 2b, where the network is of better quality, the probability that 1 obtains job information from his/her direct neighbor 5 is now 1 since worker 1 is the only direct neighbor of 5 who is unemployed. In other words, the more information sharing constraint exists, the less likely an unemployed worker obtains a job.

It should be clear from these simple examples that something is missing from formula (1). Indeed, $p(s)$ gives the probability to find a job through the social network using only one neighbor. However, each worker has s direct links. As a result, in a symmetric network of size s, the individual probability of hearing a job from personal contacts through word-of-mouth communication, $P(s, u, v)$, is given by:

$$P(s, u, v) = 1 - [1 - v(1-u)p(s)]^s \tag{2}$$

Indeed, since $v(1-u)p(s)$ is the probability that one of the direct neighbors of a given worker i transmits the job information, then $[1 - v(1-u)p(s)]^s$ is the probability that none of his/her s direct neighbors transmits this information to i and thus $P(s, u, v)$ is the complementary probability. Of course, (2) does not prevent the unemployed worker i to receive more than one offer (he/she can hear directly from a job and through one (or several) friend(s)). In this case, this worker takes one job at random (since all jobs are assumed to be identical) and the other offer(s) is (are) lost.

Observe that this probability is directly linked with the quality of the social

network. For example, if one compares figures 2b and 2c, it is easy to see that any unemployed worker in the network described in figure 2b has a higher probability to find a job through friends and relatives than in the network of figure 2c. Indeed, take worker 1 (who is unemployed in both figures) and let us calculate his/her probability to find a job through his/her friends and relatives. We have seen above that the probability to obtain a job through worker 5 is 1 in figure 2b and 1/2 in figure 2c. Furthermore, since in figure 2c, worker 1 has only one worker who is employed (i.e. 5), then the probability to find a job is $\frac{1}{2}v(1-u)$. In figure 2b, since worker 1 has two workers that are employed, the probability to find a job is $2v(1-u)$. Finally, because our hypothesis of uniform mix implies that all the unemployed workers have exactly the same probability $P(s,u,v)$ to obtain a job through their social network, then any unemployed worker in the network in figure 2b has a strictly higher probability to find a job than any of the unemployed in figure 2c.

Since the worker can also find a job using the "job application or at the gate" search method, the (general) individual hiring probability of an unemployed worker is given by:

$$h(s,u,v) = v + (1-v)P(s,u,v) \tag{3}$$

We have the following result:[10]

Proposition 1 *Conditional on being employed, for reasonable sizes of networks (i.e. $s < \overline{s}$),*[11] *the probability to have found a job through personal contacts, relative to other search methods, increases and is strictly concave with the network size s. However, when networks are very large (i.e. $s > \overline{s}$), then this probability decreases.*

The following comments are in order. First, in larger networks, the unemployed as well as the employed workers hear on average about more jobs through their friends and relatives but their chance to find a job directly (i.e. "job application or at the gate" search method) does not increase. Formally, this means that, for a fixed size of population n, increasing the size of the

[10] Proofs of Propositions 1 and 2 can be found in Calvó-Armengol and Zenou (2003).

[11] The critical size of the network $\overline{s}$ is such that

$$\frac{\partial P(s,u,v)}{\partial s} = 0$$

network s, rises $P(s, u, v)$ the probability to find a job through friends and relatives, but does not affect $v = V/n$ the probability to find a job directly. This result is quite intuitive since when the number of direct connections increases, the source of information about jobs is larger and people find it more easy to obtain a job through their friends and relatives. This is the first prediction of our model, which implies that, conditional on being employed, workers have a greater chance to find a job through their friends and relatives in bigger and more populated areas (cities). Second, this relation between $P(s, u, v)$ and s is concave, meaning that at the margin the increase is less and less important. Indeed, when the network size increases, each unemployed worker has more direct connections that can transmit job information, but each of his/her direct neighbors has also more direct connections so that the information held by every employed worker is now shared by a larger group of unemployed workers. Since everybody has the same network quality (uniform mix), workers' relative locations create a *negative network externality* for their direct vicinity and thus *congestion.* There is in fact more frictions and thus more coordination failures as the network expands since it is more likely that multiple vacancies reach the same unemployed worker. This implies that, in very dense and populated areas, the probability to find a job is higher than that in less dense and less populated areas, but the increase is not at the margin very large because of congestion effects. Finally, when the size of the network is very large, then the congestion created by workers' negative network externalities is so large that it outweighs the benefit of knowing more people. As a result, when s is large enough, $P(s, u, v)$ decreases.

Let us describe our second main result.

Proposition 2 *Conditional on being employed, the probability to have found a job through personal contacts, relative to other search methods, decreases with the unemployment rate u.*

This is also very intuitive. When the unemployment rate u increases, it does not affect $v = V/n$ the probability to find a job directly but it does influence the one using friends and relatives. In fact, two effects are in order: (i) the likelihood that a worker, who is directly informed of a vacancy through formal channels (with probability v), is unemployed increases, and also (ii) the number of unemployed directly connected to every informed and employed worker rises. In other words, when u increases, there is a deterioration of the social network (compare for example the networks in figures 2b and 2c where

the first network is characterized by less unemployment than the second one) and thus u and $P(s, \cdot, v)$ are negatively correlated.

Let us summarize our results.

(i) Conditional on being employed, the probability to have found a job through social networks, relative to other search methods, increases and is concave in denser networks;

(ii) When networks are very dense, this probability decreases when the size of the network increases.

(iii) The probability to find a job through friends and relatives decreases with the unemployment rate.

