Job Search Through Weak and Strong Ties: Theory and Evidence from Indonesia

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Abstract

This paper analyzes workers who may search for jobs using different social contacts. We study a dynamic general equilibrium model where jobs are matched through either strong ties (family and friends) or weak ties, such as an ethnic group. We test the model using data from the Indonesian Family Life Survey. We show that workers are more likely to search through their strong ties when the ethnic network in their city is either very small or very large. Workers who find their job through their strong ties of family and friends earn about 10 percent lower wages.

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1 Introduction

Both formal and informal social networks play an important role in the labor market. Numerous papers show that wages or employment duration are affected if a worker finds a job through a social network. However, networks come in many shapes and forms, and there is no consensus on what the most relevant networks are.[1] It is natural to think that different types of networks influence labor market outcomes in different ways. Moreover, most individuals belong to several different networks, and can choose which one to rely on when looking for a job. Depending on the circumstances, using some networks may be more costly than others: for example, reaching out to friends and family may require less effort than asking past classmates or co-workers for help.

The goal of this paper is to analyze both theoretically and empirically workers' network choice and associated labor market outcomes. Following Granovetter (1973) we distinguish two types of networks. A network with "strong ties" (strong network) is a narrow network which consists of a worker's friends and family with strong personal connections. By contrast, a network with "weak ties" (weak network) is a broader set of information sources, to which the worker does not necessarily have personal connections, but where belonging to the group might still influence his labor market outcomes. Depending on the setting, the weak ties could be based on geography, ethnicity, language, etc.[2]

We study a worker's choice between searching for jobs through weak and strong networks in a dynamic equilibrium model of search and matching pioneered by Mortensen and Pissarides.[3] The general equilibrium structure of the model allows us to identify the equilibrium

[1] Previous studies have proxied networks with census blocks (Topa, 2001; Bayer et al. 2008), ethnic background (Borjas, 1992; Bertrand et al. 2000, and Bandiera et al. 2009, Battu et al. 2011), immigration status (Beaman, 2012), citizenship (Dustmann et al, 2011), caste system (Munshi and Rosenzweig, 2006), race (Giuliano et al., 2009), US postal codes combined with race and gender (Aizer and Currie, 2004) or combined with ethnic background and immigration status (Borjas, 1995), or much smaller groups such as alumni (Oyer and Schafer, 2016), Facebook friends at large universities (Mayer and Puller, 2008) or close neighbors (Hellerstein and Neumark, 2008).

[2] This distinction between strong and weak ties is based on Granovetter's (1973, p1361) definition: "the strength of a tie is a (probably linear) combination of the amount of time, the emotional intenstiy, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." See Gee et al. (2017) for recent cross-country evidence on the importance of weak and strong ties.

[3] See, e.g., Mortensen and Pissarides (1994).

linkages between wages, job finding rates and job search through the weak and strong ties. In our model, workers are either employed or unemployed at any point in time, and jobs are filled through either weak or strong networks. Unemployed workers who search for jobs using weak ties incur a fixed cost, such as the cost of joining a club or association, registering and attending job fairs, accessing job listings, etc. Like Holzer (1988), we assume that it is less costly to search through family and friends.[4] Following Loury (2006), we also assume that different types of contacts yield job offers of different quality. By using the weak network the worker gains a higher probability of an offer and lower separation rate but faces a cost of using these ties in the job search. The strong ties yield lower probability of an offer and a higher separation rate, but without associated costs.[5] Unemployed workers consequently always use their strong ties in the job search, but may choose to also use their weak ties taking this trade-off into account. A worker's decision to use weak ties is influenced by labor market conditions and the size of the weak network. We also extend our model to a world where workers are heterogeneous in their productivity (or education), which may also influence the type of network they use.

Our model predicts that the role of the strong ties depends on the size of the weak network. Workers are more likely to use exclusively their family and friends if they belong to either a very small or a very large weak network. If the weak network is small, there are not enough connections to help the worker in finding a job. On the other hand, if the weak network is large, the connections lose their efficiency since a given worker is providing decreasing search effort to a larger number of unemployed members. In these cases workers need to use their strong ties more extensively. We also predict that jobs obtained through the strong ties, which result in lower match quality, will pay lower wages.

To test our model, we use data from the Indonesian Family Life Survey (IFLS, round 4) collected during 2007 and 2008. This data is particularly suited to test our predictions,

[4] This is also consistent with our data, where twice as many workers search through family and friends as through the more costly channels.

[5] As we discuss below, these assumptions are consistent with our raw data, where jobs found through strong ties exhibit higher separation rates. One reason for this could be that family members have less information on potential good matches compared to the worker's weak network.

since it contains a wide range of individual characteristics and it allows us to define the weak and strong networks in a sensible way. First of all, workers' family and friends are the single most important channel of job search. In the data, 85% of the unemployed use these strong ties in searching for a job, and 55% do not use any other search method. Second, Indonesia is a country with many ethnic groups divided across a large number of islands that differ from each other in both size and ethnic composition. The 2010 Census identifies over 900 ethnic groups, many of which are separated by culture and languages spoken. This gives us the opportunity to analyze weak ties based on ethnicity. We define a worker's weak network as the set of individuals with whom he belongs to a common ethnic group within a geographic area. In the main analysis, we define ethnic networks at the city (regency) level and the robustness section consider broader, provincial ethnic groups.[6] These networks are likely to capture the broad set of sources from which a worker may possibly gain information about job openings. To guard against endogeneity, ethnicity is defined based on the parents' ethnic background, and we restrict the main analysis to the native population (individuals who have resided in the same regency since birth).

Our empirical analysis confirms the predictions of the theoretical model. We find that the probability of having found the job through strong ties is a U-shaped function of the size of the weak network. In terms of labor market outcomes, workers' first best option is to find a job through their weak ties which provide better quality matches. Incurring the cost of searching through weak ties yields a higher payoff if the worker belongs to an effective (not too small and not too large) weak network. Consequently, workers rely relatively less on their strong ties if they belong to a medium-sized weak network. Compared to the most effective network, changing network size by 50% in either direction increases the probability of getting the job through strong ties by approximately 9 percentage points. In terms of wages, we find that after controlling for individual characteristics, workers who find their job through family and friends earn 10 percent less than others.

Few existing papers test models of job search where workers can choose between different

[6] Patacchini and Zenou (2012) emphasize the importance of considering geographical areas of different size for measuring the impact of ethnic networks in the UK.

search methods. One exception is Wahba and Zenou (2005) who ask how the size of a worker's network of friends and family (proxied by city population density) affects the probability that the worker finds employment through this network as opposed to formal methods such as job fairs and advertisements. The choice between a network and formal methods is relevant in their empirical context (Egypt): in their data, only half of the unemployed mentioned using friends and family. The Indonesian context is fundamentally different. As we describe below, here almost everyone searches through friends and family. Other methods of job search involve using one's weak ties based on ethnicity, and there are few "formal" methods of search that do not involve network considerations. This feature of the environment makes it possible to study a worker's choice between multiple networks in a clean way. Another advantage of the Indonesian data is that it allows us to study the correlation between different search methods and wages.

More generally, our paper complements studies addressing the impact of network size on job market outcomes (e.g., Munshi, 2003, Damm, 2009, Dustmann et al. 2011, Beaman 2012). In contrast to these papers, we do not attempt to identify the effect of network size on wages or employment status. Instead, we study the complementary question of how workers look for and find jobs given different ethnic network sizes.

Our paper also relates to studies investigating the impact on wages of obtaining a job through family and friends (e.g., Simon and Warner, 1992, Loury, 2006, Bentolila et al., 2010, Pellizzari, 2010, Goel and Lang, 2016). Like Antoninis (2006), we document a negative correlation in a developing country, and our model provides a new explanation for this pattern which complements those proposed in earlier papers.[7]

There is a large theoretical literature on job search through networks. Montgomery (1994), Calvo-Armengol (2004), Calvo-Armengol and Jackson (2004), Calvo-Armengol and Zenou (2005), Fontaine (2008), Galenianos (2014), and Horváth (2014) connect exogenous network structures to aggregate labor market outcomes. While some of these earlier studies

[7] This paper also relates to a group of papers emphasizing that the role of networks in the job search process depends on the education level of the applicant (Rees and Schultz, 1970; Granovetter, 1995; Smith, 2000). It complements these by focusing on the various types of networks that workers with different education levels may choose in their job search.

provide a detailed analysis of different network structures, we instead focus on the search and matching aspect of the model in general equilibrium. This choice is motivated by our available data which provides measures of market outcomes, including wage, employment duration, but has little information to test any micro foundation of network models. Like Galeotti and Merlino (2014), Kuzubas (2009) and Schmutte (2016), our model endogenizes network formation (in the sense that the effectiveness of network search depends on how many workers decide to use the network) and provides an explicit link between individual choices and aggregate labor market outcomes.[8] Our model differs from these papers by incorporating workers' choices across multiple networks as a function of network size.[9] In work independent of ours, Zenou (2015), Sato and Zenou (2015), and Stupnytska and Zaharieva (2015) also study models where workers choose between weak and strong ties but they do not test the models empirically. In particular, Stupnytska and Zaharieva (2015) study a search and matching model where workers can choose to look for jobs through family and friends, professional contacts, or formal channels (sending formal job applications). The authors motivate their model with stylized facts from developed countries and ask how workers' skill level affects search channel decisions. In their model, in equilibrium, low skilled workers search mostly through family and friends; as their skills increase, workers switch to formal search, and finally to professional contacts, resulting in a kind of U-shaped relationship between job search methods and workers' skills. Our model features fewer search channels than the Stupnytska and Zaharieva model: as we argue below, in the Indonesian context workers' main choice is between using the strong network of family and friends and the weak network of ethnic peers. Our model also differs by focusing on the size of the weak network (the worker's ethnic group) rather than skill levels as the main determinant of search channel decisions. We provide detailed empirical results showing that, for this Indonesian

[8] In Galeotti and Merlino (2014), workers invest in network connections to obtain information about available jobs. They test this model on region-level data from the UK and find that a worker's propensity to search through the network is a concave function of the job separation rate.

[9] In most models, the default search method is formal search (e.g., through newspaper advertisements) and workers may obtain additional information through some type of network. In our setup, consistent with the data, the default is that workers search through their costless strong ties (family and friends) and they may also choose to receive additional help from their weak ties.

data, our model does a good job of explaining the available evidence. Nevertheless, with more detailed data or in a different context it would be interesting to empirically test an extended model with more search channels and / or more skill types, as suggested by Stupnytska and Zaharieva.

The remainder of the paper is organized as follows: Section 2 presents the model. Section 3 describes the data used in the empirical analysis, and Section 4 presents the empirical strategy. Section 5 contains the results and Section 6 concludes.

2 Model

2.1 Setup

In this section, we outline the basic model. Following Granovetter (1973, 1995), an individual has strong and weak ties. An individual's strong ties are her family and friends. Her weak ties are the group of people who belong to her ethnic group in a given geographic area: this is the worker's broader source of information about relevant job opportunities.[10] The number of weak ties a worker has is determined exogenously. Depending on the worker's location and her parents' ethnicity, each individual has a potentially different number of weak ties. The number of strong ties is assumed to be homogeneous across individuals for simplicity. There is a unit measure of individuals. We denote the set of all ethnicities by $\Gamma = \{l_1, l_2, ..., l_k\}$ and the power set of Γ by 2^Γ which is the set of all subsets of Γ with a generic element $g \in 2^\Gamma$. An individual's parents may be of different ethnic groups, and because this is true for all his ancestors, each parent may belong to multiple ethnic groups. Thus, each individual belongs to a non-empty subset of Γ.[11] We partition the set of individuals based on their ethnicities. As an example, consider $\Gamma = \{1, 2, 3\}$ and its non-empty subsets $\{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}$. If an individual belongs to

[10] In the empirical context below, ethnicity is highly correlated with the set of languages an individual uses in daily life. We elaborate on the precise definition of weak ties used in the empirical work in Section 3.

