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Social Networks and Labour productivity: A survey of recent theory and evidence*

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ABSTRACT

In this paper we survey some of the more recent theoretical and empirical literature on social networks and labour productivity. We discuss the use of referrals in recruitment of workers and the possible mechanisms underlying their use as well as ex-post effects on productivity from having connected workers in the firm and the channels for these effects. We also suggest some open questions for further research.

KEY WORDS: Referrals, Screening, Search, Learning, Moral Hazard, Peer effects, co-worker networks, strength of ties, wage premia, wage penalty, favouritism.

JEL CLASSIFICATION: J41, J31, D82, D86, O12, O17

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1 Introduction

The use of social networks in labour markets is a widespread phenomenon- estimates of the use of referrals for recruitment in developed countries vary from about 50% to 87% (Topa (2011)). In the case of developing countries, Munshi and Rozenzweig (2006) show a high prevalence (70%) of referral based entry in blue collar jobs in Mumbai while the white collar equivalent is lower at 44%. Apart from recruitment, social networks affect important labour market outcomes such as wages, employment and tenure. Networks may have some negative effects such as creating inequalities and inefficiencies through the matching process. Ioannides and Loury (2004) document that the use of friends and family to get job information has been growing overtime; however, there is much heterogeneity across locations and demographic characteristics (age, race and ethnicity) in the use of networks. Indeed, US data suggest that almost 1/5th of the difference in the probability of getting employment between black and white youth can be attributed to the use of social contacts (Ioannides and Loury, 2004). Do jobs acquired through referral have better outcomes? The literature mainly supports a wage premium for jobs found through referrals. Firms tend to invest more in formal search in high value jobs. There is robust support for longer tenure and lower turnover for referred jobs. Weak ties are usually associated with higher status of referrers and higher wages while strong ties are associated with lower status jobs and referrers on the same level as workers (Lin et al (1981)). But what are the explanations for these stylised facts? Do networks improve or worsen outcomes in labour markets and how do the answers depend on the context - developed or developing country, types of occupations, market parameters etc? It is important to consolidate the findings to be able to take away the most robust results that carry across different contexts so that policy can be focused on harnessing the power of social networks or constraining them to prevent undesirable outcomes. In this paper, we bring together some of the recent research on the role of social networks in the labour market and suggest some open questions for further research.

The seminal work in the use of social networks for recruitment was done in sociology by Granovetter (1973) whose main insight was that "weak" ties (loosely defined as ties with low levels of interaction) are more important for getting new or non-redundant information. The implications of this theory were explored in a study of a Massachusetts town where he found that the majority of people surveyed had found

their jobs through social contacts and moreover that blue collar workers (characterised by weak ties) were much more likely to find an employee through friends. Since then, a large literature has documented the widespread prevalence of social networks for job search in both white collar and blue collar jobs (see Ioannides and Loury (2004) for a survey of job information networks). In this literature, some of the important questions revolve around supply side issues such as whether social networks are productive, and whether they yield a wage premium or wage penalty. While the evidence suggests that social networks are quite productive for workers i.e. they increase the probability of getting a job, there is less agreement about whether getting a job through a social contact yields a wage premium or a wage penalty¹. Pellizari (2004) uses a large panel dataset on European households to show that there is a lot of variation in wage differences between jobs obtained through formal vs informal means across industries and countries. On the demand side, the questions are concerned with firms' hiring practices: e.g what are the conditions under which the use of social networks improves efficiency and profits? What are the channels through which (if) they do this? Once a worker is hired, how do social connections affect productivity, tenure and promotions of the referred worker? Most recently there has been some focus on the role of the intermediary referrer as well as the strength of ties that are optimal (e.g. Beaman and Magruder (2010), Bandiera et al. (2009) for the role of the intermediary and Karlan et al. (2009) for the strength of ties). We discuss the main themes in the literature organised according to recruitment and post- recruitment use of networks. Section (2) looks at the role of networks on hiring by firms. Once a worker is hired and has social connections among co-workers, these connections may affect subsequent productivity of the firm. Thus Section (3) surveys the literature on the impact of social networks on ex-post outcomes.

¹Rosenbaum et al (1999), Marmaros and Sacerdote (2002) show that workers hired through informal contacts earned a wage premium while Elliot (1999), Green, Tigges and Diaz (1999) showed a wage penalty, Simon and Warner (1992) find a temporary wage premium while others like Marsden and Gorman (2002) find no effect.