In other words, take one employed individual with a given set of characteristics (age, education, gender...). Then, other things being equal (i.e. fixing u and v):

(i) This individual had a higher chance to find a job through friends and relatives if he/she has 10 friends rather than 5 friends. However, switching from 10 to 11 friends gives him/her a higher chance to find a job through friends and relatives rather than switching from 20 to 21.

(ii) There is a critical size of the network, say $\overline{s} = 100$, such that this individual has a higher chance to find a job through friends and relatives if he/she has 200 friends rather than 300 friends.

Now, if we fix $s = 10$ and v, then:

(iii) This individual has a higher chance to find a job through friends and relatives if among his/her 10 friends 2 rather than 4 are unemployed.

We would now like to test these results. Our conjecture is that the same individual in different areas will not have the same number of friends s. More precisely, since our focus is exclusively on social networks of *weak ties*, we conjecture that in more densely populated areas (such as big cities), individuals are exposed to more random contacts and thus are more likely to have more friends of these types (i.e. random encounters)[12] to rely whereas the probability to find a job directly (i.e. using other search methods such as direct

[12]Even though in rural environment, social networks of kinship ties, intimacy, and necessity prevail, in an urban environment, friendship, superficial contacts, instability, and voluntary action prevail and, as a result, the number of potential "unstable" (or weak ties) friends is higher. See in particular our discussion in the introduction.

application) is not affected by the density of the area. With this interpretation of the model, the predictions of our theoretical results are as follows:

Take an individual with a given set of characteristics (family, strong ties, age, education, gender...). Then, other things being equal (i.e. fixing u and v):

(i) Conditional on being employed, this individual has a higher chance to have found a job through friends and relatives than through other search methods if he/she lives in denser area rather than less dense areas. However, this probability increases with population density at a decreasing rate.

(ii) There is a critical size of population density above which this individual has a lower chance to find a job through friends and relatives if he/she lives in a denser area.

Finally, if we fix the density of the area and v, then:

(iii) This individual has a higher chance to find a job through friends and relatives than through other search methods if he/she lives in an area where the (local) unemployment rate is lower.

We would now like to test these three predictions (i), (ii) and (iii). Let us first describe the data that we are using in the empirical analysis.

3 The data

This study uses data from the Egypt Labor Market Survey (ELMS 98), which is a nationally representative household survey carried out on a sample of almost 5000 households, sampling over 20,000 individuals, in late 1998.[13] The survey includes extensive data concerning basic demographics, employment characteristics, unemployment, occupational history, and education. In addition, the ELMS 98 collected information on job search methods used by unemployed workers, as well as job finding methods used by employed waged workers.

[13]See Assaad and Barsoum (1999) for a description of the sampling and questionnaire design of the ELMS 1998. All results are weighted by the appropriate sampling weights to reflect the characteristics of the population.

The survey allows us to identify the following eight job search methods:[14] 1) asked friends and relatives, 2) inquired at work place, 3) job application, 4) advertisement in newspapers, 5) registered in private employment office, 6) registered in government employment office, 7) entered government job competition,[15] 8) a residual group of other methods used. Employed individuals[16] working for wages were asked about the main method used in obtaining their current jobs, while those currently unemployed[17] were asked about the main job search method they are using to find a job. For the unemployed, more than one job search method is allowed i.e. respondent reports yes or no to a list of job search methods.

The analysis is based on 4522 employed workers and 976 unemployed workers, aged 15-64 years old. Tables 1 and 2 provide information on search methods used by the unemployed and job finding methods used by employed workers. Table 1 shows that the most popular method used by the unemployed is "friends and relatives" since 52% of the unemployed are using their social network as their main method when looking for a job. More precisely, in Table 3, 55% of young unemployed workers (15-19 year old) are searching for a job using friends and relatives. Compared to the U.S., Holzer (1987, 1988) found that, among the young unemployed, 80% are using "friends and relatives". Table 2 is even more interesting. It indicates that 32% of currently employed workers have obtained their current job through their friends and relatives and only 27% found their current job through employment agencies. Table 3 shows that,

[14]Observe that the theoretical model has shown that, as long as firms use informal methods to recruit their workers, then whatever these methods are, all our theoretical results hold. This implies that, in the empirical analysis, we do not need to have information on the search methods used by firms, but only on the ones used by workers.

[15]Egypt has a large public sector where around 35% of non-agricultural jobs belong (McCormick and Wahba, 2002). A public employment drive was undertaken in the early 1960s which was underpinned by an 'employment guarantee' entitling university graduates to apply for public appointment two years after graduation and secondary school graduates after three years to allow males to finish their military service. Once a year, the Ministry of Manpower invites applications specifying preference from eligible graduates. However, with high demand for those jobs and the pressure on the government to downsize, the waiting period for those jobs has been getting longer with more than ten years to wait. Thus, during the 1990s, the job guarantee has effectively, though not officially, been suspended. In effect, this has led many graduates to resort to the private sector for employment. See Wahba (2002).

[16]Methods used in getting current main jobs were collected for waged workers only and not for self-employed, employers and unpaid workers

[17]The definition of "unemployment " used here is the ILO conventional one and refers to a worker who has no work, currently available for work and searching for work. The reference period is 3 months.

among employed men, 35% obtained their jobs through friends and relatives compared to 21% for women, and 57% of young employed workers (15-19 year old) have obtained their current jobs through social networks. Compared to the U.S., approximately 50% of all workers currently employed found their jobs through friends and relatives (Montgomerry, 1991). Finally, our data (Table 3) indicate that the less educated workers use the most "friends and relatives" as their main method of search. This is true both for the unemployed and the employed. Similar results are found by Holzer (1987, 1988). As a result, even though the figures are a little below the ones obtained for the U.S., it should be clear that social networks are an important aspect of the Egyptian labor market.