[11] In our empirical work below, we define an individual's ethnic group(s) based on her own description of her parents' ethnic group(s).

$g = \{1\}$, she only belongs to ethnic group 1. If she belongs to $\{1, 2\}$ she belongs to groups 1 and 2, but not 3, etc. Note that $\{1\}$ and $\{1, 2\}$ are distinct sets. In this way, we sort individuals according to the set of groups to which they belong. Our empirical exercise below will measure workers' ethnic group in a similar way.

Denote the measure of individuals who belong to group l_k with N_{l_k}. The network size for the individuals in a particular g is the sum of the measure of individuals who belong to at least one of the groups in g. More formally, the measure of network size associated with a particular g is given by $\eta_g = \sum_{l_k \in g} N_{l_k}$. For example, if $g = \{1, 2, 3\}$, then the network size for the individuals in this particular g is the sum of the measure of individuals who belong to at least one of the groups 1, 2 and 3. Every individual in g has the same network size.

The labor market is similar to the benchmark model of Mortensen and Pissarides (1994) and builds on the extension of Kuzubas (2009) but adds workers' choice between multiple networks to the model. Workers are either employed or unemployed at any point in time. An employed worker earns a wage income w, but cannot search for a job when employed. Unemployed workers search for jobs and obtain unemployment benefit b. Throughout the model we normalize the level of unemployment benefit to zero, because we are not interested in the effects of these benefits on the job search behavior of individuals. Firms are equally productive and discount the future at the same rate r as the workers. A firm-worker pair produces p units of output per unit of time. We assume that the value of output exceeds the value of not working for the worker, $p > b = 0$. Firms open vacancies by paying a flow cost c and there is no cost for the firm to enter the labor market.

A worker's strong and weak ties can both help unemployed workers by transmitting information about job opportunities in the labor market.[12] While using strong ties is free, when individuals use their weak ties they incur a fixed cost c_0 (Zenou, 2015). In general, this cost could represent joining or using a network, such as an association or a club, registering for and attending government or private job fairs, accessing job listings, etc. (see for example

[12] Contrary to some previous theoretical studies, we trade off modeling the details of the information transmission process in the network in favor of modeling the connection between individuals' network usage and aggregate outcomes of the model. This choice is motivated by our available data which provides little information to test any micro foundation of network models.

Jackson and Wolinsky, 1996). It can also represent the cost of helping other unemployed members of the network once one becomes employed. In our context, c_0 is the cost of using ethnic ties in the job search. While belonging to an ethnic group is costless, *using* ethnic contacts is assumed to be costly. The assumption that using strong ties is free is not important, what matters is that using weak ties is more expensive. This is in line with Holzer (1988), who argues that the cost of using friends and relatives in the job search is less costly compared to other forms of search. It is also supported by our data: among unemployed workers in our sample, over 85 percent contacted friends and relatives, but less than 45 percent used any other search method.[13] This is despite the fact that, as we will show empirically, jobs found through friends and relatives yield lower wages. This suggests that searching through strong ties is less costly in practice.

Unemployed workers only searching through their strong ties benefit from a search effort normalized to 1. This is the search effort of the worker himself plus that of his strong ties. Workers who, in addition to their strong ties, choose to use their weak ties as well benefit from additional search effort. This is provided by workers who currently hold jobs. Thus, employed "network members" help unemployed network members by searching on their behalf. We assume that the search effort $s(\eta_g)$ exerted by an employed worker on behalf of an unemployed worker is a decreasing, concave function of the network size η_g. We also assume that $s(1) = 0$ and $s(\eta_g) < 1$ for all η_g, i.e., weak ties provide less search effort than the combined effort from the strong ties and the unemployed individual's own search effort.

This formulation captures the idea that exerting search effort $s(\eta)$ on behalf of others is a social norm in the network. If larger networks have difficulty incentivizing their members to provide this public good, the social norm will call for a lower value of $s(\eta)$. One example of $s(\eta)$ could be the amount of information (e.g., number of vacancies) that an employed worker shares with his social contacts. In a small network the norm could be to pass all job information along to social contacts, while in a large network the social norm could be to

[13] Detailed summary statistics on job search methods of the currently unemployed appear in the Online Appendix.

only pass some of the information along. Alternatively, $s(\eta)$ may be affected by the "quality" of connections between network members, with connections having lower quality when the network is larger.

Let u_g^w denote the measure of individuals in group g who chose to use their weak ties and are currently unemployed and u_g^s the measure of individuals who only used their strong ties and are currently unemployed (these are endogenous in the model and will be determined in equilibrium). Thus $\eta_g - u_g^w - u_g^s$ is the measure of employed individuals. An individual who belongs to a particular group, say $\bar{g}$, benefits from the search effort of individuals in other groups with whom he shares an ethnicity (i.e., all groups g for which $g \cap \bar{g} \neq \varnothing$).[14] The search effort received by an individual is given by

$$s_{\bar{g}} = \sum_{g \cap \bar{g} \neq \varnothing} s(\eta_g)(\eta_g - u_g^w - u_g^s),$$

Total search effort in the labor market is given by

$$S = \sum_{g \in 2^\Gamma - 1} u_g + \sum_{g \in 2^\Gamma - 1} s_g u_g^w, \tag{1}$$

where u_g is the measure of all unemployed in group g. The first term represents the search effort exerted by the unemployed workers and by their strong ties (this is normalized to 1 for each worker). The second term denotes the search effort from the weak ties.

The number of new matches between firms and currently unemployed workers is given by a matching function $m = M(S, v)$, where S denotes units of search effort, and v is the measure of vacant jobs (both of these are determined endogenously in the model). The matching function exhibits constant returns to scale, is strictly increasing and concave in both arguments and satisfies the standard Inada conditions.[15] Since the matching function contains units of search effort rather than only the number of unemployed, the model implies

[14] For example, an individual whose father is Javanese and mother is Batak ($\bar{g}$ =(Javanese,Batak)) receives help from all groups g that include Javanese or Batak.

[15] These are weak assumptions that are satisfied by virtually all matching functions used in the literature (cf. Chuhay, 2013). See Petrongolo and Pissarides (2001) for a survey of the literature on matching functions.

different job finding rates for workers who are using only their strong ties and for the ones who choose to use their weak ties as well. The job finding rate for a worker who relies only on the 1 unit of search effort provided by her strong ties is given by

$$\frac{M(S,v)}{S} = M(1,\theta) \equiv q(\theta), \tag{2}$$

where $\theta = v/S$. A worker in group g who has chosen to use her weak ties as well experiences a higher job finding rate: $q(\theta)$ from the strong ties plus $s_g q(\theta)$ from the weak ties.

All workers are the same with respect to their productivities but their search channels imply different match quality.[16] This is in line with Loury (2006) who shows empirically that different types of social contacts yield different quality jobs. We assume that the (expected) separation probability is λ_s for jobs found through strong ties, and λ_w for jobs found through weak ties, with $\lambda_w < \lambda_s$. This reflects the fact that jobs obtained through weak ties lead to better matches in terms of more stable firm-worker relationships. This assumption is motivated by our empirical setting. First, in our data workers who found their job through strong ties have significantly shorter durations in their current job (average duration among those hired in the previous 10 years is 41 vs. 47 months, p-value for difference = 0.006). Second, as we shall see below, an important implication of this assumption is that workers who use their weak ties will receive higher wage offers on average, and we will show that this is indeed the case in the data.[17]

In sum, by choosing to use weak ties the worker gains a higher probability of receiving an offer and a lower separation rate but faces a fixed cost of using the network in the job search. Strong ties yield a low probability of an offer and higher separation rate without any associated costs. The decision of individuals on whether to use weak ties will depend on the

[16] That different search channels lead to different match quality is a common assumption in partial equilibrium models. See Galenianos (2014) and Dustmann et al. (2011) for a set of assumptions in a Jovanovic type model yielding different separation rates for jobs found through a social network.

[17] In Indonesia, once a written employment contract is established, dismissing employees is extremely difficult and requires government authorization on a case-by-case basis (Bennington and Habir, 2003). To the extent that jobs filled through the weak network are more likely to involve such written contracts, this would be consistent with the lower separation rates assumption.

effectiveness of the weak ties which in turn depends on the search effort received and the cost of using the weak ties. We describe the environment through a series of Bellman equations, looking at the steady-state, where aggregate labor market conditions are constant.

Let U_g^s represent the value function of an unemployed worker belonging to group g who searches only using her strong ties. Let E_g^s be this worker's value once he becomes employed. The continuous time Bellman equations for an unemployed worker takes the form

$$rU_g^s = q(\theta)[E_g^s - U_g^s], \tag{3}$$

where $q(\theta)$ is the job offer arrival rate, $[E_g^s - U_g^s]$ is the option value of being employed. For an employed worker, the Bellman equation is

$$rE_g^s = w_g^s - \lambda_s[E_g^s - U_g^s], \tag{4}$$

where w_g^s is the wage paid to the worker and λ_s is the separation rate. Similarly, let U_g^w represent the value function of an unemployed worker who has decided to use his weak ties. This worker may receive an offer from his weak *or* his strong ties. Let E_g^{ww} and E_g^{ws} denote, respectively, the worker's value in each of these cases. We have

$$rU_g^w = -c_0 + s_g q(\theta)(E^{ww} - U^w) + q(\theta)(E^{ws} - U^w), \tag{5}$$

where c_0 is the flow cost the worker incurs while searching through the network. For employed workers, we have

$$rE_g^{ww} = w_g^{ww} - \lambda_w[E_g^{ww} - U_g^w], \tag{6}$$

and

$$rE_g^{ws} = w_g^{ws} - \lambda_s[E_g^{ws} - U_g^w], \tag{7}$$

reflecting the different separation rates a worker who uses his weak ties will obtain depending on whether his job arrives through the weak or strong ties. This formulation also allows

workers who use their weak ties to receive different wages depending on whether they end up finding employment through weak or strong ties.

The probability of a firm meeting a worker through strong ties is

$$\frac{M(S,v)}{v} = \frac{q(\theta)}{\theta}. \tag{8}$$

The probability of meeting a worker through weak ties is

$$\frac{s_g q(\theta)}{\theta}.$$

Turning to the firm's problem, the value of a posted vacancy (V) is given by

$$rV = -c + \sum_{g=1}^{2^k-1} \frac{s_g q(\theta)}{\theta}[J^{ww} - V] + \frac{q(\theta)}{\theta}[J^{ws} - V] + \frac{q(\theta)}{\theta}[J^s - V],$$

where c is the cost of posting a vacancy. The value of a filled vacancy is J^s for matches using exclusively the strong ties, and J^{ww} or J^{ws} when weak ties are used as well (depending on the channel through which the match actually takes place). These are

$$rJ^s = p - w_g^s - \lambda_s(J^s - V) \tag{9}$$

$$rJ^{ww} = p - w_g^{ww} - \lambda_w(J^{ww} - V) \tag{10}$$

$$rJ^{ws} = p - w_g^{ws} - \lambda_s(J^{ws} - V) \tag{11}$$

There is an infinite supply of firms that can post vacancies and there is no cost of entry.