2 Recruitment

This section focuses on networks which are formed before the worker is selected into the workplace. Recruitment via networks which we call *referrals* can take place either via an employee at the firm or an outsider. The literature identifies four possible reasons for the use of referrals: (1) search costs are lower for network jobs (Topa (2001), Calvo-Armengol and Jackson (2004, 2007));(2) raising the quality of the match through better information (Saloner (1985), Simon and Warner(1992), Mortenson and Vishwanath (1994), Dustman et al (2011)); (3) Screening (Montgomery (1991), Kono (2006)); (4) monitoring of workers post-employment (Kugler 2003, Heath (2010), Dhillon et al. (2014), (2015)). We will briefly review each of these motivations for the use of social networks in recruitment.

(1) Lowering search costs: Calvo-Armengol and Jackson (2004) formalise the intuition that better connected workers fare better in the workplace. They analyse a model where agents are connected to others in an exogenously given network. Job information arrives randomly across the network and agents transmit information about jobs depending on their own employment status. Agents who are unemployed use the information themselves. Those who are employed will either move if the job is more attractive than their current job, or they will pass on the information to other agents to whom they are directly connected. In each period some of the employed agents randomly lose their jobs. The better the employment status of a given agent's connections, the higher the chances that he benefits: if more of his connections are employed the more likely they are to pass on information on jobs to their links. Moreover, if we consider two networks that are identical, except for starting status of employment, the dropout rate in the lower employment network is higher as well given that agents decision to drop out depends on the future opportunities of getting a job. Thus, dropping out has a contagion effect. The model also explains why unemployment displays duration dependence and persistence. This is because the chances that an agent is unemployed are correlated with the direct and indirect connections with those who are unemployed. This in turn translates into a lower probability of getting job information. The model explains why labour force participation rates and drop-out rates differ substantially between different groups such as blacks and whites in the US. The differences in participation and drop-out rates in turn lead to persistent wage inequality. Their model also explains the positive correlation in employment status of connected agents.

This result is corroborated empirically by Topa (2001) e.g. who shows geographic correlation in unemployment across neighbourhoods in Chicago. Conley and Topa (2002) find such correlation for race and ethnicity status as well as occupations. The model is among the first in the literature that examines how the structure of the network might matter when designing policy interventions². Of course, given the already complicated model, the network structure is assumed to be exogenous and the information transmission mechanism is quite simple. In reality, an agent who already has a job is in a position to choose which of his acquaintances or friends he passes on the information to. It is not clear that the information would be passed on randomly especially if the job is within the same firm as the employed worker. Secondly, there is no difference in ties between agents. As the authors suggest, different types of motivations for using networks might lead to different dynamics. In particular, co-worker networks are likely to be important for the search costs of finding new jobs. A recent paper by Albrecht (2013) studies co-worker networks and shows empirically that the probability of finding a new job as a result of an establishment closure is positively related to the strength of the network of his co-workers (co-workers in the last five years are defined as strong ties). A 10 percentage point increase in the employment rate of a displaced worker's network of former coworkers increases the probability of finding a job in the year after displacement by 7.5 percentage points. The effects, however, are short lived. Calvo-Armengol and Zhenou (2005) show that networks may create negative externalities because of coordination problems: as network size increases the same worker may receive information from multiple vacancies so that above a critical size networks can work to increase the unemployment rate. Cahuc and Fontaine (2009) incorporate networks into a search model. Their focus is on how the availability of choice of different search methods can generate inefficiencies because of the complementarity between firms and workers in using the same search strategy. It is thus possible that everyone uses more costly formal mechanisms even though networks might be cheaper. Thus decentralised equilibria might have inefficiently high costs.

(2) Raising the quality of the match (learning): This approach assumes that there is uncertainty about the productivity of the potential match- Simon and Warner (1992) build on the job matching model of Jovanovic (1979) and show that using old boy

²Later work that builds on the model includes Calvo-Armengol and Zhenou (2005), Fontaine (2008) and Galenianos (2014) who incorporate networks in a general equilibrium search model.

networks of current employees of a firm reduces the uncertainty of the match, improves initial wages and tenure but reduces subsequent wage growth in the firm. A recent paper by Brown et al (2013) uses a new firm level dataset which includes information on referred workers and referrers to examine the predictions from various theories. The size and diversity of the firm permits the analysis of different jobs with different skills and experience levels. The theoretical model is a learning model and emphasizes the effect of a referral in improving the informativeness of the match productivity. The prediction is that the probability of hiring conditional on referral is not necessarily higher with referral, there is a wage premium generated by the higher reservation wages of referred workers due to the lower probability of match productivity exceeding the expected productivity, and a flatter wage profile for a referred worker. The model also predicts longer tenure due to better match productivity. Empirically, they find (i) an initial wage premium that dissipates over time, (ii) longer tenure for referred workers. We refer the interested reader to Topa (2011) for a survey of the theoretical models of job search and matching with networks.

