Networks and youth labor market entry

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by

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Abstract

The paper provides an overview of existing knowledge regarding the role played by social networks in the process where young workers are matched to employing firms. We discuss standard theories of why social networks may be an important element in the job-matching process and survey the empirical literature on labor market networks with an emphasis on studies pertaining to the role of social contacts during the school-to-work transition phase. In addition, we present some novel evidence on how contacts established while working during the final year in high school affect youth labor market entry. Finally, we discuss how insights from this literature can be used to improve the quality of social programs targeted towards young workers in the Nordic countries.

Keywords: Referrals, school-to-work transition, youth unemployment
JEL-codes: M51, J64, J24, Z13

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1   Introduction

The successfulness of young workers' transition from school to working life is influenced by a number of factors, including the human capital provided by the schools, the beliefs and motivation of the young and the conditions at the relevant labor market. A defining feature in this process is however that the intrinsic uncertainty of the recruiting process which motivates key economic concepts such as statistical discrimination, search frictions and the signaling value of education is likely to be particularly pronounced when employers evaluate previously untested workers. A salient feature of most labor markets is that employers try to mitigate this uncertainty by relying on the direct personal interactions between workers and agents of the firms that are provided by social networks. In this article, we discuss the role played by networks for the labor market entry of young workers.

Recently, the economic literature has seen a huge flow of theoretical and empirical papers discerning the role played by labor market networks (see Kramarz and Skans, 2013 for references). An obvious reason for this growing interest is the prevailing fact that labor market networks appear to be at least as important for the matching of workers and jobs as are all formal recruitment channels combined. In this article we summarize some of this evidence, although we are by no means claiming to provide a full account of all the relevant literature. We focus on studies that we believe to be relevant for understanding the role played by networks when young workers transit from school to work. We start off by documenting the prevalence of networks as an important mechanism for the matching process, with a focus on the situation in Sweden. Next, we briefly describe the different rationales for the use of labor market networks that have been emphasized in the economic literature and discuss what we can learn from recent empirical studies on the relevance of these competing theories. We end our overview of the existing literature by surveying the evidence regarding how social contacts affect the job finding rate and the ensuing match quality with an emphasis on studies that refer to the situation for young workers.

We then turn to an empirical investigation of how the contacts established during summer or extra jobs held by students that are enrolled at Swedish vocational schools affect their labor market entry. By focusing on the role of job contacts obtained through in-school work experience, we complement the picture emerging from a closely related

previous study on Swedish data which focus on the role family links (Kramarz and Skans, 2013).

The results confirm that social networks are indeed important, both in determining which particular establishments students sort into after high school as well as the time it takes to find a stable job. The estimated magnitudes are non-trivial: graduates who had a summer/extra job at a particular establishment have 35 percentage-points higher probability to find a stable job there compared to other students from the same class; and they are estimated to have around 4 percentage points higher probability to end up in an establishment where someone from the summer/extra job has moved. The interpretation in terms of networks is supported by the fact workers who move just before the summer jobs are found to be unrelated to the ensuing post-graduation employment patterns of the graduates. In addition, we find that the employment rate of graduates is estimated to increase by 14 percentage points if all high school job contacts were employed relative to a case where none of the contacts were employed. Consistently, the estimates are found to to be substantially larger if the contacts are specialized in the same occupation as the graduating student.

In the final section of the paper we summarize the evidence presented in the article and try to spell out how the results can guide policy makers in the design of social programs for young workers.

2   Networks are a key element in the job matching process

A vast number of international studies suggest that job finding networks are a key element in the process where workers and firms are matched. The literature is surveyed by e.g. Ioannides and Loury (2004) and Bewley (1999), reporting that most studies that tries to document the fraction of job-matches that are formed with the help of social networks and informal contacts find results in the range of 30 to 60 percent. Essentially, the original studies of interest come in one of two forms; the first is based on surveys to workers who are asked how they found their last job, and the second is based on surveys to firms that are asked how they filled their last vacancy.[4] It is noteworthy however that the results, although uniformly showing that networks are important, tend to differ

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[4] A third set of studies focuses on documenting which channels the unemployed are using in their attempts to find employment, but we since these are less informative regarding the question under study here, we have not included them in this review.

between studies in exactly *how* important. One potential reason for this is that survey questionnaires may phrase their questions differently (e.g. "how did you find your job", or "how did you first learn about your job"). Another obvious reason is that the surveyed populations may differ. In general, youths and low educated appear to be overrepresented among those using social contacts, see e.g. Pelizzari (2004).

The picture presented by Ioannides and Loury, and by Bewley, is also well matched by Swedish survey evidence. Data from the Swedish Labor Force Survey presented in Behtoui (2008) show that around 40 percent of jobs were found through informal contacts and that this share is higher among the young, the less educated, men and when unemployment is high. In addition, informal contacts appear to be used less frequently among immigrants. Similarly, the Public Employment Service (PES) regularly surveys previously unemployed workers who have found jobs, asking them how they found information about these jobs. Results in Nilsson (2011) for the period 2006-2010 show that around 70 percent received information through some form of informal channel (slightly more for the younger), whereof about half was through a friend or acquaintance. An additional source of information is provided by the Swedish National Board for Youth Affairs which regularly surveys Swedish youths regarding how they got their current job. Results from the years 2004 to 2011 suggest that a fairly stable 70 percent of employed 19 to 25-year olds found employment through informal contacts, whereof somewhat more than half through people they knew (the other half from direct contact with an employer).

A second strand of studies has instead surveyed the demand side of the labor market; asking employers how they find suitable employees. Here, we have again found a number of Swedish studies, all of which present results from specific surveys to employers. Examples include Klingvall (1998), Behrenz (2001), Nutek (2000), Ekström (2001), Svenskt Näringsliv (2010) and Riksrevisionen (2010). The results suggest that around 60 to 70 percent of employers rely on informal recruitment channels, where suggestions from incumbent employees provide one important component.[5]

On top of the survey evidence, the international literature contains a number of ambitious attempts to identify the causal impact of social contacts on the probability that workers are matched to a specific establishment or firm. In contrast to the survey

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[5] The main outlier is Behrenz (2001) which found a lower fraction for informal contacts. A possible reason is that the sample was drawn from firms with posted vacancies at the PES.

based studies, these studies use a control group to identify the probability that a particular worker should have ended up at the same establishment, had the contact not been present. For example, Bayer, Ross and Topa (2008) show that individuals are more likely to work with very close neighbors (contacts) than with somewhat more distant neighbors (control group) in the US. Similarly, Kramarz and Skans (2013) show that Swedish graduates are much more likely to find their first stable job where their parents (contacts) work than where their classmates' parents (control group) work. These differences also remain when they compare graduates with parents who are employed within the same firm, but at different establishments; a result that implies that parents have to be present in an establishment for the effect to be potent. A key insight from these studies is that it is very difficult to predict to which specific establishment a worker will be matched without access to network data. In other words, if someone ends up in an establishment where he or she has a contact, it is usually because of the network and not because of some other correlated factor.