Therefore, in equilibrium the value of a posted vacancy is zero, $V = 0$. Then,

$$c = \sum_{g=1}^{2^k-1} \frac{s_g q(\theta)}{\theta} J^{ww} + \frac{q(\theta)}{\theta} J^{ws} + \frac{q(\theta)}{\theta} J^{s} \tag{12}$$

We assume that wages are determined through Nash bargaining when a worker and a firm are matched. Specifically, the worker and the firm allocate the (intertemporal) surplus according to their respective bargaining powers, β and $(1-\beta)$. Thus, depending on how the worker searched for the job and how the match occurred, we have

$$(1-\beta)(E_g^m - U_g^m) = \beta(J^m - V) \tag{13}$$

for $m = s, ws, ww$.

In a stationary equilibrium, the inflows to and outflows from unemployment will be equal for workers using different search methods. As above, let μ_g^s be the measure of workers who belong to g and choose to search using only their strong ties and let u_g^s be the measure of unemployed in this group. The stationary unemployment rate for these workers is given by

$$\lambda_s(\mu_g^s - u_g^s) = q(\theta) u_g^s. \tag{14}$$

The left hand side of (14) is the flow of workers from employment into unemployment (governed by the separation rate λ_s) and the right hand side is the flow from unemployment to employment (governed by the job finding rate $q(\theta)$). Similarly, the stationary unemployment rate for workers who choose to use their weak ties is given by[18]

$$\lambda_s(\mu_g^w - u_g^w) = q(\theta) u_g^w (1 + \frac{s_g \lambda_s}{\lambda_w}). \tag{15}$$

[18] To see this, write the measure of workers using their weak ties as $\mu^w = e^{ws} + e^{ww} + u^w$ where e^{ws} are the workers employed through their strong ties, e^{ww} those employed through their weak ties, and u^w the unemployed. The steady state conditions are $\lambda_w e^{ww} = s_g q u^w$ and $\lambda_s e^{ws} = q u^w$, i.e., the flows in and out of employment have to be equal in each group. After some algebra these three equations yield the expression in the text.

The variables μ and u are determined endogenously in our model based on the optimal search channel decisions of workers. Given the network structure and the aggregate labor market conditions, unemployed workers decide whether to use solely their strong ties or invest also in their weak ties. That is, unemployed workers compare the values U_g^s and U_g^w and select the channel(s) which gives a higher utility:

$$max(U_g^s, U_g^w) \tag{16}$$

The next section defines the stationary equilibrium for this economy and characterizes the steady states.

2.2 Steady States

Definition 1 *A stationary equilibrium for this economy is a set*

$(E_g^s, E_g^{ww}, E_g^{ws}, U_g^s, U_g^w, J^s, J^{ww}, J^{ws}, w_g^s, w_g^{ws}, w_g^{ww}, S, v, u_g^s, u_g^w, \mu_g^w, \mu_g^s)$ *consistent with the following conditions given* c, c_0 *and* $s(\eta_g)$*, for all* g*:*

(i) *The value functions for the workers and firms satisfy (3), (5), (4), (6), (9) and (10).*

(ii) *The equilibrium measure of firms is determined by the free entry condition (12).*

(iii) *The stationary unemployment rates satisfy (14) and (15).*

(iv) *The measure of workers using each search method is determined by the individual decisions described by (16).*

The following proposition states that unless using weak ties is prohibitively costly, there is a unique equilibrium in which a positive measure of individuals use both search channels (all proofs are in the Appendix).[19]

Proposition 1 *For* c_0 *small enough, there is a unique equilibrium in which a positive measure of individuals search through weak ties.*

[19] The case in which nobody uses the weak network is always an equilibrium, because if the network provides no search effort, no individual can gain by using it. Here we focus on the equilibrium in which we have a positive measure of individuals who have chosen to use their weak ties.

We outline the main empirical predictions to be tested in the propositions below. Our focus is to understand how the probability of finding a job through weak and strong ties depends on the primitives of our model, specifically on the size of the weak network. We then consider the wage implications of the model.

For all our comparative statics exercises, we fix a stationary equilibrium and compare across groups or individuals in that equilibrium. For example, when comparing groups with different network size, we are comparing two groups in the same equilibrium where one has a "slightly" larger size than the other. We are *not* comparing before and after an exogenous increase in one group's size. This is consistent with our empirical exercise below which is based on a cross-section of individuals.

Observe that a larger network has more workers who provide search effort for a given unemployed, which increases the probability of finding a job through weak ties. At the same time, the search effort from the employed workers depends on the size of the network. As the size of the network becomes larger, the help provided by each worker decreases. These forces imply that relatively small and large networks are not efficient enough to cover the worker's cost. In this case, workers optimally decide to rely exclusively on their strong ties. By contrast, workers with "medium-sized" networks use their weak ties as well. This is shown formally in the following proposition.

Proposition 2 *In stationary equilibrium with a positive measure of individuals in each g, there is a non-monotonic, U-shaped relationship between the size of the network η_g and the probability that a worker finds a job through strong rather than weak ties.*

Workers who rely on their weak ties in job search achieve a higher job finding probability and can find matches with better quality in terms of longer employment durations, which provides a higher outside option in the bargaining process. As these are internalized by the firms, wages offered are lower for workers who only search using their strong ties. The following proposition formalizes the argument.

Proposition 3 *In a stationary equilibrium with a positive measure of individuals in each g, workers who find their job through strong ties receive lower wages on average.*

2.3 Model Extension: Heterogeneous Education Levels

Several empirical studies show that highly educated workers are less likely to rely on their friends and relatives when searching for a job, and this is also the case in our data (described below).[20] We extend our baseline model to capture these educational differences. First, we introduce heterogeneous productivity levels to proxy for different education levels. Suppose the environment is the same as above except that workers can have high or low education levels with associated productivity levels p_h and p_l such that $p_h > p_l$. We assume that the fraction of less-educated workers is equal to α and the fraction of highly educated workers is $1-\alpha$ in the population. Workers now differ in two dimensions, the size of their weak ties and their education levels.

As before, wages are determined through Nash bargaining, but now we are allowing for different wage patterns between less and highly educated workers. Specifically, wages are determined by

$$(1-\beta)[E_g^{e,m} - U_g^{e,m}] = \beta[J^{e,m} - V]$$

where $e = l, h$ denotes workers with low or high education levels, and $m = s, ws, ww$ denotes the method of job search and matching as above. The value functions are determined similarly to equations (4), (6) and (7) for the currently employed and to (3) and (5) for the unemployed except that the values U and E and the wages w are all indexed by e.[21]

The firms' problem is straightforward to extend to the heterogeneous case. Firms can match with workers through two different channels: workers' strong and weak networks, and obtain different values depending on the worker's education level e. The value of a posted

[20] See Holzer (1988) and Ioannides and Loury (2004) and references therein.

[21] For simplicity, we assume that the cost of using the weak network is independent of productivity, and instead focus on the different $benefits$ from the weak network that arise endogenously. This is largely for convenience, nothing important would change if instead the cost of using weak ties was made a function of network size, and productivity was held constant.

vacancy is now

$$\begin{aligned} rV &= -c+\alpha\sum_{g=1}^{2^k-1}\frac{s_g q(\theta)}{\theta}[\alpha(J^{ww,l}-V)+(1-\alpha)(J^{ww,h}-V)] \\ &\quad +\frac{q(\theta)}{\theta}[\alpha(J^{ws,l}-V)+(1-\alpha)(J^{ws,h}-V)]+\frac{q(\theta)}{\theta}[\alpha(J^{s,l}-V)+(1-\alpha)(J^{s,h}-V)] \end{aligned}$$

In a stationary equilibrium, the inflows and outflows from unemployment will be equal for workers with different networks. The stationary unemployment rates are given by equations similar to (14) and (15), with the unemployment rate u and network use μ indexed by e.

Given the network composition and the aggregate labor market conditions, highly educated unemployed workers compare the values $U_g^{s,h}$ and $U_g^{w,h}$ and less educated unemployed workers compare the values $U_g^{s,l}$ and $U_g^{w,l}$ and select the channel which gives a higher utility. The search channel decision with heterogenous productivity levels is determined by:

$$max(U_g^{s,h}, U_g^{w,h}) \tag{17}$$

$$max(U_g^{s,l}, U_g^{w,l}) \tag{18}$$

The definition of the stationary equilibrium of the model extended with heterogeneous education levels and the proof for the existence of a unique equilibrium is along the same lines as in the benchmark model (see the Appendix for details).

In this extended model, the U-shaped relationship between the size of the weak network and the job finding probability through the strong ties still holds. The decision problem of the workers results in two cut-off values $\eta_{g,1}^e$ and $\eta_{g,2}^e$ for each education level $e = l, h$ depending on the size of the network, the fraction of highly educated workers using their weak ties, the separation rates, and the cost of relying on the weak ties.[22] With this modification, Proposition 2 applies to the case with heterogeneous education levels as well. Similarly, as in Proposition 3, workers who obtain their job through strong ties receive lower wages on average. This is summarized in the following proposition:

[22] One can show that, taking the size of the weak network as given we have $\eta_{g,1}^l > \eta_{g,1}^h$ and $\eta_{g,2}^l < \eta_{g,2}^h$.

Proposition 4 *(i) In stationary equilibrium with a positive measure of individuals in each g, there is a non-monotonic, U-shaped relationship between the size of the weak network η_g and the probability that a job is filled through the strong ties for each education level.*
(i) For each education level, workers who find their job through strong ties receive lower wages on average.

In the next section, we empirically test the main implications of our model. We focus on how the probability of searching through the strong ties is affected by the size of a worker's weak network. We also test empirically our model's predictions regarding the wages of workers finding employment through the strong ties.

3 Empirical setting and Data

3.1 Ethnicity and job search in Indonesia

To test our model we use data from Indonesia, by combining data from the 2010 Indonesian Census and the 4th round of the Indonesian Family Life Survey (IFLS) collected during 2007 and 2008 (Strauss et al., 2009). The IFLS survey provides extensive data on employment, including detailed industry and job characteristics, wages and as well as the method of job search that resulted in employment (for those currently employed). It was designed to be representative of 13 out of 27 provinces in the Indonesian Census, covering 83% of the population of Indonesia (see the Online Appendix for a detailed comparison of the Census population and the IFLS sample).

Indonesia is an ideal environment to study the relative roles of different networks in the job search process. First, it is an ethnicly diverse country where belonging to and using ethnic networks is natural among the native population. Second, informal networks play an important role in filling vacancies in the private sector. We elaborate on each of these points in more detail below.

We identify an individual's weak ties with his or her ethnicity. Indonesia is a country with enormous diversity: respondents in the 2010 Census identify themselves as belonging to 964 different ethnic groups. Ethnic groups are typically separated by culture as well as language: there are over 700 languages spoken throughout the country. Since the fall of the Suharto regime in 1997, the relationship between ethnic groups has often been violent. Until recently the constitution did not explicitly forbid discrimination based on race or language, and labor market discrimination on ethnic and religious grounds is rife (Bennington and Habir, 2003). The separation of ethnic groups also has an important geographical component because the country consists of 922 inhabited islands. These different dimensions of separation result in labor markets that are highly localized. Recruitment from other firms or other regions (let alone from overseas) is rare (Gropello et al., 2011). Many Indonesian firms recruit employees from one ethnic group only (Habir and Rajendran, 2007).

This implies that in contrast to previous studies of the role of ethnic networks in job search among immigrants, Indonesia provides a setting where ethnic networks can be meaningfully studied in the native population.