(3) Screening models: the seminal paper in this vein is Montgomery (1991). The model is worth repeating here. There are two periods. Each worker lives one period. There are many workers, with an equal number in each period. Workers can be of two types, either high or low ability. One-half of the workers are of each type in each period and high-ability workers produce one unit of output while low-ability workers produce zero units. Employers are uncertain of the ability of any particular worker. Each firm may employ (at most) one worker. A firm's profit in each period is equal to the productivity of its employee minus the wage paid. (Product price is exogenously determined and normalized to unity.) Each firm must set wages before learning the productivity of its worker. Firms are free to enter the market in either period. Workers are observationally equivalent and unable to signal their ability to potential employers. Each firm must set its wage before learning the productivity of its employee; piece-rate compensation schemes and other forms of output-contingent contracts are prohibited. Given the assumption of free entry of firms, expected profit (for entering firms) is driven to zero. Thus, firms will offer wages equal to the expected productivity of those workers on the market.

The contribution of this paper is to introduce a social structure: each employed worker in a firm (referrer) is connected to at most one worker. The worker connection is stochastic: suppose that referrer and worker are of the high type. There is a probability

$\tau\alpha$ that they are connected, while if the worker and referrer are of different types this probability is $\tau(1 - \alpha)$. Given that each referrer has at most one connection, this implies that some workers may get more than one referral while others get none. E.g. suppose we have three referrers and three workers, assuming that all three referrers have one connection, the possible outcomes are that 1 worker gets all referrals, the first and second worker get a total of 3 referrals and the third gets none and so on. Once the links have been assigned then we know which workers are highly connected and which are not. Conditional on a high productivity referrer being matched with a worker, that worker has a probability $\alpha > \frac{1}{2}$ of being a high type. This is the advantage to firms from using referrals.

The time line of the game is as follows: Firms hire period-I workers through the market, which clears at a wage w_{M1} . Production occurs; each firm learns the productivity of its worker. If a firm desires to hire through employee referral, it sets a referral offer- referral offers can be different between different firms. Social ties are assigned. Each period-I worker i possessing a social tie relays his firm's wage offer, w_{Ri} to his period-2 acquaintance. Each period-2 worker compares wage offers received, either accepting one or waiting to find employment through the market. Those period-2 workers with no offers go to the market which clears at a wage w_{M2} . Finally once the allocation of workers is decided, then production takes place. Basically, the firm uses high productivity workers to increase the chances of hiring high productivity workers via referrals. The period 1 workers are equally likely to be high productivity as low productivity so if there are $2N$ workers, at most N of them can be hired through referral. Given the social structure above, some workers get multiple offers and they choose the highest one as long as it is bigger than the market wage. Those workers who do not receive any offers go to the market and get w_{M2} . In equilibrium there is wage dispersion, referred workers earn a premium: the more connected they are, the higher this premium. There is a spillover in the market- since a majority of high productivity workers get hired through referrals, the expected wage in the market is not bigger than the minimum referral wage. Given free entry of firms, they earn zero expected profit in the market but when hiring through referrals, they face competition only from firms that make offers to the same worker. Thus they make positive expected profits when hiring through referrals. So, the main findings are that referred workers earn a wage premium and all period 1 workers earn a wage premium because of the "option value" of being able to use these workers in the next period. When

the network density parameter τ increases or when α increases, the wage premium to period 1 workers increases at the expense of referred workers and there is greater wage dispersion. Hensvik and Skans (2014) provide an empirical test of the predictions in Montgomery (1991). They show that firms use co-worker networks of incumbent workers to recruit high ability candidates when ability has unobservable dimensions. High ability employees are called upon and wages of referred workers are predicted by incumbent worker (referrer) ability.