Overall our reading of the existing evidence is that it consistently shows that networks are very important factors in the job matching process. Our review of Swedish evidence suggests a rough decomposition into one third of jobs found through formal channels (responding to formally posted vacancies), one third through direct contact with employers, and one third through social networks. This picture is fairly well-mirrored by firm-side responses on how vacancies are filled. Overall, both Swedish and international evidence also seem to suggest that networks are more important for the young and less-educated.

3   Why are networks so important?

Given that a host of different types of studies consistently show that social networks provide an important factor in the worker-firm matching process, in particular for the young, a natural next question is "why?". Below, we provide an overview of the key theoretical explanations and discuss some existing empirical evidence which may shed light on why social networks act as a crucial intermediary in modern labor markets.

There is an enormous amount of studies pertaining to the use of job finding networks within both sociology and economics, and it is not within the scope of this article to provide a full account of this literature. However, following Jackson (2010), we believe

that it is fair to distinguish between two broad motivations for the use of social networks in the job matching process.

The first of these explanations focuses on the role played by networks in diffusing information about available jobs among potential job seekers. We can think of this explanation as being *supply-side oriented* since it focuses on the behavior of job seekers, whereas firms feature as passive agents. The seminal paper is this tradition is Granovetter (1973) who emphasizes the *Strength of weak ties*, an hypothesis suggesting that contacts that are further away from an individual convey more novel information (about job vacancies) and that weak social ties therefore are crucial for the job finding process. Recently works by several economics have explored various aspects of how supply oriented networks could be incorporated into standard models of matching on the labor market (see e.g. Calvo-Armengol and Jackson, 2004). According to this strand of the literature, access to networks matter for labor market outcomes since it provides information about additional job openings. In terms of different types of networks it is clear that it is most useful for agents to have access to networks that are as dispersed as possible since that provides the broadest possible coverage of information about possible vacancies. Since the focus in this tradition mainly is on the diffusion of information about vacancies as such, there is very little emphasis on aspects related to information about the quality of jobs and (in particular) the information about the characteristics of individual workers. It therefore, in general, does not appear to be particularly important what type of social tie one has to the employed agents.[6]

The other main explanation focuses on firm side rationales and could thus be viewed as *demand-side oriented*. A key insight motivating this focus is that firms appear to be fully aware of, and actively promoting, the use of social contacts in the matching process. But why do they find it beneficial to do so? Recent research argues that a probable reason is that social networks allow firms to find the types of workers they want to hire. In other words, the social tie may serve as an intermediary reducing the ex ante uncertainty workers and firms may experience when trying to evaluate the opposing agent. One version of these models emphasize that social networks serve as a

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[6] An interesting early exception is Boorman (1975) which provides an interesting model where employed agents first provide information about job openings to their closest friends (if these are unemployed) and only provide information to acquaintances if all the close friends are employed, suggesting that strong social ties may be particularly important when unemployment is high.

direct means to reduce the uncertainty regarding how well-suited the capabilities of a certain worker are for a particular firm by providing credible information in both directions (see e.g. Simon and Warner, 1992).

In contrast to the supply side models, a key element arising from many models in the demand focused literature is that the quality of the demand-side agents matters. A prominent example is Montgomery (1991) who argues that firms like to hire friends of *productive* workers under the assumption that friends resemble each other so that recruited friends also are likely to be more productive than other workers. Similarly, a recent randomized field experiment by Beaman and Magruder (2012) shows that productive workers are more able to refer other productive workers, and that they will do so if firms let the referring (incumbent) worker gain from the productivity of their referred entrants. Such incentives also appear to shift the types of used networks from family ties to professional ties. Importantly, the (perceived) productivity of those belonging to a young worker's network becomes a key determinant for the usefulness of the network if it is true that referrals primarily are asked from workers who are believed to be productive by their employers.

Casella and Hanaki (2006) provide a very interesting extension to Montgomery's (1991) referral model which sheds lights on the salience of the use of job-finding networks by young workers. In short, they postulate that young workers without experience can invest in costly formal merits or in contacts with older workers who may generate referral offers. They show that if firms can obtain referrals at no (or low) cost, they will always choose to hire through personal referrals rather than via formal merits, even when the formal signals are more informative about the workers productivity. The reason is that while formal merits transmit information to the entire market, personal referrals transmit *private* information to the establishments who are connected to the worker, allowing them to extract some of the surplus from the referral hires. The private information is in this way a source of monopsonistic power, which redistributes more of the surplus from the match to the firms.

There are good reasons to believe that the demand side models are particularly relevant for young workers who are entering the labor market. The reason is that employers may find it particularly difficult to identify the individual abilities of workers who are at the beginning of their careers. Evidence in line with this line of argument

shows that firms overprice formal merits (such as schooling) and that they underprice abilities that are difficult to screen early in workers' careers (Altonji and Pierret, 2001 and Hensvik and Skans (2013) for replication using Swedish data).

Although, as always within social sciences, it seems obvious that different proposed explanations all contain elements of truth, a host of recent evidence suggests to us that information about worker heterogeneity is a key element motivating the frequent use of job-finding networks. An interesting recent contribution is Brown et al. (2012), who study explicit data on referrals from a large single firm in the US. They find that employees who receive referrals from older workers, more tenured workers or workers in higher ranks have the highest initial starting salaries. Earlier work by Fernandez et al (2000) and Castilla (2005) on data from a US customer support center suggest that referrals and referrers have correlated characteristics and that referrals are more productive than other entrants early in their careers. Dustmann et al (2011) who use ethnic similarity as a proxy for social ties also show evidence of wage growth and mobility patterns that is consistent with a model where networks reduce the ex ante uncertainty regarding the quality of matching between workers and jobs. Finally, Hensvik and Skans (2013), who rely on Swedish data show that workers who enter via coworker networks have better test scores (that are difficult for employers to observe) but lower schooling (which is easy to observe) suggesting that networks provide employers with information about abilities that are difficult to observe otherwise. In addition, they find that abilities are correlated between linked incumbents and entrants along the lines suggested by both Montgomery (1991) and Beaman and Magruder (2012).

It also seems to matter empirically who the demand side agent is. Kramarz and Skans (2013) and Hensvik and Skans (2013) both find that networks to a larger extent lead to employment when the demand side agent (the employed) is of a better quality. More precisely, Kramarz and Skans find that parents with higher wages and longer elapsed tenure matter more—also when comparing different parents within the same firm. As Hensvik and Skans (2013) show, firms are more likely to recruit former coworkers of incumbent workers when the incumbent workers have higher test scores.

A key result found in Kramarz and Skans (2013) is also that the impact of networks requires that the demand side contacts are present at the actual establishment. Once

demand side contacts have left the establishment, or if these contacts are employed by another establishment within the same firm, the effect is essentially zero.

Overall, we take this evidence as supporting the notion that considerations regarding aspects related to worker heterogeneity provide an important element which motivates the widespread use of networks in the matching process. Ultimately, this is a very important insight, in particular when thinking about networks in a policy context, since it implies that not all social contacts matter alike. In order to make a difference, networks should to carry useful information to employers about worker characteristics.