Another important feature of the Indonesian labor market is that most hiring is through referrals and other methods involving personal interactions (e.g., personally contacting companies). Referrals from employees or business partners are believed to yield employees who are trustworthy (Habir and Rajendran, 2007). A 2011 World Bank report highlights the "predominance of private networks and contacts as means for employers to identify recruits and for employees to find suitable opportunities" (Gropello et al., 2011, p 151). In that report, 80% of firms cite "private network" among the methods by which vacancies are normally filled, followed by 50% for "employee recommendation." Impersonal recruiting methods are used infrequently: "Advertising is very expensive in the few newspapers considered to have the reach to make an advertisement placement worthwhile and therefore not used as frequently as in western countries." (Bennington and Habir, 2003, p383). In the World Bank report cited above, only 30% of firms report posting newspaper ads for vacancies, 10% mention advertising on the internet, and 1% mention using job fairs for the registration process

can take up to six months. These patterns are also reflected in the IFLS dataset we use: only 5% of workers in our sample found their current job through a job ad and 3% through job fairs, while over 50% found their job "through friends and relatives" (see Table 1). Among those currently unemployed (and actively searching for a job), 91% report searching through friends and relatives but only 15% responded to a job ad (see the Online Appendix). Such extensive reliance on informal networks is unusual even among developing countries. For example, in their study on Egypt Wahba and Zenou (2005) report that 32.5% of the currently employed found their current job through friends and family (their Table 1) and 52% of the unemployed used friends and relatives in their job search (their Table 2).

Table 1: Job finding methods in the sample, private workers

	All	Completed college or higher	Less than college
Through government job fairs	0.39	1.65	0.22
Through private job fairs	3.32	6.61	2.88
Through school/university fairs	1.27	4.13	0.89
Responded to a job ad	4.50	8.26	3.99
Contacted company	22.68	31.4	21.51
Through friends and relatives	50.54	34.71	52.66
Contacted by company/employer	17.30	13.22	17.85
N	1,023	121	902

Notes: All workers identified as currently having a job were asked "How did you get this job?" The possible answers and their percentage distribution are given in the table.

Based on this descriptive evidence, workers' relevant choice appears to be not between formal and informal job search methods, but rather between different informal methods - namely, using weak and strong ties. We identify strong ties with "friends and family" and all other job search methods with using the weak network composed of a worker's ethnic peers (see Table 1 for the list of search methods reported in the survey). In other words we assume that the important distinguishing feature of other search methods from "friends and family" in this context is not that they are more formal but that they target a worker's weaker ties. Under this interpretation Indonesia offers an ideal setting to test our model in which workers choose between job search through two types of social contacts: the strong ties of family and friends, and the weak ties defined by ethnicity.

Note that the fact that almost everyone searches through their strong ties of family and friends is reflected in the model, where we assumed that by default every worker searched through their strong ties, and additionally decided whether or not to incur the cost of searching through weak ties as well. Like in the extended model in section 2.3, the relative importance of strong ties appears to differ by education level (Table 1). 34.7 percent of workers with some college education found their current job through their strong ties, compared to 52.7 percent of the less educated workers.

3.2 Measuring the size of the weak network

In the IFLS dataset we observe the ethnicity of the individuals in a very precise way. The survey asks "What is your father's ethnicity?" and "What is your mother's ethnicity?" For each of these questions, the survey lists 28 different ethnic groups (as well as an "other" category) and allows the respondent to indicate multiple groups. We define the respondent's ethnicity as the union of ethnicities listed for the two parents (5 percent of the individuals indicated different ethnic groups for the mother and the father).

Once we identified the ethnicity of the worker, we use data on the size of the ethnic groups from the Indonesian Population Census 2010, collected by Badan Pusat Statistic (Central Board of Statistics).[23] We calculate the size of the ethnic groups at the "regency" (*kabupaten*) level, the lowest level of aggregation available in the census. The highest level of Indonesian local government is the province, and these are further divided into areas called cities (typically parts of metropolitan areas, e.g., Jakarta is divided into five cities) or regencies (typically a collection of rural villages). Cities and regencies are at the same administrative level and for simplicity, we will refer to all these areas as "regencies."

Of course, we do not assume that an individual has close ties to the thousands of members of his or her ethnic group. Rather, the size of the ethnic group serves as a proxy for an individual's weak ties - for example, larger ethnic groups are likely to provide more sources

[23] The data was obtained from the Minnesota Population Center. Integrated Public Use Microdata Series, International: Version 6.3 [Machine-readable database]. Minneapolis: University of Minnesota, 2014.

of relevant job information. This is similar in spirit to Wahba and Zenou (2005) who assume that the number of network connections of an individual can be proxied by the population density of a given city. We believe regencies are a reasonable approximation of the workers' relevant job market in the model.[24]

The 2010 census wave is one of only two census waves that collected information on ethnicity.[25] Surveys were conducted verbally, and respondents were free to indicate any ethnicity they wished. The raw data contains 964 ethnicity codes. In order to match these to the 28 ethnic groups contained in the IFLS we use the classification of Ananta et al. (2014) which indicates the subgroups belonging to each of the 28 ethnic groups listed in the IFLS. Ananta et al. (2014) presents a careful classification of the raw census data into the biggest 31 ethnic groups. Difficulties arise because the same ethnic group can have different names and spelling, the same ethnic group with a different religion can have different names, or ethnic groups may be described by their local name (without an English translation). In all these cases the same ethnic group may receive a different code in the Census. Ananta et al. (2014) discuss these difficulties and the rules behind their classification in detail. The Online Appendix contains the matching of the IFLS and the Census ethnic codes.

The three smallest ethnic groups we can identify are Nias in the city of Makassar in South Sulawesi (size 90), Sumbawa in the city of Palembang, South Sumatra and Tionghoa in Tanah Laut regency in South Kalimatan (size 410). The three largest groups are Javanese in Malang Regency, East Java (2,340,210), Sundanese in Sukabumi Regency in West Java (2,271,540) and Javanese in the city of Surabaya, East Java (2,188,820).

We identify an individual's weak ties with the ethnic group(s) to which he or she belongs, and proxy the number of weak ties with the size of these groups in the respondent's regency (the lowest level of aggregation available). For example if the respondent's mother is Tiong-

[24] Recall that regencies are the lowest level of aggregation available in the census. Even if ethnic group size was available for a smaller geographic area, such as a neighborhood, this would not necessarily be useful since the relevant job market is likely to extend beyond neighborhoods. Having micro information about a worker's specific contacts would be very desirable but we are not aware of any such data for Indonesia.

[25] The first wave that contains information on ethnicity (in 2000) cannot be matched to the IFLS data at the regency level because of changes in regency boundaries and the creation of 154 new regencies between 2000 and 2010.

Table 2: Weak network size

	All	Less than college
Average network size (000s)	744	747
Median network size (000s)	667	677
10% network size (000s)	111	111
90% network size (000s)	1552	1552
Number of different networks	239	221
Number of regencies	142	138
N	1023	902

Notes: Network size computed based on mother's and father's ethnicity as described in the text, using regency level ethnic group sizes from the Indonesian Population Census 2010.

hoa and the father is Banjar and he lives in Banjarmasin, where the size of these ethnic groups is, respectively, 9,860 and 488,480, then our proxy for the size of the respondent's weak ties is 498,340. Note that the model specifically allows for such overlapping weak ties. The empirical definition of network size corresponds exactly to its theoretical counterpart. Once we construct workers' network sizes in this way, we have 239 different network sizes in the data, ranging from 90 to 2.34 million, with the average-sized network consisting of 744,044 people. Note that since the weak ties are defined based on the parents' ethnicity, this measure is clearly exogenous for the individual. Table 2 presents summary information on the size of the weak network.

3.3 Sample

We use data on employed male workers. We restrict attention to individuals between the age of 18 and 65 who work in the private sector for more than 15 hours per week. We exclude employees in government jobs and seasonal workers because of the expected different patterns of employment and unemployment duration as well as job search methods.[26] We also exclude workers who were paid in any informal way, such as exchange labor, or in any unconventional way, such as with a share of harvest or output. In our sample, all workers are paid per hour, day, week or month. The Online Appendix describes in detail the construction

[26]For example, only 19.2 percent of government workers in the data found their job through friends and relatives (in contrast to 50.5 percent for private workers). See the Online Appendix.

of the sample and the number of observations excluded in each step.

Because the network size measures from the census are for 2010, workers who have held their current job for many years could potentially have been hired under very different regency ethnic composition. In order to study a comparable cohort while ensuring a large enough sample, in the main analysis we restrict attention to workers who were hired no more than 10 years ago. In the Robustness section we show that our results are robust to allowing for an even shorter horizon by including different controls for workers' job duration.

Workers moving between regencies could potentially lead to endogeneity concerns. For example, if people decide where to move based on both the share of their co-ethnics and the local labor market conditions, then labor market outcomes and network characteristics may be jointly determined. To guard against this, we restrict the main analysis to workers who did not move to another regency since birth. In the Robustness section we discuss concerns related to endogenous sorting at length and present alternative specifications.

There are 1023 employed workers included in the main sample.

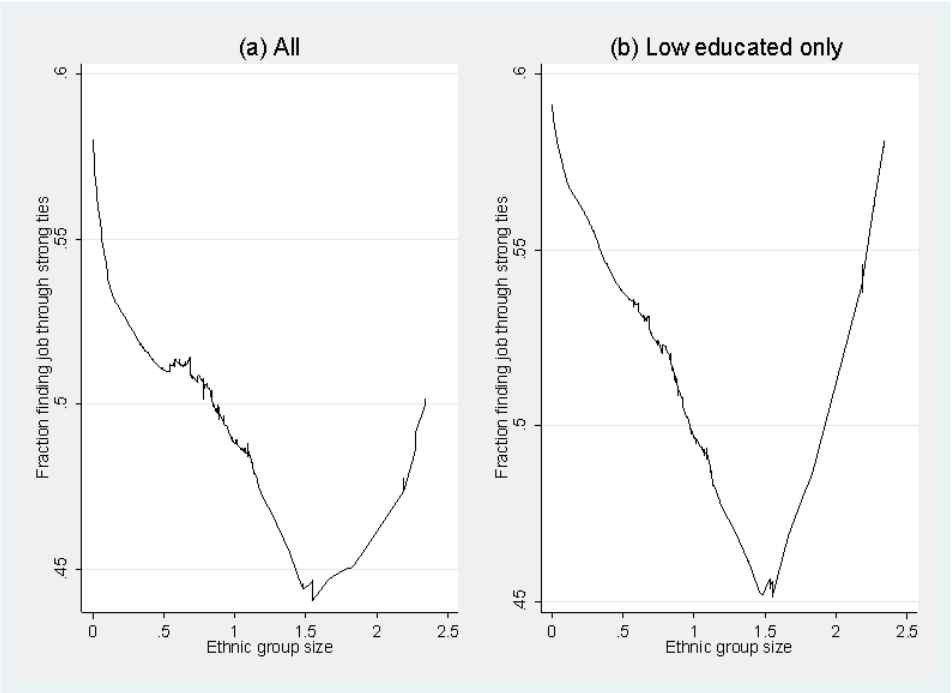
4 Empirical strategy

4.1 The role of strong ties in finding jobs

Our model implies a U-shaped relationship between the size of a worker's weak network and the probability of finding a job through strong ties (Proposition 2). Recall that our survey contains a question that measures exactly the theoretical object, the probability of finding a job through one's strong ties (see Table 1). Figure 1 provides some preliminary evidence by showing a local linear smooth plot of the probability that a worker found his job through his strong ties against the size of the weak network. Figure 1, right panel shows the same plot, restricting attention to low educated workers. The U-shaped pattern predicted by our model seems to be present in the raw data.