[*Insert Table* 3 *here*]

4 The econometric model

We model the determinants of employed workers having found a job through friends and relatives. We assume that the probability of success is a logistic function where: $z = 1$ if an employed worker successfully managed to find a job through friends and relatives, and $z = 0$ if an employed worker successfully managed to find a job otherwise (through other methods). We examine, conditional on being employed, the probability of having used friends and relatives as the main job search method versus not (having used other job serach methods).

$$P(z_i = 1) = \frac{e^{\beta' x}}{1 + e^{\beta' x}}$$

$$P(z_i = 0) = \frac{1}{1 + e^{\beta' x}}$$

A set of explanatory variables explaining the probability of using friends and relatives are included, namely individual characteristics, network characteristics and regional characteristics.

Our theoretical model predicts that the transmission of information is better in larger social networks, i.e., conditional on being employed, the probability to find a job through networks increases with the size of the network. It also predicts that there are decreasing returns to scale if the network is too large and that the quality of the network does matter for finding a job. As stated above, in our empirical analysis, we capture the size of the network of

weak ties and the transmission of information by the population density of the area (population measured in thousands per inhabited square Kilometer) in the governorate (county).[18] Our conjecture is that in denser areas the same individual is more likely to have more random encounter friends to rely on than in less dense areas. Thus, we expect that in dense areas, the transmission of information through networks is better than in sparse areas. However, as the theoretical model predicts, if the area is too dense, then there is congestion and, at the margin, the probability to find a job through network is concave and can eventually decrease. To allow for this non-linear relationship, density squared is also included.

In addition, we capture the quality of the network by including unemployment rates in the governorate for three different educational levels. We assume that an individual's friends tend to be of similar educational background and use the unemployment rate of the relevant educational group.

We control for strong ties by including in the regression the number of individuals in the household who are in the Labor Force. The idea is that the more relatives (strong ties) who are in the labor force, the better knowledge and information on jobs they will have and transmit. In addition, we use three other variables related to the father's background and employment. Thus, we include a dummy if the father is illiterate, a dummy if the father has a public sector job, and therefore would have access to influential acquaintances, and a dummy if the father is out of the labor force.

We also control for job characteristics of employed workers. First, we distinguish between 5 sectors of employment. (i) public sector (government and public enterprises), (ii) private non-agricultural formal sector, (iii) private non-agricultural semi-formal sector, (iv) private non-agricultural informal sector, and (v) agricultural sector. Informal employment refers to activities that are unregulated by the formal institutions and regulations of society such as labor laws, registration and taxation. We use three different indicators to explore the various dimensions of informality: (i) no job contract, (ii) no social security coverage, (iii) neither contract nor social security. So, a private formal worker is a worker who has a job contract and social security. A private semi-formal worker has either a job contract or social security contribution. A private informal worker has neither a job contract nor social security. In addition, we distinguish between blue and white collar workers. The reference is blue collar

[18] We use the Egypt Human Development Report (1998/9) to calculate the population density for each governorate. There are 26 governorates (administrative units) and 6 regions in Egypt.

worker and we use three dummies to capture the differences in white-collar occupation: 1) technical and scientific, 2) management, and 3) clerical. Finally, we capture the industry/economic activity to which the current job belongs to using: manufacturing, trade, agriculture and others.

We finally control for individual characteristics: gender, age, education and martial status. We use a dummy for male. Six age dummies are included: 15-19, 20-29, 30-39,40-49, 50-59, and 60-64, where the reference age group is 20-29. We use three educational dummies: illiterate, less educated (primary and less than secondary education) and educated (secondary and university graduates). We also use a dummy for married individuals and for heads of households. Finally, we capture regional characteristics by including 6 regional dummies: Greater Cairo, Alexandria and Canal Cities, Urban Lower, Urban Upper, Rural Lower and Rural Upper.[19]

[*Insert Table* 4 *here*]

5 The empirical results

Table 5 confirms the predictions of our theoretical model. Indeed, conditional on being employed, the probability to have found a job using friends and relatives, compared to other search methods, is higher in denser areas than in less dense areas. This means that, in denser areas, the transmission of job information between weak ties through social networks is better: people are more likely to have more random encounters (weak ties), either directly or indirectly (friends of friends) in denser areas. More precisely, increasing the average population density by 10 %, increases the mean probability to find a job using friends and relatives by 2.6 percentage points. Moreover, Table 5 also indicates that congestion effects do exist. When the area becomes too dense, then the probability to find a job through friends and relatives increases at a decreasing rate. Our theoretical conjecture is that in too dense areas, the friends of my friends are in competition with me and create negative externalities to each other. The quality of the network has the predicted sign. When the average local unemployment rate increases by one percent, the mean probability to find a job through networks falls by 0.4 percentage point. This is because, in addition to the size, what really matters is the quality of the network: it is who you know! (Mortensen and Vishwanath, 1994). In other

[19]The definition of all the explanatory variables are given in Table 4.

words, the transmission of job information is not always valuable since not all personal weak ties lead to a job. Another variable aiming at controlling for strong ties is whether the father of the job holder works in the public sector or not. Indeed, public sector jobs in Egypt imply tenure jobs (civil servants) and prestige, which lead to high quality social contacts. We find that the mean probability to find a job through networks increases by 6 percentage points if the father has a public job. Finally, the last two columns of Table 5 show that these results are robust if we exclude public sector jobs, or rural areas.

[*Insert Table* 5 *here*]

Figure 3 confirms our seemingly surprising theoretical predication that the probability to find a job through social networks can even decrease for very large networks.[20] Indeed, in Egypt, when population density is above 4,000 inhabitants per square kilometer, then the predicted probability to find a job through friends and relatives starts to decline. Interestingly, in Greater Cairo, which is the most dense area (around 27,000 inhabitants per square kilometer), a worker with similar characteristics has a lower probability to find a job through friends and relatives (34 percentage points) than for example in Port Said (around 4,000 inhabitants per square kilometer) in which this probability amounts to 43 percentage points. It is indeed more likely that, in Greater Cairo, social networks of weak ties are very dense and lead to negative externalities and congestion for job seekers because the job information sharing is much more higher than in less dense areas.