4   Networks and labor market consequences for the young

4.1   Time-to-job

A key aspect in terms of the consequences of job finding networks is to what extent access to useful networks reduces the time it takes for young workers to find employment. Conceptually, networks could matter for *where* young workers work without affecting the time to employment. The issue can be studied in two ways, either by analyzing the relationship between measures of network quality and the duration until employment, or by studying differences in the elapsed time to job between youths that found their job through a social contact and those that found employment through other means. Essentially, the first strategy is more appealing, but also more demanding, and we have not found any studies in that vein that pertain to youths in particular (although, see our analysis below).

More generally, Bayer et al (2008) tries to identify the impact of network quality on labor market outcomes by studying the impact of close neighbors, while using somewhat more distant neighbors as a control group. They show that workers whose close neighbors, in particular neighbors with similar demographic characteristics, are employed have higher employment rates themselves. Similarly, Cingano and Rosolia (2012) show that displaced workers, who lose their jobs during a mass-layoff, have shorter ensuing spells of unemployment if the employment rate within their network of former coworkers is higher.[7] None of these studies pertain specifically to youths however.

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[7] We have also, within an ongoing project, replicated this finding on Swedish data, finding comparable results.

A second vein of studies documents the relationship between the time-to-employment and the means by which these jobs were found. Here, we would like to emphasize two studies which focus on young workers. The first is Bentolila et al (2010) who use survey data from the US and 13 EU countries (including Denmark and Finland but not Sweden). They show that youths who found their jobs through social contacts had shorter preceding unemployment spells, even after accounting for fairly detailed individual and firm-level characteristics. The second study is Kramarz and Skans (2013) who use Swedish register data, focusing on the role of family ties. Consistent with Bentolila et at (2010) they find that youths who found employment through family ties, did so half a year faster than other youths. This remarkably large effect is present regardless of whether the comparison is made relative to other graduates from the same class or relative to other graduates entering into the same firm. Even when estimated relative to other graduates from the same school and field entering the same firm, an effect of one quarter of a year remains.

Thus, overall we take the existing evidence as suggesting that networks not only provide a quantitatively important job finding channel but also that a stronger network in general tend to increase employment and re-employment among displaced workers. Most importantly, youths who (are able to) use social contacts to find employment appear to substantially reduce their exposure to joblessness after graduation.

4.2   Match quality

A second important aspect is to what extent the use of networks affects the match quality. Most studies trying to measure this effect has relied on wages as a measure of match quality, and our reading of the literature is that the results are enormously dispersed. A number of well-executed studies have find negative wage effects, but at least as many studies found positive wage estimates. One possible reason for this diverging evidence is that the population varies across studies, which complicates the overall picture if there is heterogeneity in the usefulness of networks across settings.

In line with the latter interpretation, a number of studies have found diverging wage estimates depending the type of contacts that have been used (e.g. Brown et al, 2012 and Hensvik and Skans, 2013). Consistent with the demand-side oriented models, Loury (2006) argues that contacts must be able to convey relevant information to employers about the potential worker in order to generate wage effects, suggesting that the effects

of networks may depend on e.g. the degree to which they overlap with the field of education.

The most relevant studies for the purpose of this article are, again, Bentolila et al (2010) and Kramarz and Skans (2013) since they both focus on youths. In fact, both of these studies suggest that the impact on initial wages is negative. In the case of Kramarz and Skans, wages are, in particular, lower compared to other entrants within the same firms. Interestingly, however, Kramarz and Skans also find that wage growth and ensuing tenure within the plant is substantially higher among those that enter through parental contacts, which suggest that the employing firms reward these workers over time. In effect, wages after three years are at par with comparable youths who enter through other means.

In our view, this last result also shows that wages provide an incomplete measure of match quality. A more direct measure of the impact on the quality of recruited workers is provided by Hensvik and Skans (2013) who show that firms that recruit via (coworker) networks in general are able to recruit workers with better unobserved abilities compared to the average recruited worker entering the same firms. Although this analysis only looks at match quality from the firm perspective (finding good workers) and not from the worker perspective (finding a good job), it illustrates that networks can provide a tool for firms to increase match quality, and that this can be studied directly, given appropriate data. Notably, the mirror image of this picture can be inferred from results presented in Kramarz and Skans (2013): They find that the firms which hire children of employees tend to on average pay higher entry wages (to all entrants). These firms are also on average more profitable and more productive. Thus, workers who enter the labor market through family networks appear to be matched to "better" firms, just as employers who rely on coworker networks appear to be matched to better workers.

5   Labor market contacts and the school-to-work transition

So far this text has reviewed existing evidence regarding job search networks in general, with an emphasis on studies that are relevant for the school-to-work transition in a Nordic context. Our reading of this evidence is that the recent literature has provided a wide set of informative results, but that many things remain undocumented.

In terms of entering workers' networks, we conjecture that they mainly appear in three forms: family contacts, contacts established during summer jobs or extra jobs while in school, and contacts established through social programs such as activities within schools or public employment services. Kramarz and Skans (2013) provide a very detailed analysis of parental contacts using Swedish data. To complement that analysis, this section, provide parallel evidence regarding the role of contacts obtained through summer/extra jobs while in school. In the next section we provide a discussion regarding the possibility of generating useful networks through the design of social programs.

The analysis in this section is divided into three parts. First, we briefly describe the empirical-set up and the data. Second, we analyze the probability that recent high-school graduates start working in the same plants as the contacts obtained through high-school jobs. Third, we examine how the employment rate of job contacts influence the job finding rate upon high-school graduation.

5.1   Empirical set-up and data

Our analysis in this section is focused on graduates from Swedish vocational high school programs (*Gymnasieskolans yrkesprogram*). These programs are three year long and students graduate at age 19. Roughly half of Swedish high school graduates take part in the vocational (rather than "Academic") programs which provide the main direct formal route to the labor market for young workers in Sweden. Each program is directed into a specific occupation, examples include "construction work", "health care", and "auto mechanics". The programs primarily provide class-room training but at least 5 weeks per year on average should be spent on site with actual employers. In contrast to e.g. Demark, the Swedish system does not rely on apprenticeship programs to any substantial extent.[8]

High school graduates

For the analysis we use a register based data set covering all 39,000 19-year old graduates from vocational high schools during the summer of 2006. For this population, we identify all jobs held by the graduates during the preceding year (2005). We identify all coworkers who are at least 20 years old (to avoid classmates), and think of these

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[8] However, since 2011 a minor fraction of students receive their vocational training through apprenticeship tracks.

coworkers as contacts. To facilitate interpretation, we also exclude contacts who are the graduate's parents.

Our analysis will compare the job outcomes of "classmates". Classmates are defined by the interaction of a school identifier and a field-of-study code. Although a school may have several classes within a field, so that our concept in a strict sense includes measurement errors, it is important to note that this is of minor importance since we only use the concept as a means to control for the types of skills the classmates receive as well as the local valuation of these skills.