Turning to a regression analysis, we estimate the correlation between weak network size and the probability that an employed worker has found his job through his strong ties with

Figure 1: Ethnic group size and the fraction of workers getting a job through strong ties in the data



Notes: Lowess plots of an indicator for having found job through strong ties against the size of the weak network, using a bandwidth of 0.8. N = 1023 (left panel) and N=902 (right panel).

the following equation:

$$P_{ilj}^{E} = \alpha_0 + \alpha_1 N_{lj} + \alpha_2 N_{lj}^2 + \mathbf{X}'_{ilj}\boldsymbol{\alpha}_3 + \gamma_l + \mu_j + u_{ilj}. \tag{19}$$

Here P_{ilj}^{E} is the probability that employed worker i belonging to weak network l in regency j has found his job through his strong ties, N_{lj} is the size of the weak network based on parents' ethnicity constructed as described above, $\mathbf{X}_{ilj}$ is a vector of individual level control variables, and γ_l and μ_j are, respectively, ethnic group and regency fixed effects. Controlling for ethnic group fixed effects is particularly important in our context as looking for jobs through weak or strong ties may be more common in some groups than others due to culture or tradition. Individual controls include age, age^2, marital status (married = 1), and four dummy variables describing the highest level of education attended (elementary school, high school, college, higher than college). To characterize the job, we include the firm's industry and size. We distinguish between 9 industries, which include agriculture, mining, manufacturing, electricity/gas/water, construction, wholesale/retail/restaurant, transportation, finance, and social services. We use four dummy variables to describe the size of the firm (1-4 employees, 5-19 employees, 20-99 employees, or more than 100 employees). Further, we include a dummy variable for respondents living in urban areas (urban=1) to capture potential differences in local labor markets. The urban indicator is created by the survey team and is an individual characteristic of the respondent that varies across individuals within a regency. In each regression below the excluded category is a worker whose highest attended education level is elementary school, who works in agriculture, and whose firm employs fewer than 5 workers. Table 3 contains the summary statistics. Throughout we allow for heteroskedasticity and arbitrary correlation within an ethnic group. Accordingly, we report robust standard errors clustered at the ethnic group level.

The key parameters of interest in (19) are α_1 and α_2. We expect that workers with more effective weak ties gain their job through their strong ties less frequently, giving us a U-shaped relationship between the probability of getting the job through strong ties and the size of the ethnic group (i.e., $\alpha_1 < 0$ and $\alpha_2 > 0$) as in Proposition 2. We present the

Table 3: Descriptive statistics

	All	Less than college
Age	30.48	30.45
Married	0.68	0.70
Hourly wage (Rp)	4,776.55	4283.49
Current job duration (months)	43.69	44.00
Urban area	0.67	0.64
Education		
Elementary school	0.25	0.28
High school	0.63	0.72
College	0.05	-
Higher than college	0.06	-
Industry		
Agriculture	0.12	0.13
Mining	0.01	0.01
Manufacturing	0.27	0.29
Electricity, gas and water	0.01	0.01
Construction	0.09	0.10
Wholesale, retail and restaurant	0.18	0.18
Transportation	0.04	0.05
Finance	0.03	0.02
Social services	0.25	0.21
Firm size		
Less than 5 employees	0.25	0.26
5-19 employees	0.33	0.33
20-99 employees	0.23	0.21
100 or more employees	0.20	0.20
N	1023	902

Notes: Mean values in the IFLS data, main sample. Hourly wages calculated based on monthly salary and hours worked as described in the text. Urban area is an indicator created by the survey team based on each respondent's location. Education variables indicate highest level attended.

estimates of the quadratic specification (19) in the text, and a more flexible specification using fractional polynomials in the Appendix. The Appendix also presents Probit estimates of equation (19) with similar results.

In using equation (19) to estimate the correlation of interest, the identifying assumption is that, within a regency, the size of an ethnic group is not associated with unobserved factors that affect whether workers find employment through their family and friends. Since we do not have an instrument for ethnic group size, the existence of *some* such factor cannot be ruled out. At the same time, as described above, we observe and control for several natural candidates, most importantly, ethnic group fixed effects. We also note that, to invalidate our findings, the unobserved factor would have to generate the same non-monotonic relationship that is predicted by our model.

4.2 Wages

Our model implies that employed workers who find a job through strong ties receive lower wages in equilibrium than workers finding employment through weak ties (Proposition 3). To test for this negative correlation between wages and obtaining a job through strong ties, we estimate the following regression:

$$\ln w_{ilj} = \beta_0 + \beta_1 I_{ilj} + \mathbf{X}'_{ilj}\boldsymbol{\beta}_2 + \gamma_l + \mu_j + u_{ilj}. \tag{20}$$

Here $\ln w_i$ is the log hourly wage of employed worker i, I_i is an indicator equal to 1 if the worker found his job through strong ties, and the control variables $\mathbf{X}_i$ and $\mathbf{Z}_j$ are the same as in (19). Hourly wages are computed for each currently employed individual in the following way. The survey asks about salary/wage during the last month, which includes the value of all benefits, and we also have information on the number of hours worked per week. Based on this information, hourly wages are computed for a 4 week month. Hourly wage gives us a better measure of earnings than daily or monthly wage, since hours worked per month vary substantially in the dataset with a mean of 49.0 hours and 12.9 hours standard deviation.

Based on the model, we expect $\alpha_1 < 0$ in the above regression, and this relationship should be easier to detect for the less educated workers who gain their jobs more frequently through their strong ties (Proposition 4). Clearly, equation (20) does not represent a causal relationship, since search and wages are jointly determined in our model. Testing whether $\alpha_1 < 0$ simply establishes whether a correlation predicted by the model is present in the data. In this regression, the identifying assumption is that whether a worker found his job through family and friends is not correlated with unobserved factors that also affect the wage he is getting. Although we are controlling for a large set of individual characteristics (including characteristics of the job), we do not have an instrument for method of job search and therefore cannot rule out the existence of *some* unspecified confound.

5 Results

5.1 Ethnic group size and the role of strong ties

Table 4 shows the result of estimating equation (19). The dependent variable is an indicator equal to 1 if the individual found his current job through strong ties (family and friends). Ethnic group size is defined as the number of coethnics at the regency level. Column (1) includes regency fixed effects and column (2) adds ethnic group fixed effects as well. The coefficients for the full set of controls included in the regressions are presented in Table 6 in the Appendix.

The coefficients on ethnic group size and its square are consistent with the U-shaped pattern seen in Figure 1 for the raw data and confirm the predictions of our model (Proposition 2). Initially, more weak ties decrease the probability of getting the job through strong ties, but there is an "optimal" network size after which the effect is reversed. This is consistent with the model: If the number of weak ties is low, this network does not have enough members to provide information about job opportunities to the currently unemployed. If the number of weak ties is too large, the unit effort of the employed network members in providing help with job search benefits a larger number of unemployed, decreasing the effec-

tiveness of the network. Consequently, workers who have very few or very many ethnic ties in the regency do not benefit much from using these ties in their job search, and they are more likely to get a job through their strong ties.

Figure 2 plots the estimated effects of ethnic group size on the probability of getting the job though family and friends. The upper panels plot the predicted probabilities as a function of ethnic group size based on column (2) in Table 4. The lower panels show the corresponding predicted marginal effects with confidence intervals. We find a clear U-shaped relationship between ethnic group size and the probability of getting the job through strong ties. At the turning point of the U, the most "effective" ethnic network yields the lowest probability of getting the job through family and friends. Compared to this, changing the size of the network by 50% in either direction increases the probability of getting the job through family and friends by approximately 9.4 percentage points (Panel (a) of Figure 2).

The estimates in Table 4 are from the Linear Probability Model specified in (19), which has the disadvantage that predicted probabilities might fall outside of the unit interval. As shown in Figure 2, this turns out not to be the case within our sample. On the other hand, a major drawback of a Probit specification in our case is that observations that do not vary in their outcome conditional on the fixed effects would be dropped in this case. Nevertheless, as shown in the Appendix, a Probit model also yields a significant U-shaped pattern.

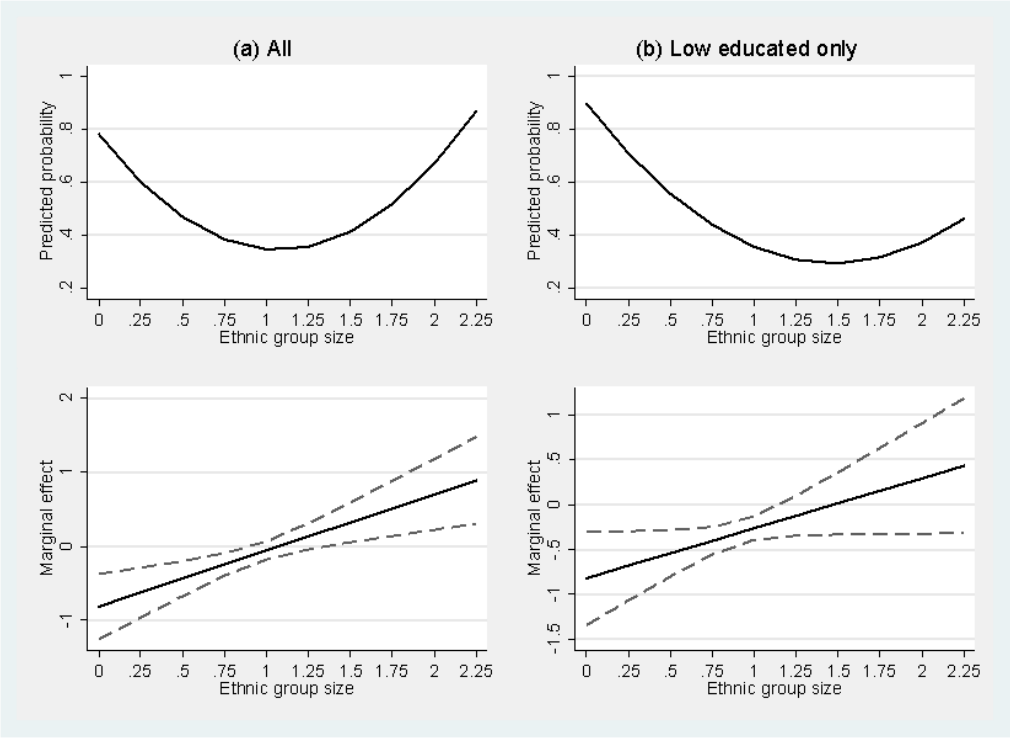
Based on our extended model (Proposition 4), we also expect the U-shaped relationship to hold for different education levels. We test this in Column (3) of Table 4, where we estimate equation (19) separately for the less educated. Figure 2, panel (b) illustrates the results, confirming the U shape for this sample. Table 6 in the Appendix shows that, consistent with Proposition 4 more educated workers (those who attended college or higher) are less likely to have found their job through family and friends (although the difference is not statistically significant for those who attended higher than college).

Table 4: Probability of getting a job through strong ties

	(1)	(2)	(3)
Ethnic group size	-0.543**	-0.816***	-0.819***
	(0.215)	(0.267)	(0.315)
Ethnic group size^2	0.266**	0.380***	0.278*
	(0.121)	(0.135)	(0.168)
Regency fixed effects	x	x	x
Ethnic group fixed effects		x	x
N	1023	1023	902

Notes: Linear Probability Model estimates. The dependent variable is a dummy variable equal to 1 if the worker found his or her current job using friends and relatives. Column (1) and (2) are for all workers, column (3) is for the low educated-only sample. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Figure 2: Estimated correlation between ethnic group size and the probability of getting a job through strong ties



Notes: The upper panels plot the predicted probability of getting a job through friends or family as a function of ethnic group size (in millions). The lower panels show the estimated marginal effects of ethnic group size on this probability. Dotted lines denote the 90 percent confidence interval. Based on estimates from Table 3, column (2) (all workers) and (3) (low educated only).