[*Insert Figure* 3 *here*]

In order to test the robustness of our results, we study the impact of population density on the probability of the unemployed workers to use friends and relatives as their main search method.[21] Table 6 displays these results. We indeed find that population density does positively affect social network since

[20] For sake of clarity, in Figures 3 and 4, Greater Cairo is excluded because it is out of scale. In Figure 3, the predicted probability of obtaining a job is continuously decreasing after 7,000 inhabitants per square Kilometer while in Figure 4, the probability of unemployed using friends and relative is increasing after 7,000. Figure 3 is based on Col 1, Table 5 and refers to a representative individual: a male, blue-collar worker, aged 20-29 years old, who has no education, and lives in Greater Cairo.

[21] For the econometric model, as in the previous case, we assume that the probability is a logistic function, where $y = 1$ if the unemployed uses friends and relatives as a job search method and 0 otherwise.

denser areas imply that the unemployed use more their social networks. This strengthens our previous results since it shows that, not only the unemployed use more their social networks in denser areas, but they also have more chance to find a job in denser areas. This result is similar to the findings of Holzer (1987, 1988) and Blau and Robins (1990) since it shows that friends and relatives is a popular and efficient search method. However, the most relevant result for us is displayed in Figure 4.[22] Contrary to Figure 3, one observes that there is not a monotonic relationship between the predicted probability of using friends and relatives as the main search method for the unemployed and the population density. In particular, we do not have here the interesting, but surprising result of Figure 3 that this probability could sharply decrease when areas are very dense (it does decrease but just slightly). This could confirm our theoretical intuition in which congestion effects are so important in very dense areas that they reduce the probability to find a job through friends or relatives. Here, there is no reason to believe that the unemployed workers would use less their social networks in very dense areas since there is no competition between the unemployed in using their contacts whereas competition is fierce for the ones who want to obtain a job.

[*Insert Table* 6 *and Figure* 4 *here*]

Table 7 runs the same types of regressions as Table 5 but for different levels of education. We find that the effects are much stronger for less educated workers than educated ones. Indeed, when a worker is less educated, he/she relies more on friends and relatives because low-skill jobs are less likely to be advertized and are more likely to belong to the informal sector, especially in Egypt. Table 8, which uses predicted probabilities, confirms this result. It shows that the predicted probability of getting a job through friends and relatives for the reference worker (i.e. a blue-collar worker aged 20-29 years old who lives in Greater Cairo) is the highest for illiterate individuals: Nearly fifty percent of them find a job using their networks whereas it is only fifteen percent among the educated workers. Even though the numbers are different, this result is also consistent with the US since Holzer (1988) finds that less educated are also more likely to use friends and relatives than educated workers.

[*Insert Tables* 7 *and* 8 *here*]

[22] Figure 4 is based on Col 1, Table 6 and refers to a representative unemployed individual: a male who is aged 20-29 years old, has no education, and lives in Greater Cairo.

We also find that the effect of density on the probability to find a job through friends and relatives is robust to employment duration.[23] In addition, to test for whether in denser areas there are more jobs, and therefore the probability of getting any job is higher, we estimate a multinomial logit of the determinants of getting a job using different methods. Three search methods were used in addition to "asked friends and relatives" : 1) job application, 2) inquired at work place, and 3) other methods. One would expect that if there were more jobs in denser areas then there should be a positive relationship between density and each and every job search method. However, Table 9 shows that this is not the case. We find that there is a negative relationship between density and the probability of directly finding a job relative to using friends and relatives, i.e. denser areas reduce the probability to find a job through direct applications. This is also true for all the other methods. In other words, *denser areas increase the probability to find a job only through friends and relatives and not for the other methods.*

[*Insert Table* 9 *here*]

6 Conclusion

In this paper, we study the impact of population density (as measured by the population per inhabited square Kilometer) on the probability to find a job using social networks. For that, we develop a theoretical model in which individuals are embedded within a network of social relationships and firms only advertise their jobs using informal methods (e.g. help-wanted signs on their windows). What is crucial here is to obtain information about jobs. This can be done either directly by an unemployed worker or indirectly via an employed friend who does not need the job and transmits this information to his/her direct neighbors. We show that the probability to find a job through friends and relatives increases and is concave with population density. We also show that, beyond a certain size of the network, this probability decreases. Finally, the probability to find a job through friends and relatives decreases with local unemployment rate.

We then test empirically these theoretical findings using Egyptian data. The empirical evidence supports the predictions of our theoretical model. The

[23] We have tried several employment duration: 3 years, 5 years, 8 years and more than 8 years of employemnt. The results, which are not reported but are available upon request, were robust throughout.

empirical findings indicate that conditional on being employed, the probability to have found a job through friends and relatives increases and is concave with population density. In addition, the evidence supports the seemingly surprising theoretical prediction that, above a certain size of the population density, that predicted probability is reduced. We also find that this probability is negatively affected by the local unemployment rate.

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Table 1: Search Method Used by Unemployed

	Percentage*
Friends & Relatives	52.1
Governmental job competition	32.3
Governmental employment office	29.6
Inquired at work place	27.3
Job application	24.2
Private employment office	7.6
Newspaper Ads	1.2
Others	28.8

* More than one method of search is allowed.