Table B 1 in Appendix B shows summary statistics for the most relevant variables in our analysis. 46 percent of the graduates are women and 6 percent have parents born outside Sweden ("immigrant background"). The average graduate finishes high school with 29 other classmates, suggesting that the combination of the school and program is a fairly good measure of a class. The table also lists the ten largest programs in terms of the number of students, which illustrates the rather mixed selection of occupations under study.

Jobs before graduation and high school job contacts
An important feature of the data is the full characterization of the jobs held by the graduates both *before* and *after* graduation. Table B 1 in Appendix B shows that 68 percent of the graduates had some form of employment during the year before graduation. Unsurprisingly, the in school-jobs typically generate a very low income, the majority being either summer jobs which start in June or July and last 1-3 months, or evening/weekend jobs which start in January and last the full year. The table also suggests that the graduates who obtained some work experience during high school have, on average, higher final grades.

Jobs after graduation
We measure the graduate's post-graduation employment status in November of 2006, i.e. five months after graduation. Since we are interested in high school job contacts and their role for the transition from school into the labor market upon graduation it makes sense to focus on the first *stable* job, in particular in contrast to the jobs held when at school. Any definition of a stable job will be somewhat arbitrary, but we follow Kramarz and Skans (2013) and require that the job lasted for at least 4 months and generated a total income greater than three times the monthly minimum wage in order to

be considered as "stable".[9] The purpose of this restriction is to define a level of employment that is substantially greater than what is sustainable during the school years. Table 1 reports that 66 percent of the graduates received an income during the year of graduation whereas 31 percent had a stable job in November according to our definition. It should also be noted that the post-graduation employment rate is seven percentage points higher among graduates who held a summer or extra job during the last high school year compared to the average graduate.

Table 1 Employment outcomes after graduation (2006)

	Fraction
All graduates:	
Positive income five months after graduation	.66
Stable job five months after graduation	.31
Graduates with summer/extra job in high school:	
Positive income five months after graduation	.73
Stable job five months after graduation	.38

Final datasets

The first stage of our analysis considers the propensity that a graduate finds his/her first stable job in the same plant as a high school job contact. For this analysis, we keep (*i*) all graduates who found a stable job in the end of 2006 (*ii*) the identity number of the graduate's employer and (*iii*) the id number of all plants employing the job contacts in the end of 2006. In addition, we keep the combination of the school and vocational track (the "high school class") for each graduate, in order to use class-mates as a comparison group.

The second stage of the analysis examines the association between the employment rate in the network of high-school job contacts and the propensity that the graduate has found a stable job five months after graduation. For this analysis we add the graduates who did not find employment in 2006. For each graduate, we also calculate the share of contacts employed in the November of 2006 and retain one observation per high-school graduate.

5.2   Sorting: High school job contacts and place of work

We start by examining whether graduates find their first stable employment in plants where they have high-school job contacts. The empirical strategy which closely mimics that of Kramarz and Skans (2013) is described in further detail in Section A.1 in

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[9] The minimum wage is defined from the 10th percentile of the actual wage distribution.

Appendix A. But the intuition is fairly simple: We analyze whether graduates with a contact within a particular establishment are more likely to find a stable job there than his or her classmates are.

In order to think of the estimates as measuring the causal impact of social contacts it is necessary to assume that differences in how well graduates are matched towards different establishments are small within classes, or at least not too heavily correlated with the probability of having a summer job within the plant. This is not an innocuous assumption, in particular when analyzing the probability of returning to the same establishment as the summer or extra job, and it should be kept in mind when interpreting the estimates. However, we will also estimate the impact of finding stable employment at another establishment where a former coworker from a summer or extra job has moved. Although alternative explanations can be raised also in this case, we believe that those are less likely to be of a major concern. In addition, to validate that the effect captures the role of contacts we later show that the graduate's propensity of being matched to the same establishments as someone who were employed in the summer/extra job establishment *prior to* (i.e. not at the same time as the graduate) is of a trivial magnitude.

The results reported in the first row of column 2 in Table 2 shows that there is a positive and significant increase in the propensity to find a job in an establishment if a contact works there. On average, each contact increases the probability to start working in a particular establishment by about one percentage point. This may not sound much, but as seen by column (1) the median graduate has contacts in 16 different establishments (the average is 49), so the estimated effect would imply a 16 percentage-point increase in the propensity to work with at least one contact (column 3).[10] Here it could also be noted that we have estimated the same model using a less stringent definition of stable employment, finding similar patterns.

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[10] We calculate this probability by following Bayer, Ross and Topa (2008). They treat the likelihood of working in a plant with a contact as an independent event, and calculate the aggregated effect as
$0.158 = (1 - 0.00024)^{16} - [1 - (0.00024 + 0.0107)]^{16}$, where 16 is the median number of plants to which the graduate has at least one contact, 0.00024 is the baseline propensity to work in a particular establishment in absence of a contact, and 0.0107 is the estimated effect reported in column (1). Since a few graduates have contacts to a very large number of establishments we chose to base the calculation on the median in order to obtain a more accurate estimate of the importance of contacts.

The establishment or the contact?

In the lower panel of the table, we differentiate between the establishment where the graduate worked in high school and establishments to which a contact (former coworker) have moved between 2005 and 2006. The former case captures the propensity that an employer offers a stable job to a graduate who has work experience within the plant through a previous summer or extra job. Thus, this effect also includes mechanisms through the acquisition of firm-specific human capital. The second case measures the willingness for employers to hire young workers with a link to an employee when the graduate him/herself had not worked in the establishment. This latter effect could be thought of as a relatively "pure" network effect.

The results imply that establishments are much more likely to offer a stable job to graduates who worked there during summers or weekends in the final high school year. The fact that we find a positive estimate here is probably not particularly surprising, although the magnitude is quite striking: Graduates who worked at a particular establishment during the year preceding graduation are 35 percentage points more likely to find a stable job there than the classmates are (within the sample who finds employment).

The results derived from contacts that have changed employer imply that establishments are much more likely to offer a stable job to graduates who are linked through former coworkers even if the graduate have not been employed there in the past. While the point estimate here is much smaller in comparison (0.3 percentage points), the implied additional propensity for a graduate to end up in an establishment where a contact have moved is about 4 percentage points using a similar calculation as in the case above. The reason is that most graduates have contacts that move into a fairly large number (15 for the median) of different establishments and the total effect is an aggregate across all of these establishments.[11] An impact of four percent is around two thirds of the parental network effect for a similar population reported in Kramarz and Skans (2013).

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[11] Here it could also be noted that Kramarz and Skans (2013) find that the impact of low-tenured insiders is much smaller than the impact of workers who just entered the firm. By construction, we are identifying the effect from fresh entrants since we rely on contacts who moved during the preceding year. .

Table 2 High school job contacts and place of work, baseline

	(1)	(2)	(3)
		Average effect	**Aggregated effect from median number of contacts**
	Median number of contacts	*All contacts*	*All contacts*
Total effect of contacts	16	0.0107*** (0.0005)	0.158
Summer/extra job establishment	1	0.3558*** (0.0076)	0.356
Establishments where the link is through contacts that have moved	15	0.0027*** (0.0001)	0.040
Observations			

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at the class (school×field) level reported in parentheses. Column (1) reports the median number of establishments to which a graduate has at least one contact. Column (2) reports the average probability of working in the same establishment *as one of his/her contacts* (each column is from a separate regression) and Column (3) reports the probability of working with *at least one of his/her contacts*.