In Figure 3 we confirm that the U-shaped relationship uncovered in the above regressions was not an artifact of the quadratic specification. We use Stata's fp routine to estimate and select fractional polynomial models that allow a large degree of flexibility in modeling the functional form of interest (see Royston and Suerbrei, 2008). Specifically, we control for the same covariates and fixed effects as in equation (19) and let the routine select the best fitting polynomial of the network size variable allowing for terms with the standard powers: {-2, -1, -0.5, 0.5, 1, 2, 3} as well as the natural logarithm. Figure 3 shows the result of this exercise, indicating that the U-shaped pattern observed above is fairly robust.[27]

5.2 Wages

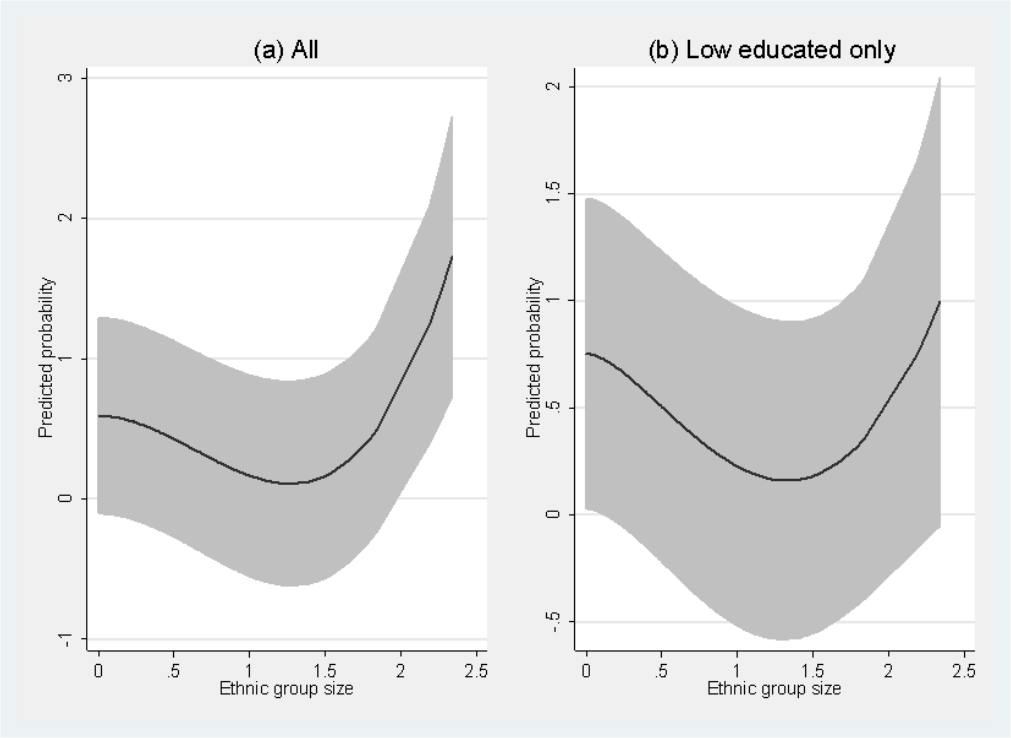
Next, we turn to the wage implications of our model. As described in Section 2.3, in the model jobs found through strong ties provide a lower quality match which in turn results in lower wages. To check for this association in the data, we estimate equation (20), regressing the log of hourly wages on whether the worker found this job through family and friends. As mentioned in Section 4, equation (20) does not represent a causal relationship, since search and wages are jointly determined in our model. We are testing whether the correlation predicted by the model is present in the data.

The results are presented in Table 5 for all workers (columns (1)-(3)) and separately for the low educated (columns (4)-(6)). All regressions include worker characteristics, regency and ethnic group fixed effects. Because the theoretical result in Proposition 3 is not conditional on network size, the specification in column (1) and (4) does not control for network size. Because there may be reasons outside our model implying that network size could affect wages, we included network size as a linear control in column (2) and (5), and also add its squared term in column (3) and (6).

As predicted by the model, strong ties are associated with lower wages: the estimated

[27] The specification selected was $P = \underset{(0.23)}{-0.90}N^2 + \underset{(0.12)}{0.47}N^3 + controls$ for the full sample and $P = \underset{(0.14)}{-0.53}N^2 + \underset{(0.22)}{0.67}N^2\ln(N) + controls$ for the low educated.

Figure 3: Ethnic group size and the probability of getting a job through strong ties, fractional polynomial estimates



Notes: The figure plots the predicted probabilities from fractional polynomials corresponding to Table 3 columns (2) and (3). Estimation was done using Stata's fp routine. Predicted values and corresponding 95 percent confidence intervals are from the selected specification.

Table 5: Strong ties and wages

	All			Low Educated		
	(1)	(2)	(3)	(4)	(5)	(6)
Found job through strong ties	-0.090**	-0.090**	-0.092***	-0.109***	-0.110***	-0.111***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
Ethnic group size	-	0.009	-0.194	-	-0.024	-0.403
		(0.096)	(0.248)		(0.139)	(0.320)
Ethnic group size^2	-	-	0.120	-	-	0.235
			(0.125)			(0.187)
Regency fixed effects	x	x	x	x	x	x
Ethnic group fixed effects	x	x	x	x	x	x
N	1023	1023	1023	902	902	902

Notes: The dependent variable is the logarithm of hourly wages in Rp. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

coefficient on strong ties is consistently negative. As expected, this effect is also present among the less educated, who rely on the strong ties more frequently. We estimate that getting the job through family and friends is associated with around 9-11% lower wages and this difference is statistically significant in all specifications.

5.3 Robustness

Controlling for "quality" of the network. The ability of ethnic networks to provide search effort may differ for the same ethnic group across regencies. Studies emphasizing the importance of controlling for this "quality" of ethnic networks includes Wahba and Zenou (2005) and Damm (2009, 2014). To control for network quality, we create two measures from the 2010 Census. For the relevant population (males aged 18-65) we calculate the average unemployment rate and the average age of the employed workers (to proxy for experience) in each ethnic group in each regency. One disadvantage of unemployment as a measure of network quality in our context is that ethnic group level unemployment is an outcome variable based on our model. The average age variable does not have this problem. In Table 8 in the Appendix we present regressions controlling for each of these measures separately as well as jointly and find that our main results remain robust.

Different job durations. As discussed in section 3.3, different job durations could pose a

problem for our analysis if individuals obtained their current job under very different ethnic compositions of the population. To address this, we restricted attention to workers hired within the past 10 years. In order to check whether different durations could matter *within* this sample, we ran several regressions including job duration as a control or interacting it with our main variables of interest. The results are in the Appendix, Table 9. We find that adding job duration as a control leaves our findings for both job search methods and wages intact. We also do not find that changing the job duration has a significant impact on the U-shaped relationship between network size and the use of strong ties (the interactions between network size and job duration are always statistically insignificant). Similarly, in the wage regressions we do not find that changing the job duration affects the relationship between wages and job search method.

Endogenous sorting. Several studies of ethnic group size and labor market outcomes emphasize the difficulties of obtaining valid estimates when workers sort into locations (e.g., ethnic enclaves) based on unobserved characteristics that may be correlated with labor market outcomes (see, e.g., Edin et al. (2003), Munshi (2003), and Damm (2009)). Our setting does not offer a randomized policy experiment or similar source of variation in ethnic group size. At the same time our exercise is arguably less susceptible to the concern of endogenous sorting than some earlier studies because of two reasons. First, recall that in order to make the relevance of different networks comparable across individuals, we have excluded from the analysis individuals who moved between regencies since birth. Thus our analysis excludes workers who have revealed themselves to be mobile (e.g., in contrast to studies that explicitly focus on networks among immigrants). Of course, workers who did not move may also have been mobile (but decided not to move), so this does not fully take care of endogenous sorting but in our view it does reduce the concern. Second, unlike most previous studies, we do not aim to identify the effect of network size on wages or employment. In our wage regressions, we looked for the correlation between wages and job search methods predicted by the model. We are not aware of an immediate sorting mechanism that would imply a

bias in this estimate.[28] While the regressions of job search methods do focus on ethnic group size, the sorting mechanism that would bias these estimates would also have to be somewhat special. Although sorting into ethnic enclaves based on wages or employment seems very plausible, it is less clear that individuals sort into enclaves based on how they expect to search for jobs. This is especially true given our finding of a nonlinear effect. An endogenous sorting story would require that in some range individuals be more likely to stay in their current location because they want to use their weak ties for job search while in some range they be more likely to stay because they do *not* want to use these ties.

In order to provide some suggestive evidence on whether endogenous sorting could be strong enough to influence our results, we repeat our main regressions for some of the movers excluded from the analysis above. Specifically, we look for respondents who are most likely to have moved specifically for job market considerations in the recent past. In the survey, we know which respondents moved since the previous survey round (held in 2000). Thus, we can restrict attention to those respondents who moved in the previous 7 years (and also satisfy the same selection criteria as in the main sample with respect to age, gender, occupation, and job duration). We can further restrict this sample to those individuals who obtained a new job after they moved (since those who held on to their previous job are less likely to have moved for job market reasons). Regressions for both of these samples are shown in the Appendix, Table 10 and Table 11.[29] We find that both the U-shaped relationship between job finding through strong ties and network size as well as the negative correlation between wages and strong ties continues to hold in this group. These patterns show no obvious sign that endogenous sorting into (not) moving biased the estimates reported above.

Measuring strong vs. weak ties. In taking our model to the data, we assumed that workers who indicate finding their job through "friends and family" mean their strong ties, rather than the type of casual acquaintances an ethnic network provides. We attempt to provide some support for this interpretation by controlling for individuals with multiple

[28] Recall that the wage results hold whether or not we control for network size.

[29] The size of these samples does not permit the use of regency fixed effects. Instead, we use province fixed effects (as well as ethnic group fixed effects).

ethnicities.[30] It seems plausible that ethnic ties have less importance for these individuals. Thus, if respondents include jobs found through weak ethnic ties in the "friends and family" category, we might expect multiethnic individuals to be less likely to find jobs in this manner. Columns 1, 3 and 5 in Table 12 include an indicator for multiethnic workers and show that there is no evidence that these individuals are less likely to find jobs through friends and family. In columns 2, 4 and 6, we interact the multiethnic indicator with the network size variables. For both network size and its square, the interactions have the same signs as the main effects and they are never statistically significant. There is no evidence that network size has different effects on getting a job through "friends and family" across these groups, which further increases our confidence in the interpretation of the results above.

Alternative proxy for network size. Like our model, Wahba and Zenou (2005) also present theoretical results concerning the relationship between network size and various outcomes of interest. They present an extensive argument for why, in their empirical context (Egypt), population density is the best available proxy for network size (see section 3 of their paper). By contrast, we use ethnic group size as a proxy for network size because we view it as a better proxy in our context. Note that our baseline results control for regency fixed effects, thus, our results on the effects of network size control for population density at the regency level. To provide further comparisons between the two proxies, we now investigate what would happen if we used population density instead of ethnicity as our proxy for network size. In the Appendix, we present regressions without the ethnic group size variables but including regency level population density and its square (and replacing the regency fixed effects with province fixed effects). This closely matches Wahba and Zenou's specification for our dataset. As shown in the Appendix, Table 13, the population density variables do not yield statistically significant results. This supports our argument that, in our case, ethnicity is a more useful proxy for network size than population density.