Table 2: Job Finding Methods Used by Employed Workers

	Percentage of jobs found using each method
Friends & Relatives	32.5
Governmental employment office	27.5
Governmental job competition	13.9
Job application	5.5
Newspaper Ads	2.6
Inquired at work place	2.5
Private employment office	0.2
Others	15.3

Table 3: Characteristics of Individuals Using Friends & Relatives (%)

	Employed[1]	Unemployed[2]
Gender: Male	35.29	55.12
Female	20.71	49.13
Age Group: 15- 19 years	57.49	54.79
20-29	44.67	52.04
30-39	28.62	51.42
40-49	20.50	53.71
50-59	19.24	37.22
60-64	48.43	12.95
Education: Illiterate	47.26	43.72
Less than Secondary	36.17	55.31
Secondary & University	15.00	45.30
Marital Status: Married	25.00	46.29
Head of Household	27.91	51.52
	49.00	34.72
Father's Characteristics: Illiterate		
Public Sector	30.75	39.09
Out of the Labour Force	6.08	5.16
Occupation: Technical & scientific	11.37	--
Management	11.95	--
Clerical	14.84	--
Sales	60.51	--
Services	34.76	--
Agriculture	50.29	--
Production	48.32	--
		--
Sector: Public	10.51	
Private Formal	49.45	--
Private Semi-formal	69.31	--
Private Informal	57.28	--
Other	50.29	--
Industry: Agriculture	47.11	--
Manufacturing	51.70	--
Utilities	17.11	--
Construction	27.87	--
Trade	61.55	--
Transport	47.71	--
Finance	37.33	--
Services	12.22	--
Region of Residence: Greater Cairo	44.05	59.97
Alexandria & Canal Cities	30.00	64.47
Lower Urban	23.47	51.55
Upper Urban	23.30	39.38
Lower Rural	31.86	54.01
Upper Rural	30.76	39.97
Sample Size	4522	976

Note: 1. Employed workers who got their job through using friends and relatives.
2. Unemployed using friends and relatives as one job search method.

Table 4: Definition of Variables

	Definition
Social Network:	
Density	Population (in thousands) per inhabited square Kilometre, by governorate
Density Squared	Density squared
Unemployment rate	Unemployment rate in governorate by educational group
Number of Individuals/HH in the LF	Number of individuals in the household who are in the labour force
Father's Characteristics	
Father: illiterate	Dummy=1 if father is illiterate
Father: Public	Dummy=1 if father is employed in the Public Sector
Father: OLF	Dummy=1 if father is out of the labour force
Individual Characteristics:	
Male	Dummy=1 if male
Age Group: *(ref. 20-29)*	
15- 19 years	Dummy=1 if 15-19 year old
30-39	Dummy=1 if 30-39 year old
40-49	Dummy=1 if 40-49 year old
50-59	Dummy=1 if 50-59 year old
60-64	Dummy=1 if 60-64 year old
Education: *(ref.: illiterate)*	
Less than Secondary	Dummy=1 if educational level is less than secondary
Secondary & University	Dummy=1 if educational level is secondary or university
Married	Dummy=1 if married
Head of Household	Dummy=1 if head of household
Region of Residence: *(ref. Greater Cairo)*	
Alexandria & Canal Cities	Dummy=1 if individual lives in Alexandria or Canal Cities
Lower Urban	Dummy=1 if individual lives in Lower Urban Egypt
Upper Urban	Dummy=1 if individual lives in Upper Urban Egypt
Lower Rural	Dummy=1 if individual lives in Lower Rural Egypt
Upper Rural	Dummy=1 if individual lives in Upper Rural Egypt
Occupation: *(ref. blue collar)*	
Technical & scientific	Dummy=1 if technical & scientific
Management	Dummy=1 if management
Clerical	Dummy=1 if clerical
Sector: *(ref. public)*	
Private Formal	Dummy=1 if non-agriculture private formal
Private Semi-formal	Dummy=1 if non-agriculture private semi-formal
Private Informal	Dummy=1 if non-agriculture private informal
Other	Dummy=1 if agriculture
Industry: (ref. other industries)	
Manufacturing	Dummy=1 if industry is manufacturing
Trade	Dummy=1 if industry is trade

Table 5: Probability of Getting a Job Using Friends & Relatives: Marginal Effects

	Total Sample	Private Sector	Urban Areas
Social Network: Size			
Density	0.071***	0.068*	0.059***
	(4.71)	(3.26)	(2.91)
Density Squared	-0.002***	-0.003***	-0.002***
	(4.40)	(3.29)	(2.50)
Social Network: Quality			
Unemployment rate	-0.004***	0.001	-0.005***
	(3.68)	(1.11)	(3.17)
Control Variables			
Number of Individuals/HH in LF	0.0004	-0.001	-0.020
	(0.05)	(0.13)	(1.33)
Father's Characteristics			
Illiterate	0.020	0.031	0.030
	(0.88)	(1.02)	(0.75)
Public Sector	0.060***	0.034	0.087***
	(2.84)	(1.36)	(3.67)
Out of the Labour Force	0.054	0.004	0.052
	(1.12)	(0.09)	(0.71)
Individual Characteristics			
Male	-0.004	-0.030	-0.001
	(0.18)	(0.89)	(0.05)
Age Group:			
15- 19 years	-0.052	-0.012	-0.037
	(1.36)	(0.30)	(0.63)
30-39	-0.037	-0.015	-0.047
	(1.02)	(0.41)	(1.01)
40-49	-0.077**	-0.022	-0.100***
	(1.98)	(0.86)	(2.55)
50-59	-0.116***	-0.101**	-0.135***
	(2.44)	(2.18)	(2.85)
60-64	0.104	0.170**	0.146**
	(1.39)	(2.35)	(1.91)
Education:			
Less than Secondary	-0.018	-0.003	-0.006
	(0.57)	(0.13)	(0.12)
Secondary & University	-0.081**	-0.063	-0.060
	(1.80)	(1.53)	(1.14)
Married	-0.103***	-0.072***	-0.109***
	(5.23)	(2.61)	(3.92)
Head of Household	0.024	0.045	0.004
	(0.83)	(1.07)	(0.11)
Region:			
Alexandria & Canal Cities	-0.189***	-0.172***	----
	(3.11)	(3.26)	