A robustness check: Evidence from placebo-contacts

A potential worry regarding the interpretation of our estimates is that the graduates and the contacts may have accumulated similar (and certain) types of skills in the summer/extra job establishment that are valued by certain types of employers. Another possibility would be that employers always prefer to hire workers from a particular establishment. Both of these stories could potentially have been generating the results presented above observed patterns in our data. However, these (and similar) explanations would predict a correlation in sorting patterns between graduates and contacts irrespectively of whether they actually interacted in the summer/extra job establishment or not. In Table 3 we have therefore estimated the same model as before, but instead of looking at the role of actual contacts, we focus on a set of workers (or "placebo-contacts) who left the summer/extra job establishment the year before the graduate was hired and hence had a nearly identical work history as the actual contacts (who by definition left one year after), but without interacting with the graduating student. The estimated effect, which is reported in column (2) suggests that the probability of ending up in the same establishment as a placebo-contact is very close to zero, which clearly highlights the importance of actual interaction in order to generate a contact effect. In our view, this is very strong support for our interpretation of the results

Table 3 Difference in the contact effect for true and placebo contacts

	(1)	(2)
	True contacts	**Placebo contacts**
Establishments where the link is through contacts that have moved	0.0027*** (0.0001)	-0.0003** (0.0001)
Class fixed effects	yes	Yes
Observations	6,175,541	1,648,190

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at the class (school×field) level reported in parentheses. Each column is obtained from a separate regression. The estimates and standard errors of the combined effects have been calculated using nlcom in stata (see Appendix A for more details).

Contact relevance: occupations and age

In column (1) of Table 4 we let the estimate differ depending on if the contact is specialized within the same ("relevant"), or a different ("not relevant") field of study defined by their education.[12] Notably, both types of contacts matter, but the estimated effect is substantially (three times on average) larger from contacts specialized in the same field as the graduating student. This is an important insight since it shows that the occupational relevance of contacts reinforces the impact of the networks. This result is mirrored in Kramarz and Skans (2013) who find that the impact of parent-child links is larger when the parents share field with graduating youths, although the effect is far from zero even in the cases where the fields are very different.

In the second column we look at the differential impact depending on the contact's age. Overall, it appears clear that older contacts matter more, and this differences in clearly driven by the cases when the contacts have moved. One possible interpretation is that the reemployment probability into the original establishment is larger if the original firm uses a younger staff. On the other hand, moving contacts may be more relevant if they are more experienced and therefore trusted to refer other workers into their new establishments.

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[12] Since one graduate may have multiple contacts within the same establishment, we define an interaction term measuring the fraction of contacts within the establishment having the same field of education and report the inferred estimates when this fraction is projected at zero and one as the relevant versus irrelevant. Note that we do not require the same level of education, to allow for changes in the education system over time.

Table 4 High school job contacts and place of work, by contact type

	(1)		(2)	
	Effect by contact relevance:		**Effect by contact age:**	
	Relevant contacts	*Not relevant contacts*	*Old age>25*	*Young age<25*
Total effect of contacts	0.0320*** (0.0021)	0.0092*** (0.0004)	0.0149*** (0.0007)	0.0044*** (0.0002)
Summer/extra job establishment	0.7470*** (0.0318)	0.2915*** (0.0080)	0.3343*** (0.0099)	0.4303*** (0.0243)
Establishments where the link is through contacts that have moved	0.0094*** (0.0008)	0.0023*** (0.0001)	0.0034*** (0.0002)	0.0015*** (0.0001)
Observations				

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ Robust standard errors clustered at the class (school×field) level reported in parentheses. The two columns report the differential impact by contact's type obtained from a pooled regression in each panel with interactions. The estimates and standard errors of the combined effects have been calculated using nlcom in stata (see Appendix A for more details).

Are contacts more important for some graduates than for others?

Table 5 shows the differential contact effect depending on the graduate's final grades, gender and immigrant background. We focus on the importance of moving contacts, as this effect is more interesting from a social network perspective. Overall, there are sizable effects for all graduates but the effect is slightly higher in the upper part of the final grade distribution. Consistent with much of the earlier literature we also find the effect to be stronger for males. In addition, we find that the effect is larger for natives within our sample.

We have also estimated the effect for the ten most common vocational tracks, finding economically and statistically significant effect of contacts in all segments of the labor market. The effects are however more pronounced for graduates specialized in tracks directed towards the manufacturing and auto-industry, where occupational relevance of contacts also appears to be particularly important. We report these estimates in Table B 2.

Table 5 High school job contacts and place of work, by graduate type

	(1)	
	High school GPA	
	Above median	*Below median*
Establishments where the link is through contacts that have moved	0.0028*** (0.0002)	0.0026*** (0.0002)
	Gender	
	Male	*Female*
Establishments where the link is through contacts that have moved	0.0030*** (0.0002)	0.0024*** (0.0002)
	Immigrant background	
	Native	*Immigrant*
Establishments where the link is through contacts that have moved	0.0027*** (0.0001)	0.0022*** (0.0003)
Class fixed effects	yes	
Observations	6,175,541	

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at the class (*school×field*) level reported in parentheses. Each panel reports the differential impact by graduate type obtained from pooled regressions with the interactions between graduate type and the variable of interest. The estimates and standard errors of the combined effects have been calculated using nlcom in stata (see Appendix A for more details).

5.3 Employment: High school job contacts and the job finding rate

The analysis presented so far shows that high school job contacts are an important predictor of the sorting patterns across establishments among graduates from Swedish vocational high schools. Now, we turn to a second analysis aimed to shed light on how these contacts affect the job finding rate.

Previous work documents that a higher employment rate among former co-workers increase the probability of re-employment for recently displaced workers (Cingano and Rosalia, 2012). Here, we apply a similar estimation strategy in our analysis of high school graduates, and examine if the probability of finding stable employment after graduation is associated with the employment rate in the network of high-school job contacts. As before, we restrict the comparison to individuals graduating from the same class the same year using a class-fixed effects model. The inclusion of the fixed effects is important since we compare individuals entering the same occupation-specific local labor market at the same point in time, and hence account for common shocks affecting all these graduates. In addition, we control for the graduate's gender and immigrant background as well as the (log) size of the high-school job network.

As in the sorting equation above, a causal interpretation of this analysis hinges on an assumption regarding differences within classes. Here the assumption is that the employment rate among previous coworkers (from summer or extra jobs) is uncorrelated with the unobserved ability to find employment conditional on the class-

fixed effects and other covariates. To reduce the risk of remaining bias we augment the specification with the graduate's income from the high-school job as well as the final grades. If the employment prospects are associated with unobserved characteristics that also were reflected into the previous income or the high school grades, these controls should reduce the correlation between employment outcomes and network characteristics. Reassuringly the estimated effect of the contact employment rate is unaffected by the inclusion of controls for the grade percentile rank (which is shown to be significantly related to the outcome).