The model assumes that the referrer simply passes on information and there is no issue of referrer incentives. In order to introduce referrer incentives one possibility would be to explicitly model the relationship between the referrer and worker such as the strength of the tie on the social dimension as well as his ability type. The fact that referrers might favour agents who are socially close to them even if not high ability is not taken account of. Indeed, giving the right incentives to referrers (e.g. bonus linked to performance of referred worker) might make referrals more expensive, so in equilibrium it is not clear that referrals would be used. Beaman and Magruder (2012) question these assumptions in a laboratory experiment in the field. They point out that referrers may not have the right information on ability (consistently with the Montgomery model above where low ability referrers have a lower chance of referring a high ability worker), and even if they did, they may not have the right incentives to choose the high ability worker rather than a friend or relative. In their experiment they test for ability of referrers and referred workers in the lab. They vary the incentives to referrer and find that high ability referrers indeed refer high ability workers when the incentives are right (pay linked to performance of workers) but not when pay is fixed. Low ability referrers however cannot distinguish between high and low ability workers. Fafchamps and Moradi (2013) use data from the British colonial army in Ghana 1902-1928 and show that referred workers performed worse than other workers, especially when recruited by higher ranking servicemen. We conjecture that this study confirms that referrer incentives are important- one reason for the worse referrals from higher ranking servicemen might be that they have nothing to lose as they do not have a long enough time horizon to cooperate with the employer. Kono (2006) follows Montgomery in assuming that referrals help in screening potential employees, but investigates what happens when the network size (fraction of connected workers) increases. He finds that an increase in network size reduces market wages and referral wages through the lemons effect and the bargaining effect - the former refers to the market wage of unconnected

workers while the latter refers to the referral wage which falls when bargaining position of the referred workers decreases.

Saloner (1985) studies a screening model where referees know more about workers than firms. The use of intermediaries alleviates problems of asymmetric information. In the model, however, incentives of referees are aligned with the firm, but there is competition between referees to get their own candidates chosen by the firm and they act strategically in giving recommendations. Referee incentives are to get as many of their own candidates hired as possible but also ensure high quality of candidates referred as their reputation depends on it. The equilibrium has both referees choosing the same set of workers to refer in the highest quality tier in such a way that total demand is equal to the number of workers signalled as high quality. This makes the set of high quality workers recommended a function of the demand, and the average quality decreases as the number of vacancies increase. The main take away from the paper is the role of competition between different information intermediaries when intermediaries do not have misaligned incentives with the employer (due to reputational reasons) but rather have an interest in pushing their own candidates. Competition between referees thus makes the information revelation coarser than it would be with a single referee under these conditions. The idea of competing intermediaries is an appealing one and as yet is under-explored in the literature on referrals.

(4) Models of Moral Hazard: If there are jobs which do not require high skills, moral hazard may be a more important force in driving referrals. In the Montgomery model, we may then interpret α as the probability of shirking conditional on being referred. If $\alpha < \frac{1}{2}$ then a referred worker is less likely to shirk. This is the spirit of the model used by Kugler (2003) (discussed later). Since homophily is no longer important, any employed worker can be chosen to refer a connection, assuming incentives are aligned. However, for the same social network assumptions, we conjecture that connected workers will get higher wages and there will be wage dispersion. Referred workers will earn a premium and referrers might also earn a wage premium for similar reasons as before (option value). The predictions of the two types of asymmetric information end up being quite similar. This brings us to an important implicit assumption in the Montgomery (1991) model: workers and referrers have purely monetary incentives. In fact, usually workers and referrers are in a social relationship rather than just a professional one. While the model applies well to white collar jobs where referrers and referred workers are connected professionally (weak ties), it might be less suited to model blue collar jobs

where it is social relationships and strong ties that matter.

Dhillon, Iversen and Torsvik (2013) provide a model that endogenizes referrer choice of worker. Referrers and workers are assumed to have social preferences towards each other. There is only moral hazard and no role for screening because they consider low skilled jobs where the main issue facing the firm is worker moral hazard and piece rates are not possible. As in the micro-finance literature, referrers (taking the place of groups) act as social collateral when they refer a worker. Their value as social collateral depends on their stakes in the firm while their value as referrers depends on the strength of ties with the referred worker. The worker and referrer are assumed to interact in an exogenously given social network and the stronger the tie the higher the likelihood that the worker chooses not to shirk. Unlike the Montgomery model, they assume that referrers participation in the referral decision is not guaranteed and if it is, the incentive constraint is not always satisfied. Referrer and worker social preferences are explicitly modelled as a combination of directed altruism and monetary incentives, which are substitutes in utility. The fact that the worker cares about the consequences of his behaviour on the referrer coupled with the fact that the referrer stands to lose rents in the firm if the worker misbehaves, implies that the employer can reduce worker moral hazard by hiring through a referrer. In the model the referred worker suffers a wage penalty whenever his referrer gets some strictly positive utility from staying on in the firm. The referrer also suffers a wage penalty interpreted as the price paid for the patronage provided by the right to hire a worker. When collusion is possible between the referred worker and the referrer then the firm always prefers strong ties between the two (due to the wage penalty to the worker). The key assumption driving these results is that there is excess supply of labour due to underlying frictions such as minimum wages. This puts the bargaining power squarely in the hands of the firm. If the situation is reversed and there is excess demand for workers then it follows that there must be a wage premium for referrers although there is a wage penalty (conditional on the same job and the same degree of moral hazard) for referred workers relative to non referred workers. The robust findings are that strong ties are optimal when the main motivation for referrals is moral hazard and when the referrer gets some strictly positive benefits in the firm, tied to worker performance. These findings are empirically corroborated by a small study of migrants in India. The main empirical finding is that referrals for blue collar unskilled jobs are usually characterised by strong ties and that referrers are people who are higher in the firm hierarchy.