Lower Urban	-0.169**	-0.105	----
	(2.23)	(1.49)	
Upper Urban	-0.135**	-0.104	0.026
	(2.12)	(1.59)	(1.04)
Lower Rural	-0.118**	-0.067	----
	(1.73)	(1.10)	
Upper Rural	-0.217***	-0.223***	----
	(2.92)	(3.81)	
Occupation:			
Technical & scientific	-0.220***	-0.106***	-0.199**
	(9.41)	(3.08)	(8.24)
Management	-0.241***	-0.217**	-0.217*
	(2.83)	(1.88)	(2.26)
Clerical	-0.087***	-0.007	-0.062**
	(2.38)	(0.15)	(1.47)
Sector:			
Private Formal	0.251***	----	0.288***
	(7.65)		(6.72)
Private Semi-formal	0.341***	----	0.400***
	(15.81)		(10.55)
Private Informal	0.369***	----	0.370***
	(9.28)		(9.37)
Other	0.297***	----	0.319***
	(10.50)		(6.99)
Industry:			
Manufacturing	0.159***	0.091**	0.164***
	(8.02)	(3.20)	(6.61)
Trade	0.170***	0.134***	0.161***
	(7.87)	(6.14)	(4.82)
Log-Likelihood	-1958.51	-1261.72	-1351.88
DF	24	24	21
Sample size	4522	1947	3196

Notes: Absolute values of robust t-statistics are in parentheses Robust (Huber/White/sandwich) estimator of the variance was used in place of the conventional Maximum Likelihood Estimation variance estimator and observations were allowed to be not independent within *cluster*.* significant at 10% level. ** significant at 5% level. ***significant at 1% level. Marginal effects show the increment in the probability relative to the sample mean, corresponding to the particular characteristic, relative to the reference group. The reference group: a blue-collar worker, aged 20-29 years old, who has no education, and lives in Greater Cairo.

Table 6: Probability of Unemployed Using Friends & Relatives: Marginal Effects

	Total sample	Illiterates & Less Educated	Educated
Social Network: Size			
Density	0.023*	0.015	0.046
	(1.39)	(0.98)	(1.01)
Density Squared	-0.001**	-0.001	-0.0002
	(1.75)	(1.14)	(1.30)
Social Network: Quality			
Unemployment rate	0.0002	0.00003	0.009**
	(0.12)	(0.02)	(1.62)
Control Variables			
Number of Individuals/HH in LF	0.022***	0.015***	0.038***
	(3.51)	(2.57)	(2.46)
Father's Characteristics			
Illiterate	-0.034	-0.027	-0.075
	(1.28)	(1.39)	(0.95)
Public Sector	-0.012	-0.041***	-0.127
	(0.37)	(2.00)	(0.94)
Out of the Labour Force	-0.116	-0.066	-0.152
	(1.48)	(0.84)	(1.27)
Individual's Characteristics			
Male	0.030	0.030	-0.003
	(1.34)	(1.39)	(0.06)
Age Group:			
15- 19 years	-0.016	0.007	----
	(0.44)	(0.29)	
30-39	0.054	0.034	0.142
	(0.97)	(0.88)	(1.03)
40-49	-0.178**	-0.184**	----
	(2.07)	(2.64)	
50-59	-0.206**	-0.218**	----
	(2.03)	(2.55)	
60-64	-0.464**	-0.406**	----
	(1.82)	(1.61)	
Education:			
Less than Secondary	0.045	----	----
	(0.85)		
Secondary & University	-0.047	----	----
	(0.70)		
Married	-0.068***	-0.030***	-0.368***
	(2.49)	(1.23)	(3.72)
Head of Household	0.147***	0.122***	0.083
	(3.21)	(2.33)	(0.42)
Region:			
Alexandria & Canal Cities	-0.073	-0.062	-0.071
	(0.48)	(0.52)	(0.22)
Lower Urban	-0.161	-0.107	-0.231
	(1.21)	(0.97)	(1.08)

Upper Urban	-0.339**	-0.333**	-0.188**
	(1.88)	(1.92)	(0.76)
Lower Rural	-0.193	-0.143	-0.213
	(1.28)	(1.13)	(1.04)
Upper Rural	-0.372***	-0.335***	-0.243
	(2.49)	(2.37)	(1.46)
Log-Likelihood	-642.61	-498.21	-133.37
DF	19	19	15
Sample size	976	759	217

Notes Absolute values of robust t-statistics are in parentheses Robust (Huber/White/sandwich) estimator of the variance was used in place of the conventional Maximum Likelihood Estimation variance estimator and observations were allowed to be not independent within *cluster*.* significant at 10% level. ** significant at 5% level. ***significant at 1% level. Marginal effects show the increment in the probability relative to the sample mean, corresponding to the particular characteristic, relative to the reference group. The reference group: unemployed individuals, aged 20-29 years old, and live in Greater Cairo. The reference group is also illiterate - Col 1.