[30] Recall that an individual's ethnicity was defined based on his parents and survey respondents could list multiple ethnicities for both parents.

6 Conclusion

In this paper, we present a theoretical and empirical analysis of workers' choice between using different social contacts in their job search, and the resulting impact on labor market outcomes. Unemployed workers are matched through two types of ties: strong ties, which consist of family and friends, and weak ties, which are the collection of individuals belonging to the same ethnic group in each Indonesian regency (city). The model predicts a U-shaped relationship between the size of the weak network and the probability of finding a job through strong ties. If the weak network is too small or too large, weak ties become relatively less effective in providing job opportunities to the unemployed workers. Therefore workers rely on their friends and relatives more frequently in their search for a job if they belong to either a very small or a very large ethnic network. We use the Indonesian Family and Labor Survey to test the predictions of the model. The model's main results are all consistent with our data. We find that medium-sized networks result in the lowest probability of finding a job through strong ties. Increasing or decreasing network size by 50% is associated with a 9 percentage points higher probability of finding jobs through family and friends. Consistent with the model, less educated workers rely more on their strong ties. Controlling for individual characteristics, jobs found through strong ties are associated with approximately 10 percent lower wages.

While Indonesia is special in the importance of ethnic networks and informal job search methods, some features of the analysis may carry over to other settings. Most workers have access to multiple networks to gain information about job openings. Apart from family and close friends, alumni organizations, church groups, political parties etc. create additional (weaker) networks for the individual. This paper shows that there are quantifiable trade-offs for workers in how they look for a job and, in turn, wages can be correlated with which network delivered a particular job. Lowering the costs of gaining information through the weaker network can be beneficial.

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7 Appendix

7.1 Proof of Proposition 1

In order to characterize the equilibrium of the model, we first substitute the value functions (4)-(7) and (9)-(11) into the Nash bargaining solution (13) to determine equilibrium wages. This yields

$$w_g^{ws} = w_g^{ww} = \frac{-c_0(1-\beta) + [\frac{s_g}{r+\lambda_w} + \frac{1}{r+\lambda_s}]\beta pq(\theta) + \beta p}{1 + \beta q(\theta)(\frac{s_g}{r+\lambda_w} + \frac{1}{r+\lambda_s})} \tag{21}$$

$$w_g^s = \frac{p(r+\lambda_s+q(\theta))\beta}{r+\lambda_s+\beta q(\theta)} \tag{22}$$

In turn, this yields the values

$$J^{ww} = \frac{(p+c_0)(1-\beta)}{r+\lambda_w+\beta q(\theta)(s_g+\frac{r+\lambda_w}{r+\lambda_s})} \tag{23}$$

$$J^{ws} = \frac{(p+c_0)(1-\beta)}{r+\lambda_s+\beta q(\theta)(s_g\frac{r+\lambda_s}{r+\lambda_w}+1)} \tag{24}$$

$$J^s = \frac{(1-\beta)p}{r+\lambda_s+\beta q(\theta)} \tag{25}$$

$$U_g^w = \frac{1}{r}\frac{-c_0 + (\frac{s_g}{r+\lambda_w} + \frac{1}{r+\lambda_s})\beta pq(\theta)}{1+\beta q(\theta)(\frac{s_g}{r+\lambda_w}+\frac{1}{r+\lambda_s})} \tag{26}$$

$$U_g^s = \frac{1}{r}\frac{\beta pq(\theta)}{r+\lambda_s+\beta q(\theta)} \tag{27}$$

for firms and unemployed workers, respectively.

We use the free entry condition (12) and substitute the value functions (23)-(25) to obtain:

$$c = \sum_{g=1}^{2^k-1}\frac{q(\theta)}{\theta}(\frac{s_g}{r+\lambda_w}+\frac{1}{r+\lambda_s})\frac{(p+c_0)(1-\beta)}{1+\beta q(\theta)(\frac{s_g}{r+\lambda_w}+\frac{1}{r+\lambda_s})} + \frac{q(\theta)}{\theta}\frac{(1-\beta)p}{r+\lambda_s+\beta q(\theta)} \tag{28}$$

Taking the network sizes and the search channel decisions of individuals as given, the left hand side of this equation is constant, while the right hand side is monotonically decreas-

ing in θ. Given the Inada conditions $\lim_{\theta\to 0} q(\theta) = \lim_{\theta\to\infty} \theta q(\theta) = \infty$ and $\lim_{\theta\to\infty} q(\theta) = \lim_{\theta\to 0} \theta q(\theta) = 0$, there exists a unique θ which solves equation (28) for a given size of the network and search channel decisions.

Given θ, we solve for the stationary unemployment using equations (14) and (15). Taking θ and the search channel decisions as given, the left hand side of both equations is decreasing and the right hand side is increasing in unemployment, therefore these yield unique values of unemployment for each g.

The model is closed by the individuals' search channel decisions. These are determined by

$$max(U_g^s, U_g^w)$$

Note that due to the stationarity of the problem a worker who decided to use a channel at any point in time will not change her decision. Using the value functions (26) and (27), we find

$$U_g^w > U_g^s \Longleftrightarrow \beta p s_g q(\theta) \frac{r+\lambda_s}{r+\lambda_w} > c_0(r+\lambda_s+\beta q(\theta)) \tag{29}$$

Given θ, this inequality yields a critical value for s_g, s_g^*, above which individuals choose to use the weak ties and below which they only use their strong ties. Since the inequality always holds for c_0 small enough, the equilibrium has a positive measure of individuals using the weak ties in this case.

Since $q(\theta)$ is increasing in θ, the threshold s_g^* defined in equation (29) is decreasing in θ. Conversely, totally differentiating the free entry condition (28) verifies that an increase in s_g raises the value of θ defined by that equation. Thus, there is a unique set of consistent search effort thresholds and labor market tightness. This can always be achieved by setting the number of vacancies to $v = \theta S$. Thus, we have a unique equilibrium.

7.2 Proof of Propositions 2 and 3

The following Lemma will be useful:

Lemma 2

$$1 + q(\frac{1}{\lambda_s} + \frac{s_g}{\lambda_w}) - sq\frac{1}{\lambda_w}\eta > 0. \tag{30}$$

Proof. In a stationary equilibrium, employment through the weak network and unemployment among those using the weak network must satisfy

$$\lambda_w e^{ww}_{\bar{g}} = s_{\bar{g}} q u^w_{\bar{g}}. \tag{31}$$

In addition, from the definition of $s_{\bar{g}}$ we have $s_{\bar{g}} = \sum s(\eta_g)(e^{ww}_g + e^{ws}_g + e^s_g) > s(\eta_{\bar{g}})e^{ww}_{\bar{g}}$. Using (15) and (31) this inequality can be rearranged to obtain (30). ■

Next, the relationship between the size of the weak network and the help received is stated in the following lemma.

Lemma 3 *When workers in $\bar{g}$ use the weak network, the search effort received from the weak ties by an unemployed in $\bar{g}$, given by $s_{\bar{g}} = \sum_{\{g: g\cap\bar{g}\neq\varnothing\}} s(\eta_g)(\eta_g - u^w_g - u^s_g)$, is strictly concave in the number of weak ties $\eta_{\bar{g}}$ and it attains a global maximum.*

Proof. If $\eta_{\bar{g}}$ is zero, then $s_{\bar{g}} = 0$ since the number of weak ties is zero and if $\eta_{\bar{g}} = 1$ then $s_{\bar{g}} = 0$ because of the assumption that $s(1) = 0$. It remains to be shown that $s_{\bar{g}}$ is concave. Dropping the index $\bar{g}$ to simplify the notation, write the relevant second derivative as

$$\frac{\partial s^2(\eta)}{\partial \eta^2}(\eta - u^w) + 2\frac{\partial s(\eta)}{\partial \eta}(1 - \frac{\partial u^w}{\partial \eta}) - s(\eta)\frac{\partial^2 u^w}{\partial \eta^2}. \tag{32}$$

We will show that this is negative. First, use (15) to write

$$\eta - u - qu(\frac{1}{\lambda_s} + \frac{s_{\bar{g}}}{\lambda_w}) = 0, \tag{33}$$

where the notation has been simplified to $u = u^w$ and $s = s(\eta_g)$. Differentiating totally, we obtain

$$\frac{\partial u}{\partial \eta} = \frac{1 - qu\frac{s}{\lambda_w} - qu\frac{s'}{\lambda_w}(\eta - u)}{1 - qu\frac{s}{\lambda_w} + q(\frac{1}{\lambda_s} + \frac{s_{\bar{g}}}{\lambda_w})}. \tag{34}$$

Differentiating (33) again,

$$\frac{\partial^2 u}{\partial \eta^2} = \frac{u'(2q\frac{s}{\lambda_w}(u'-1) + 2q\frac{s'}{\lambda_w}(2u - \eta)) - 2qu\frac{s'}{\lambda_w} - qu\frac{s''}{\lambda_w}(\eta - u)}{(1 + q(\frac{1}{\lambda_s} + \frac{s_{\bar{g}}}{\lambda_w}) - qu\frac{s}{\lambda_w})} \tag{35}$$

Note that the denominator of (35) is positive because of (30) and the fact that $\eta > u$. Given this, substitute (35) into (32) and use algebra to show that the resulting expression is proportional to

$$s''(\eta-u)[1+q(\frac{1}{\lambda_s}+\frac{s_{\bar{g}}}{\lambda_w})]+2s'(1+q(\frac{1}{\lambda_s}+\frac{s_g}{\lambda_w}))-2u'[s'(1+q(\frac{1}{\lambda_s}+\frac{s_g}{\lambda_w}))+sq\frac{1}{\lambda_w}s(u'-1)-sq\frac{1}{\lambda_w}s'(\eta-u)]. \tag{36}$$

Since $s'', s' < 0$, the first two terms in (36) are negative. Using (34) and some algebra, the last term is

$$-q(\frac{1}{\lambda_s} + \frac{s_g}{\lambda_w})s^2 q\frac{1}{\lambda_w} + s'(1 + q(\frac{1}{\lambda_s} + \frac{s_g}{\lambda_w}))[1 + q(\frac{1}{\lambda_s} + \frac{s_g}{\lambda_w}) - sq\frac{1}{\lambda_w}\eta] < 0$$

where the inequality follows from (30). Thus, expression (32) is negative. ■

Using (29), this Lemma implies the following Corollary.

Corollary 4 *In a stationary equilibrium with a positive measure of individuals in each g, individuals who belong to relatively smaller or bigger weak networks are more likely to use only the strong ties channel, i.e. there exist threshold weak ties sizes $\eta^*_{g,1}$ and $\eta^*_{g,2}$ such that workers use only the strong ties if $\eta_g < \eta^*_{g,1}$ or $\eta_g > \eta^*_{g,2}$, and also the weak ties if $\eta^*_{g,1} < \eta_g < \eta^*_{g,2}$.*

Since the search effort from the strong network is independent of η_g, Lemma 3 and Corollary 4 imply that there is an inverse-U shaped relationship between network size η_g

and the probability that a workers finds a job through his weak ties. This completes the proof of Proposition 2.

To prove Proposition 3, observe that workers searching through weak ties obtain higher wages than workers searching through strong ties. This can be verified by comparing (21) and (22) using the condition (29). Since workers who also use weak ties find employment through their weak ties with some probability, their expected wage is higher.