The results, reported in Table 6 and Table 7 show that there is a positive association between the probability of stable employment in 2006 and the employment rate in the network of high-school job contacts. The magnitudes imply that the employment rate of graduates should increase by at least 14 percentage points if all contacts were employed relative to a case where none of the contacts were employed. A more relevant magnitude is calculated by using the "normal" variation in the employment rate provided by a one standard deviation increase in the network employment rate (15 percentage points) which would lead to an increased probability of employment among the graduates by around 2 percentage points.[13] This is a fairly substantial effect. As a comparison, it amounts to about half of the impact of having an immigrant background or half the two standard deviations (half the full range) in the grade distribution.

As in the sorting models above, the effect is substantially larger (about twice) when focusing on contacts with a relevant field of study as well as for male graduates (shown in Table 7). However, in contrast to the earlier results where we found stronger sorting for graduates with high grades and native origin, here it appears that graduates with lower grades and immigrant background seem to benefit more from a higher employment share in the network. We also find that the employment rate among younger linked workers is a better predictor of the graduate's job finding rate.

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[13] For comparison, Cingano and Rosalia find 7 percent reduction in unemployment duration which corresponds to 3 weeks. They also estimate the effect on the probability of still being unemployed after 9/12/15 months. Their estimates suggest a 18/13/10 percentage point reduction from an increase in network employment rate from 0 to 1.

Table 6 High school job contacts and the job finding rate

	(1)	(2)	(3)
	Graduates with work experience from 2005		
Contact employment rate	0.2219***	0.1429***	0.1426***
	(0.0241)	(0.0239)	(0.0239)
Number of contacts (per one hundred)	-0.0027***	-0.0032***	-0.0032***
	(0.0004)	(0.0004)	(0.0004)
Female	-0.0022	-0.0066	-0.0114
	(0.0093)	(0.0090)	(0.0090)
Immigrant background	-0.0550***	-0.0495***	-0.0458***
	(0.0154)	(0.0149)	(0.0150)
Log(lagged income)		0.0837***	0.0828***
		(0.0028)	(0.0028)
Grade percentile rank			0.0473***
			(0.0123)
Class fixed effects	Yes	yes	yes
Mean dependent variable	0.3785	0.3785	0.3785
Observations	26,460	26,457	26,457
R-squared	0.2004	0.2321	0.2326

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at the class (school*field) level reported in parentheses.

Table 7 High school job contacts and the job finding rate, differential effects

	(1)	(2)
	Contact relevance:	
	Relevant	*Not relevant*
Contact employment rate	0.2722***	0.1134***
	(0.0331)	(0.0241)
	Contact age:	
	Old	*Young*
Contact employment rate	0.1584***	0.2658***
	(0.0241)	(0.0344)
	High school GPA	
	Above median	*Below median*
Contact employment rate	0.1363***	0.1615***
	(0.0318)	(0.0352)
	Gender	
	Male	*Female*
Contact employment rate	0.1702***	0.1217***
	(0.0358)	(0.0318)
	Immigrant background	
	Native	*Immigrant*
Contact employment rate	0.1371***	0.2225**
	(0.0248)	(0.0994)
Class fixed effects	yes	
Mean dependent variable	0.3785	
Observations	26,457	

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered at the class (school×field) level reported in parentheses. Each column report the differential impact by graduate type obtained from pooled regressions interactions between the contact employment rate and type. We include the same controls as in column (3) of Table 6 as well as the interaction between each of the controls and graduate type. The estimates and standard errors of the combined effects have been calculated using nlcom in stata (see Appendix A for more details).

5.4   Summary of empirical results

In this section, we have provided new evidence on the role of job contacts established during high school for young workers entry into the labor market. In sum, our results suggest that social networks are indeed important, both in determining which particular establishments students sort into after high school as well as the time it takes to find a stable job.

The magnitudes of these effects are non-trivial: graduates who had a summer/extra job at a particular establishment have 35 percentage-points higher probability to find a stable job there compared to other students from the same class; and they have 4 percentage points higher probability to end up in an establishment where someone from the summer/extra job has moved. In addition, the employment rate of graduates is estimated to increase by at least 14 percentage points if all high school job contacts were employed relative to a case where none of the contacts were employed.

A consistent result is that the network effect appears to be substantially larger if the contacts are specialized in the same field of the graduating student.

6   Summary and policy discussion

In this section we summarize the results reported in this article and discuss some tentative lessons for policy design. In the article, we have first reviewed existing studies analyzing the role of networks at the labor market. It is shown that, although magnitudes tend to vary between studies, research consistently shows that informal recruitments channels in general, and social networks in particular, are quantitatively important for the matching of job seekers and firms. Our reading of existing evidence for Sweden, drawing on multiple sources on both the worker and firm side, suggests that about one third of realized matches appear through *i)* formal channels*, ii)* direct applications and *iii)* social networks respectively. In general, the informal channels also tend to be relatively more important for the young and low educated.

We then proceeded to review different potential explanations for why networks may play such an important role at the labor market. We primarily distinguished between two types of explanations, one supply side oriented and one demand side oriented. The first explanation focuses on the role networks can play as a tool to spread information about vacancies among job seekers and the other focus on the employers' desires to find

suitable workers. As noted in Section 3, we believe that a host of recent studies suggests that the supply-side perspective provides an incomplete description for the very widespread use of networks in the labor market and we will therefore emphasize an interpretation based on demand- oriented models in the discussion below.

The emphasis on demand-oriented models of employee selection also links the study of networks to a broader research field focusing on uncertainty at the time of recruitment and the strategies firms use in order to overcome this uncertainty, a research field which recently has received increasing attention (see e.g. Oyer and Shaeffer, 2011). In particular if firms have a strong aversion towards recruiting the wrong workers, it is likely that uncertainty at the time of recruitment will provide an obstacle for untested workers who are bound to rely on a scarce set of formal merits to signal their productivity. Such risk-aversion could be one potential explanation for the relatively modest uptake on some of the very generous employment subsidies that are available for Swedish employers.

Since demand side explanations are based on arguments related to fundamental uncertainty about worker traits, there also are good reasons to suspect that these models are particularly relevant for young workers who are entering the labor market. Existing evidence suggest that employers do find it difficult to predict the individual productivity of young workers and instead make inference regarding individual productivity relying on group characteristics. In an interesting recent Swedish field experiment, Eriksson and Rooth (2011) show that employers prefer not to interview young workers who are searching for a job from current unemployment. In addition, Altonji and Pierret (2001) show evidence suggesting that firms overprice formal merits (such as schooling) and that they under-price abilities that are difficult to screen early in workers' careers. This result has also been replicated by Hensvik and Skans (2013) using Swedish data.

The article also discusses evidence suggesting that networks do appear to be beneficial for the youths in the sense that they provide faster access to jobs among those that are able to use this job-finding channel. The evidence on job quality is fairly mixed however, where young workers often are found to receive lower wages when finding employment through networks (although the overall evidence is mixed), although wage growth and ensuing tenure suggest a good match quality. In addition, workers entering

through family networks appear to enter high wage firms that are both more productive and more profitable.