Table 7: Probability of Getting a Job Using Friends & Relatives by Education: Marginal Effects

	Illiterates & Less Educated	Educated
Social Network: Size		
Density	0.072***	0.058*
	(4.94)	(1.45)
Density Squared	-0.002***	-0.002
	(4.83)	(1.19)
Social Network: Quality		
Unemployment rate	-0.004***	-0.008*
	(3.05)	(1.32)
Control Variables		
Number of Individuals/HH in LF	0.0005	0.007
	(0.06)	(0.31)
Father's Characteristics		
Illiterate	0.016	0.038
	(0.80)	(0.59)
Public Sector	0.041**	0.127
	(1.64)	(4.87)
Out of the Labour Force	0.101***	0.155
	(2.16)	(1.55)
Individual Characteristics		
Male	-0.044	0.091
	(1.35)	(2.49)
Age Group:		
15- 19 years	-0.041	----
	(1.17)	
30-39	-0.064**	0.032
	(1.75)	(0.51)
40-49	-0.091**	-0.070
	(1.77)	(1.22)
50-59	-0.119**	-0.195**
	(2.23)	(2.08)
60-64	0.127**	-0.244**
	(1.66)	(1.30)
Married	-0.085***	-0.141***
	(3.17)	(2.66)
Head of Household	0.033	0.070
	(0.81)	(1.17)
Region:		
Alexandria & Canal Cities	-0.225***	----
	(2.75)	
Lower Urban	-0.201**	----
	(2.10)	
Upper Urban	-0.157**	-0.005
	(1.98)	(0.10)

Lower Rural	-0.142	----
	(1.55)	
Upper Rural	-0.252***	-0.0001
	(2.70)	(0.00)
Occupation:		
Technical & scientific	-0.188***	-0.099**
	(4.25)	(1.65)
Management	-0.168	-0.037
	(1.08)	(0.31)
Clerical	-0.169***	0.199***
	(3.09)	(2.76)
Sector:		
Private Formal	0.229***	0.322***
	(6.71)	(5.95)
Private Semi-formal	0.312***	0.475***
	(14.34)	(6.21)
Private Informal	0.331***	0.434***
	(7.75)	(9.59)
Other	0.264***	----
	(10.68)	
Industry:		
Manufacturing	0.137***	0.220***
	(4.97)	(4.21)
Trade	0.138***	0.306***
	(4.55)	(3.26)
Log-Likelihood	-1567.04	-356.64
DF	24	22
Sample size	3085	1437

Notes: Absolute values of robust t-statistics are in parentheses Robust (Huber/White/sandwich) estimator of the variance was used in place of the conventional Maximum Likelihood Estimation variance estimator and observations were allowed to be not independent within *cluster*.* significant at 10% level. ** significant at 5% level. ***significant at 1% level. Marginal effects show the increment in the probability relative to the sample mean, corresponding to the particular characteristic, relative to the reference group. The reference group: a blue-collar worker, aged 20-29 years old, and lives in Greater Cairo.

Table 8: Predicted Probabilities of Using Friends & Relatives

	Probability
	Predicted Probability of Getting Job through Friends & Relatives
Employed Worker:	
Illiterate	0.469
Less educated	0.341
Educated	0.143
	Predicted Probability of Searching for Job through Friends & Relatives
Unemployed Worker:	
Illiterate	0.456
Less educated	0.540
Educated	0.465

Table 9: Logit Model of the Determinants of Getting Jobs through Different Search Methods[1]

	Job application	Inquired at Work Place	Other Methods
Social Network: Size			
Density	-0.185**	-0.155	-0.320***
	(1.66)	(0.96)	(4.38)
Density Squared	-0.007**	-0.006	-0.011***
	(2.00)	(1.21)	(4.06)
Social Network: Quality			
Unemployment rate	0.005	-0.026**	-0.005**
	(0.43)	(1.98)	(4.73)
Control Variables			
Number of Individuals/HH in LF	0.094**	0.047	-0.014
	(1.88)	(0.41)	(0.40)
Father's Characteristics			
Illiterate	0.044	-0.143	-0.093
	(0.41)	(0.40)	(1.06)
Public Sector	-0.251*	-0.426**	-0.233***
	(1.42)	(2.17)	(2.51)
Out of the Labour Force	-0.260	-0.397	-0.178
	(0.86)	(0.54)	(0.95)
Individual Characteristics			
Male	-0.263	0.627	-0.002
	(1.05)	(1.94)	(0.02)
Age Group:			
15- 19 years	-1.119***	-0.507*	0.398**
	(4.63)	(1.51)	(2.16)
30-39	-0.269**	0.440**	0.154
	(1.61)	(1.97)	(1.03)
40-49	-0.041	-0.239	0.375**
	(0.14)	(0.76)	(2.54)
50-59	0.273	-0.179	0.528**
	(0.89)	(0.27)	(3.12)
60-64	-0.933	0.392	-0.530**
	(0.99)	(0.76)	(1.78)
Education:			
Less than Secondary	0.148	0.385	0.022
	(0.44)	(1.10)	(0.17)
Secondary & University	-0.297	-0.851	0.447**
	(0.62)	(1.18)	(2.62)
Married	0.076	-0.095	0.557**
	(0.51)	(0.31)	(6.68)
Head of Household	0.117	0.083	-0.108
	(0.67)	(0.21)	(0.91)
Region:			
Alexandria & Canal Cities	0.316	1.171	0.751***
	(0.70)	(1.31)	(3.41)