7.3 Details for the analysis of the extended model

The workers' value functions for the extended model are given by

$$
\begin{aligned}
rU_g^{s,e} &= q(\theta)[E_g^{s,e} - U_g^{s,e}] && (37)\\
rE_g^{s,e} &= w_g^{s,e} - \lambda_s[E_g^{s,e} - U_g^{s,e}] && (38)\\
rU_g^{w,e} &= -c_0 + s_g q(\theta)(E^{ww,e} - U^{w,e}) + q(\theta)(E^{ws,e} - U^{w,e}) && (39)\\
rE_g^{ww,e} &= w_g^{ww,e} - \lambda_w[E_g^{ww,e} - U_g^{w,e}] && (40)\\
rE_g^{ws,e} &= w_g^{ws,e} - \lambda_s[E_g^{ws,e} - U_g^{w,e}] && (41)
\end{aligned}
$$

for $e = l, h$. Firm value functions are

$$
\begin{aligned}
rJ^{s,e} &= p - w_g^{s,e} - \lambda_s(J^{s,e} - V) && (42)\\
rJ^{ww,e} &= p - w_g^{ww,e} - \lambda_w(J^{ww,e} - V) && (43)\\
rJ^{ws,e} &= p - w_g^{ws,e} - \lambda_s(J^{ws,e} - V) && (44)
\end{aligned}
$$

The free entry condition in the extended model is given by:

$$
\begin{aligned}
c &= \alpha \sum_{g=1}^{2^k-1} \frac{s_g q(\theta)}{\theta}[\alpha J^{ww,l} + (1-\alpha)J^{ww,h}] && (45)\\
&\quad + \frac{q(\theta)}{\theta}[\alpha J^{ws,l} + (1-\alpha)J^{ws,h}] + \frac{q(\theta)}{\theta}[\alpha J^{s,l} + (1-\alpha)J^{s,h}]
\end{aligned}
$$

The conditions for stationary unemployment are

$$\lambda_s(\mu_g^{s,e} - u_g^{s,e}) = q(\theta)u_g^{s,e} \quad (46)$$

$$\lambda_s(\mu_g^{w,e} - u_g^{w,e}) = q(\theta)u_g^{w,e}(1 + \frac{s_g\lambda_s}{\lambda_w}) \quad (47)$$

Definition 5 *A stationary equilibrium for this economy is a set*

$$(E_g^{s,e}, E_g^{ww,e}, E_g^{ws,e}, U_g^{s,e}, U_g^{w,e}, J^{s,e}, J^{ww,e}, J^{ws,e}, w_g^{s,e}, w_g^{ws,e}, w_g^{ww,e}, S, v, u_g^{s,e}, u_g^{w,e}, \mu_g^{w,e}, \mu_g^{s,e})$$

consistent with the following conditions given c, c_0, α, $s(\eta_g)$ *for all* g.

(i) *The value functions for the workers and firms satisfy (37)-(41) and (42)-(44) for* $e =$ *l,h.*

(ii) *The equilibrium measure of firms is determined by the free entry condition (45).*

(iii) *The stationary unemployment rates satisfy (46) and (47).*

(iv) *The measure of workers using exclusively strong and both strong and weak ties for each group* g *is determined by the individual decisions described by (17) and (18).*

Solving for the equilibrium follows exactly the arguments presented for the benchmark model. The arguments of Proposition 1 apply to this case, therefore there exists a unique labor market equilibrium for any composition of the weak network. Note that we have a finer partition over g's since we categorized individuals belonging to a particular g as having high or low education levels. The arguments in Proposition 2 still hold with a slightly modified trade-off according to the education levels. In equilibrium, the benefit obtained from the weak ties still has a concave shape, but the threshold levels now depend on the education levels. For highly educated workers the option value of being employed is higher compared to the less-educated, thus they are willing to use their weak ties for relatively smaller weak ties sizes. Workers using weak ties obtain higher wages, in line with the arguments of Proposition 3.

7.4 Additional tables

Table 6: Probability of getting a job through strong ties, detailed estimates

	All	Less than college
	(1)	(2)
Ethnic group size	-0.816***	-0.819***
	(0.267)	(0.315)
Ethnic group size^2	0.380***	0.278*
	(0.135)	(0.168)
Urban area	-0.089	-0.074
	(0.054)	(0.059)
Married	-0.012	-0.010
	(0.042)	(0.048)
Age	-0.024	-0.028*
	(0.015)	(0.015)
Age^2	0.000	0.000
	(0.000)	(0.000)
Firm size		
5-19 employees	0.080	0.081
	(0.059)	(0.063)
20-99 employees	0.030	0.048
	(0.058)	(0.063)
100 or more employees	0.004	0.044
	(0.060)	(0.065)
Industry		
Mining	-0.036	-0.135
	(0.174)	(0.249)
Manufacturing	0.007	-0.002
	(0.061)	(0.063)
Electricity, gas and water	0.150	0.217
	(0.141)	(0.154)
Construction	0.075	0.065
	(0.084)	(0.094)
Wholesale, retail and restaurant	-0.052	-0.047
	(0.077)	(0.079)
Transportation	0.096	0.106
	(0.089)	(0.086)
Finance	-0.200	-0.227
	(0.122)	(0.168)
Social services	-0.052	-0.046
	(0.076)	(0.079)
Education		
High school degree	0.002	-0.003
	(0.059)	(0.060)
College degree	-0.178*	-
	(0.091)	
Higher education degree	-0.081	-
	(0.106)	
N	1023	902

Notes: Detailed regression output corresponding to Table 3, column (2) and (3). Linear Probability Model estimates. The dependent variable is a dummy variable equal to 1 if the worker got his or her current job using friends and relatives. Both regressions include regency and ethnic group fixed effects. The excluded category is a worker whose highest attended education level is elementary school, who works in agriculture, and whose firm employs fewer than 5 workers. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Table 7: Probability of getting a job through strong ties, Probit estimates

	(1)	(2)
Ethnic group size	-0.652***	-1.039***
	(0.248)	(0.341)
Ethnic group size^2	0.318**	0.477***
	(0.142)	(0.180)
Regency fixed effects	x	x
Ethnic group fixed effects		x
N	931	906

Notes: The dependent variable is a dummy variable equal to 1 if the worker got his or her current job using friends and relatives. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Table 8: Controlling for network "quality"

	(1)	(2)	(3)
Panel A: Job finding through strong ties			
Ethnic group size	-0.765***	-0.746***	-0.699**
	(0.287)	(0.283)	(0.303)
Ethnic group size^2	0.348**	0.362***	0.331**
	(0.148)	(0.138)	(0.150)
Panel B: Wages			
Found job through strong ties	-0.090**	-0.091**	-0.091**
	(0.035)	(0.035)	(0.035)
Ethnic group average age	x		x
Ethnic group unemployment rate		x	x
Regency fixed effects	x	x	x
Ethnic group fixed effects	x	x	x
N	1023	1023	1023

Notes: The dependent variable is a dummy variable equal to 1 if the worker got his or her current job using friends and relatives (Panel A) and the logarithm of the hourly wage (Panel B).. All regressions control for individual and firm / industry characteristics. Ethnic group average age and unemployment rate calculated from the 2010 Census. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Table 9: Controlling for employment duration

	(1)	(2)	(3)	(4)
Panel A: Job finding through strong ties				
Ethnic group size	-0.530**	-0.466**	-0.808***	-0.713**
	(0.215)	(0.232)	(0.271)	(0.280)
Ethnic group size^2	0.258**	0.243*	0.372***	0.351**
	(0.121)	(0.126)	(0.136)	(0.139)
Job duration	-0.001	0.000	-0.001	0.001
	(0.000)	(0.001)	(0.000)	(0.001)
Job duration * Group size	-	-0.002	-	-0.003
		(0.002)		(0.002)
Job duration * Group size^2	-	0.000	-	0.001
		(0.001)		(0.001)
Panel B: Wages				
Found job through strong ties	-0.098***	-0.077	-0.086**	-0.067
	(0.034)	(0.052)	(0.035)	(0.055)
Job duration	0.001***	0.001**	0.001***	0.001**
	(0.000)	(0.001)	(0.000)	(0.001)
Job duration*Found job through strong ties	-	-0.000	-	-0.000
		(0.001)		(0.001)
Ethnic group size	-0.090	-0.093	0.020	0.018
	(0.075)	(0.075)	(0.095)	(0.096)
Regency fixed effects	x	x	x	x
Ethnic group fixed effects			x	x
N	1023	1023	1023	1023

Notes: The dependent variable is a dummy variable equal to 1 if the worker got his or her current job using friends and relatives (Panel A) and the logarithm of the hourly wage (Panel B).. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Table 10: Probability of getting a job through strong ties, Movers only

	All movers		Moved before new job	
	(1)	(2)	(3)	(4)
Ethnic group size	-0.443***	-0.486***	-0.535***	-0.407*
	(0.154)	(0.181)	(0.183)	(0.237)
Ethnic group size^2	0.249***	0.250***	0.319***	0.254**
	(0.073)	(0.079)	(0.083)	(0.099)
Province fixed effects	x	x	x	x
Ethnic group fixed effects		x		x
N	361	361	228	228

Notes: The dependent variable is a dummy variable equal to 1 if the worker got his or her current job using friends and relatives. Columns (1) and (2) are for workers who moved since the previous survey (in 2000). Columns (3) and (4) are for the subset of movers who received their current job after they moved. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Table 11: Strong ties and wages, Movers only

	All movers			Moved before new job		
	(1)	(2)	(3)	(4)	(5)	(6)
Found job through strong ties	-0.173***	-0.174***	-0.186***	-0.228***	-0.237***	-0.251***
	(0.063)	(0.062)	(0.064)	(0.072)	(0.071)	(0.072)
Ethnic group size	-	0.133*	-0.101		0.127	-0.181
		(0.080)	(0.231)		(0.106)	(0.305)
Ethnic group size^2	-	-	0.118			0.155
			(0.119)			(0.171)
Province fixed effects	x	x	x	x	x	x
Ethnic group fixed effects	x	x	x	x	x	x
N	361	361	361	228	228	228

Notes: The dependent variable is the logarithm of hourly wages. Columns (1)-(3) are for workers who moved since the previous survey (in 2000). Columns (4)-(6) are for the subset of movers who received their current job after they moved. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Table 12: Probability of getting a job through strong ties, controlling for multiethnic workers

	(1)	(2)	(3)	(4)
Ethnic group size	-0.603***	-0.556**	-0.816***	-0.740**
	(0.207)	(0.237)	(0.267)	(0.299)
Ethnic group size^2	0.279**	0.233*	0.380***	0.335**
	(0.117)	(0.135)	(0.135)	(0.155)
Multiethnic	0.189**	0.180	0.658***	0.860**
	(0.076)	(0.165)	(0.223)	(0.357)
Multiethnic * Group size	-	-0.249	-	-0.569
		(0.493)		(0.625)
Multiethnic * Group size^2	-	0.293	-	0.373
				(0.359)
Regency fixed effects	x	x	x	x
Ethnic group fixed effects			x	x
N	1023	1023	1023	1023

Notes: The dependent variable is a dummy variable equal to 1 if the worker found his or her current job using friends and relatives. Multiethnic is an indicator equal to 1 for workers with multiple ethnicities. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.

Table 13: Probability of getting a job through strong ties and population density

	(1)	(2)
Population density	0.072	0.064
	(0.053)	(0.052)
Population density^2	-0.006	-0.005
	(0.006)	(0.005)
N	1023	1023
Province fixed effects	x	x
Ethnic group fixed effects		x

Notes: The dependent variable is a dummy variable equal to 1 if the worker found his or her current job using friends and relatives. Ethnic group size variables are replaced with regency population density, measured in 1000 people / km^2. All regressions control for individual and firm / industry characteristics. Robust standard errors clustered at the regency ethnic group level in parentheses. ***, **, * denotes statistical significance at the 1, 5, 10 percent level, respectively.