Policy discussion

Much of our discussion regarding the empirics of labor market networks for youths has focused on lessons from the analysis of family ties provided by Kramarz and Skans (2013) and to this we add novel evidence on the role played by in-school work contacts arising from summer jobs or extra jobs during high school. We believe that it is likely that these two types of contacts are important parts of young workers' labor market relevant networks. But none of these networks are directly related to policy. Although Swedish municipalities often provide summer jobs that are directly targeted towards high school students, these tend to be provided in an artificial form which is unlikely to provide the youths with any particularly useful networks.

However, activities within a range of social programs have the ability to provide a venue for youths to establish contacts of various forms. Unfortunately, we are not aware of any systematic evidence regarding the effects of contacts provided through social programs. But a systematic finding in the program evaluation literature is that social programs that involve actual employers tend to be more successful which indicates that the provision of contacts with employers may be a key element of success in the design of social programs.[14] In addition, comparative evaluations tend to suggest that program types that are set closer to employers provide faster access to jobs than those that are class-room based, see e.g. the survey by Forslund and Vikström (2010).[15] Finally, it is often suggested that apprenticeship based vocational training at the upper secondary level of schooling provide a more efficient route into employment than class room based training (see e.g. Lindahl, 2010).

Our reading of both our own results and results in the literature at large is therefore that they jointly suggest that the provision of platforms where youths can form useful labor market contacts may be a powerful tool to ease the transition from school to work. In addition, we believe that the evidence forcefully suggest that one important reason

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[14] Swedish examples of interventions which explicitly introduces employers involvement include the evaluation of employer involvement in training programs (SWIT, see Johansson 2008), evaluations of employer-based programs for immigrants (SIN, see Åslund and Johansson, 2011) and employer-oriented job search assistance (Jobbnätet, see Liljeberg and Lundin, 2010).

[15] As an example of particular relevance for youths, Forslund and Skans (2006) provide a comparative study showing that work practice programs provide faster access to jobs than training programs for Swedish youths

for why social networks appear to play such an important role for the job-matching process is that it conveys information about worker traits to prospective employers. It is likely to be difficult to find good substitutes for this type of information transmission since, as noted by Casella and Hanaki (2006), networks provide privileged information at a low cost and firms may prefer privileged information before public information. In addition, it is evident that different firms may prefer to recruit workers with different types of specific traits (see Simon and Warner, 1993) and it may be difficult to transmit information about such traits through other means than social networks or direct contacts.

A first, and obvious, policy lesson from these results is that they suggest that it is useful to integrate meetings with potential future employers into the design of social programs targeted towards entering workers. There are also good reasons to believe that meetings between youths and prospective employers that last for a non-trivial amount of time are more useful. In particular if we believe that contacts matter because they convey information to prospective employers about worker traits, then contacts are likely to matter more if they carry more information about these traits. This could either be because firms can make inference through an assumption about similarity (as with relatives), because there is a trusted intermediary (such a public employment service officer who is known by the employer) or because firms (or particular employees) have been able to assemble direct information from a work-related context. It is also noteworthy that results in Kramarz and Skans (2013), where strong tie networks (the family) are compared to weak tie networks (classmates parents, neighbors, other plants within parents' firms), suggest that tie strength is particularly important for youths with poor formal merits (low schooling or poor grades). Although policies are unlikely to provide contacts that resemble those provided by family ties, the results, if taken at face value, suggest that policies should be weighted towards few but long-lasting contacts, in particular if targeted towards the weakest youths.

The results discussed in this article also suggest that contacts with employees, and not just employers, are useful. Most notably, the original research presented in this paper shows that coworkers (from summer jobs) who change employer before the young worker graduates continue to provide a useful bridge into employment.[16] Results

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[16] Similarly, it should be noted that the results in Kramarz and Skans (2013) exclude self employed parents.

from previous research do however suggest that individual contacts are more important if these are trusted by their employers. Notably, Kramarz and Skans (2013) show that experienced workers with higher wages matter more. Similarly, Hensvik and Skans (2013) show that firms more often recruit former coworkers of employees with higher test scores. This suggests that it is important to facilitate contacts with workers outside of the youths own social spheres since workers within these spheres are likely to be young and inexperienced. In line with this argument, our own results also show that moving contacts are more relevant if they are older (although the reemployment probability is higher if the original workplace had a younger staff).

Here, it is also important to note that solely relying on the youths' non-professional social contacts may be an inefficient policy route. As noted by Bentolila et al (2009), a heavy reliance on contacts from the social domain may distort occupational choices into fields where the youths have access to better social networks and away from the fields of their productive advantage. In practice, it may therefore be difficult for vocationally inclined youths with academic parents to find employment within a vocational field if the only route to employment within this field goes through non-professional social contacts.

The empirical results also show that contacts (parents and former coworkers) who are trained within similar occupational fields as the graduates are more important. An implication of this result is that policies that are carefully targeted to accomplish a good match between the fields of education and the types of firms where the contacts are established are likely to be more useful. For example, closer cooperation between schools and local employers in order to ease transition into summer jobs placed within a relevant segment of the labor market could further the usefulness of summer jobs as a stepping-stone towards regular employment.

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Appendix A

Empirical setup and estimated models

Figure A1 below clarifies the setup for our analysis of the role of high school job contacts on the entry into the labor market. The data consists of four components: (*i*) the students (A, B and C) who graduate from a specific vocational track and school in June of 2006; (*ii*) the establishments ("plant") where the students had a summer or extra job in 2005 (1, 2 and 3); (*iii*) the former co-workers, or high-school job contacts obtained through these jobs (a,b and c), and (*iv*) all potential employers available to students after graduation (1,2, 4, 5 and 6).
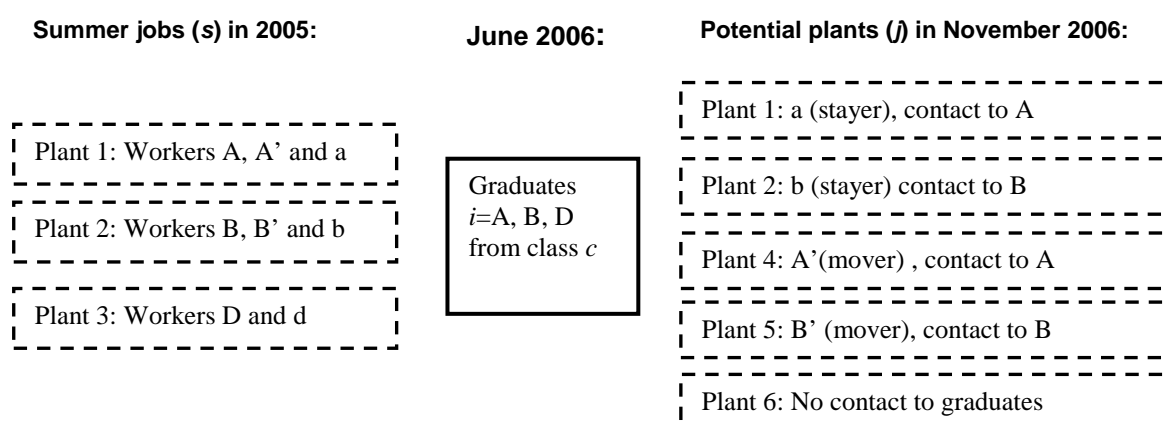

Figure A1 Empirical setup

A.1 High school job contacts and place of work

In the first analysis we examine the propensity that a graduate finds his first stable job in a particular establishment, comparing this propensity for graduates with and without high school job contacts in the establishment. Framed according to the set-up illustrated above, we analyze whether graduate A has a higher propensity to find a stable job in one of the establishments where the contacts work (Establishment 1 and establishment 4), compared to where they don't work (Establishment 2, 5 and 6).