Lower Urban	0.911**	1.069	0.598**
	(1.98)	(0.94)	(2.25)
Upper Urban	1.157**	0.225	0.503**
	(2.18)	(0.46)	(2.18)
Lower Rural	-0.118**	0.670	0.410**
	(2.06)	(0.83)	(1.68)
Upper Rural	-1.676***	0.156	0.884***
	(3.93)	(0.15)	(3.33)
Occupation:			
Technical & scientific	0.736***	0.631*	0.915**
	(3.72)	(1.56)	(7.83)
Management	0.995**	1.572**	0.970**
	(1.77)	(2.32)	(2.81)
Clerical	-0.061	-0.492	0.429**
	(0.17)	(0.96)	(2.82)
Sector:			
Private Formal	-1.148***	0.833***	-1.501***
	(3.29)	(2.34)	(9.02)
Private Semi-formal	-2.764***	-0.790***	-2.408***
	(7.29)	(2.48)	(11.32)
Private Informal	-3.400***	0.620	-1.559***
	(5.31)	(1.26)	(9.76)
Other	-4.130***	0.426	-1.722***
	(5.80)	(0.52)	(10.29)
Industry:			
Manufacturing	-0.030	-0.111	-0.896***
	(0.14)	(0.44)	(8.67)
Trade	-0.154	-0.105	-0.969***
	(0.64)	(0.69)	(7.89)
Constant	-1.133	0.627	-0.002
	(1.55)	(1.96)	(2.57)
Log-Likelihood		-3017.25	
Sample size		4522	

[1]Relative to getting job through friends and relatives.

Notes: Absolute values of robust t-statistics are in parentheses Robust (Huber/White/sandwich) estimator of the variance was used in place of the conventional Maximum Likelihood Estimation variance estimator and observations were allowed to be not independent within *cluster*.* significant at 10% level. ** significant at 5% level. ***significant at 1% level. The reference group: a blue-collar worker aged 20-29 years old who has no education, and lives in Greater Cairo.

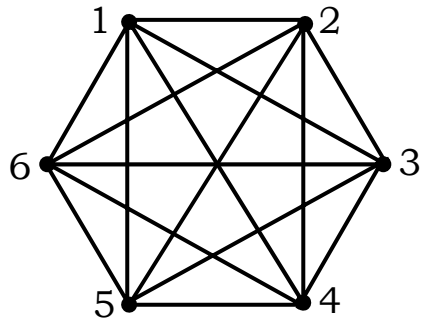

Figure 1a : Complete symmetric network (n=6 and s=5)

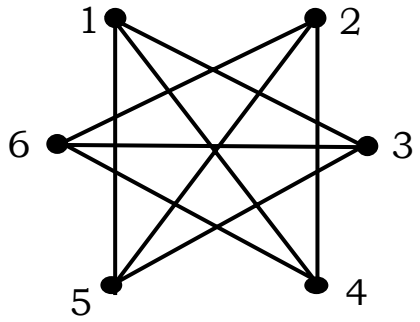

Figure 1b : Incomplete symmetric network (n=6 and s=3)

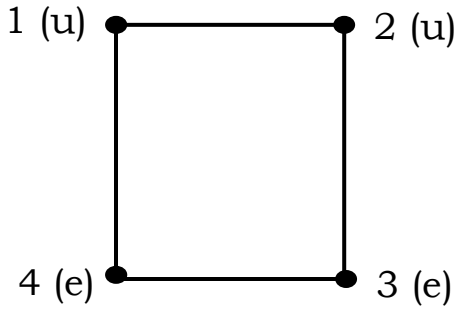

Figure 2a : Incomplete symmetric network with uniform mix (n=4 and s=2)

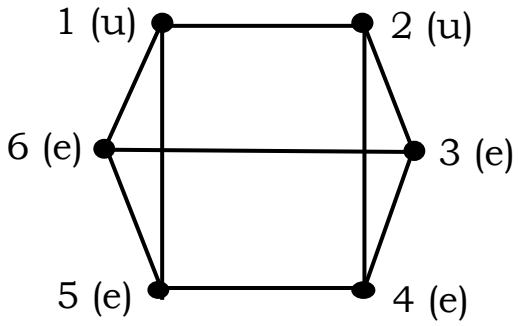

Figure 2b : Incomplete symmetric network with uniform mix (n=6 and s=3)

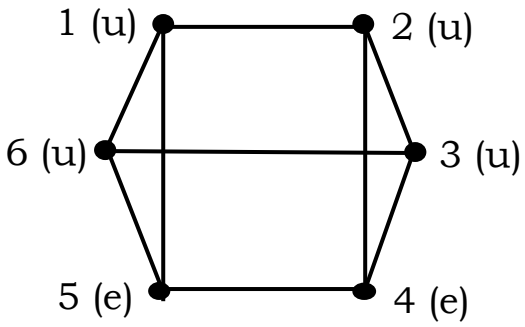

Figure 2c : Incomplete symmetric network with uniform mix (n=6 and s=3)

Figure 3: Predicted Probability of Employed Wokrer Having Found a Job through Friends & Relatives by Density

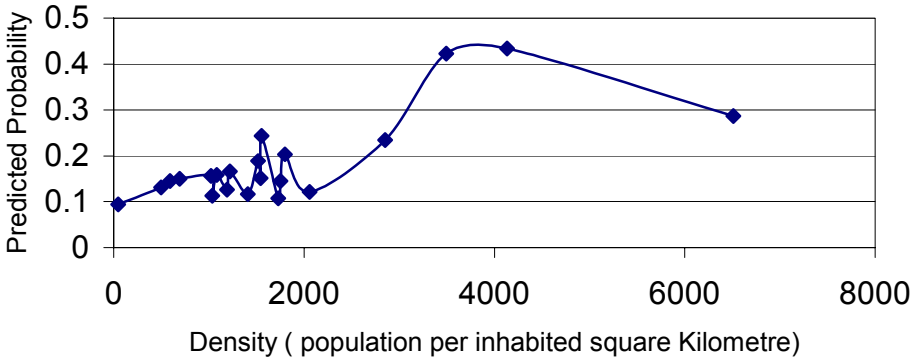

Figure 4: Predicted Probability of Unemployed Worker Using Friends & Relatives by Density