We restrict our sample to graduates who obtained a stable job after graduation. The, given that we know all possible pairs of graduates and potential establishments we can estimate the following equation:

$$W_{icj} = gContact_{icj} + q_{cj} + e_{icj} \qquad (A1)$$

Where W_{icj} takes the value 1 if graduate i from class c is employed by establishment j five months after graduation and $Contact_{icj}$ is an indicator for whether the graduate has a job contact to at least one worker in establishment j. The parameter of interest, g, captures if a graduate has a higher propensity to sort into the establishments where they have high-school job contacts compared to establishments where they don't.

To improve the identification of the parameter of interest, we include a dummy for each combination of class and potential establishment, represented by q_{cj}. The inclusion of the *class×establishment* fixed effects is making sure that we exploit variation in job contacts between individuals graduating from the same class, and is designed to account for any correlation in unobserved characteristics that could generate a spurious correlation between the presence of a contact and the propensity to find a job at a particular establishment.

Following Kramarz and Thesmar (2011) and Kramarz and Skans (2013), we limit the sample under study to cases where there is within-establishment variation in the contact-variable of interest. Thus, we exclude establishment-class combinations where no contacts to any of the class's graduates are employed, such as the combination between class c and Establishment 6 in the example illustrated in Figure A1.

We can also enrich equation (A1) by allowing the contact effect to be different depending on whether the contact stayed or moved from the establishment where he/she interacted with the graduate. Hence,

$$W_{icj} = g_1 Contact\ who\ stayed_{icj} + g_1 Contact\ who\ moved_{icj} + q_{cj} + e_{icj} \quad \text{(A2)}$$

Where g_1 captures the propensity that a graduate is employed in the summer/extra job establishment (i.e. graduate A find stable employment in Establishment 1), and g_2 captures the propensity to end up in an establishment where summer/extra high school job contact has moved (i.e. graduate A find stable employment in Establishment 4).

A.2 High school job contacts and the job finding rate

In the second analysis we assess whether the employment rate in the network of high school job contacts is associated with the graduate's job finding rate after graduation. We therefore add all graduates who had not yet found a job in November of 2006 (e.g. graduate D) and estimate the following model:

$$E_i = l_1 ER_i + l_2 N_i + X_i b + q_c + e_i \qquad (A3)$$

Where E_i measures the employment status of graduate i after graduation; ER_i is the employment rate among the high-school contacts (a, b and d) in 2006; X_i is a vector of individual characteristics (gender, immigrant background, the student's income from 2005 and the final high school grades); N_i is the total size of the network of high-school contacts and q_c is class-fixed effects.

The assumption required for identification is that the network employment rate is uncorrelated with the error term once we control for the observable characteristics and the class- fixed effects. The class-fixed effects are important since they ensure that we compare students facing the same local labor market, which mitigates the potential issue of common exogenous unobserved factors affecting the employment prospects for all individuals in the same industry and location. We furthermore check the sensitivity of the identifying assumption by stepwise including the student's previous income and the final grades, as it is reasonable to suspect a correlation between these controls and the unobserved abilities potentially correlated with the network employment rate.

Appendix B

Additional tables

Table B 1. All graduates in 2006

	mean	sd	median	min	max
All graduates:					
Age	19	0	19	19	19
Female	.46	.50	0	0	1
Immigrant background	.06	.24	0	0	1
Grade percentile rank	.50	.23	.50	0	1
Number of class mates	29.2	29.2	22	0	261
Vocational track (10 most common):					
Media	.08	.28	0	0	1
Hotel- and restaurant	.08	.27	0	0	1
Electronics, data and telecommunication	.07	.26	0	0	1
Childcare	.07	.26	0	0	1
Energy and electricity	.07	.25	0	0	1
Music and drama	.06	.25	0	0	1
Construction	.06	.25	0	0	1
Business	.06	.23	0	0	1
Technical	.05	.23	0	0	1
Health care	.05	.22	0	0	1
Other	.33	.47	0	0	1
Contacts					
Summer/extra job during high school	.68	.47	1	0	1
Observations			39,093		
Graduates with summer/extra job during high school:					
Female	.47	.50	0	0	1
Immigrant background	.04	.21	0	0	1
Grade percentile rank	.52	.29	.52	0	1
Average monthly earnings from summer/extra job (SEK)	3,374	3,915	2,172	8.3	92,067
Number of contacts	315	923	68	1	11,701
Employment rate of contacts	.80	.15	.83	0	1
Observations			26,598		

Note: Descriptive statistics of the used data sets. Data are drawn from the IFAU-data base.

Table B 2. High school job contacts and place of work, by vocational track

	(1)	(2)	(3)
	Average effect	Effect by contact relevance:	
	All contacts	*Relevant contacts*	*Not relevant contacts*
Establishments where the link is through contacts that have moved:			
Construction	0.0058***	0.0283***	0.0033***
	(0.0009)	(0.0033)	(0.0006)
Energy and electricity	0.0033***	0.0227***	0.0022***
	(0.0005)	(0.0041)	(0.0004)
Hotel and restaurant	0.0022***	0.0053***	0.0019***
	(0.0003)	(0.0019)	(0.0003)
Health care	0.0010***	0.0033***	0.0006***
	(0.0003)	(0.0009)	(0.0003)
Business	0.0039***	0.0069***	0.0036***
	(0.0005)	(0.0013)	(0.0005)
Auto	0.0026***	0.0116***	0.0021***
	(0.0006)	(0.0037)	(0.0005)
Media	0.0022***	0.0058**	0.0021***
	(0.0003)	(0.0025)	(0.0003)
Machinery	0.0009	0.0022**	0.0008
	(0.0007)	(0.0008)	(0.0007)
Electronics and computer science	0.0012***	0.0009	0.0013**
	(0.0004)	(0.0015)	(0.0004)
Childcare	0.0015***	0.0028*	0.0015***
	(0.0004)	(0.0017)	(0.0004)

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ Robust standard errors clustered at the class (*school×field*) level reported in parentheses. Each row reports in column (1) the estimate from a separate regression for each of the ten largest vocational tracks in the sample. Columns (2) and (3) report the differential impact of relevant and not relevant contacts obtained from one pooled regression for each row panel with interactions. The estimates and standard errors of the combined effects have been calculated using nlcom in stata (see Appendix A for more details).

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