Heath (2015), in a very similar vein also considers moral hazard rather than screening and she considers the use of joint punishments for a referring and referred worker. She studies garment factories in Bangladesh and finds robust patterns on the level and variation in wages for the referral pair. Her theoretical framework builds on the literature on joint liability in microfinance. In contrast to Montgomery's model she assumes that there are observable differences in ability between workers and the only issue is to incentivize workers on the effort dimension. The market structure in the garment industry is such that there is very high turnover of workers, the time horizon is usually not more than 2 years. Since future rewards are limited, the only way to incentivise workers is by offering them concurrent wage increases in response to better performance. Coupled with minimum wage laws, however, this may not be worthwhile for workers who have low productivity. In order to break even, however, the firm could offer a joint contract to the referral pair where the referrer agrees to take a wage cut in case of bad outcomes. If the theory is correct, we should observe correlated wage changes for the referral pair when quality of output can be observed. Her predictions include positive correlation in wages of both referrer and worker, a higher variance in wages conditional on referral, higher observed ability of referrers, but lower ability for referred workers. Referred workers would have a higher wage trajectory than non referred workers. She finds robust support for the predictions.

In Kugler's (2003) study, however, the focus is on the use of referrals to monitor workers. It is assumed that referrers have a comparative advantage in monitoring referred workers. On the other hand, using networks implies a smaller pool of workers to choose from for firms that do not have access to large networks. The model builds on a matching model to allow both firms and workers to choose between the two search methods. Firms and workers with larger networks prefer to use referrals while others prefer to use more efficient formal matching methods. In equilibrium there is segmentation in the labour market: firms and workers with larger networks use referrals, and pay efficiency wages while firms with smaller networks use formal methods and pay market wages. The model (as all search models) takes into account the market tightness parameter which plays a critical role when trying to explain wage premia/penalties from referrals. In her story networks create inefficiently high levels of unemployment by generating a wage premium for referred workers. When market tightness increases it reduces the arrival rate of acceptances and makes firms more keen to use formal methods but on the other hand the formal wage also increases, and this incentivizes

firms to use referrals. Networks are assumed to be inefficient in the matching technology relative to formal methods. However the model does not consider the costs of moral hazard: networks can improve efficiency if the cost of moral hazard is taken into account. On the empirical side it is shown that high wage sectors are associated with the use of referrals while low wage sectors use formal methods. *Ceteris paribus* firms with larger networks are more likely to use referrals. The model assumes that referrer incentives are satisfied. As in the Montgomery model the focus is on market based search vs network search. Montgomery assumes a perfectly competitive market while Kugler has a search model with frictions. Both allow free entry of firms. In both models, workers with larger networks benefit from higher wages. Referrals lead to higher wages thus attracting an inefficiently large number of workers: because of the coordination required between workers searching for jobs and firms making offers, this implies that there is higher unemployment in equilibrium than with no networks. The cost difference in searching with networks vs formal methods is not modelled. Neither of these papers delves too much into the mechanisms by which workers moral hazard is reduced due to the referrer's presence but the experimental paper by Dhillon et al (2015), discussed later, focuses on social preferences such as directed altruism or directed reciprocity.

What if we replaced moral hazard with screening in the Kugler model? The conclusions would be similar to Montgomery, with a lemons effect reducing the number of firms using formal methods and a higher wage for referred workers inducing an inefficiently high number of firms and workers to use referrals. If this conjecture is right, it suggests that the main difference lies in the conclusions Kugler (2003) gets on the inefficiency of informal search when markets are imperfect.

Observationally, however it is hard to separate the screening and moral hazard incentives for using referrals especially in the absence of data on different jobs within the same firm characterised by different requirements on the ability dimension and the moral hazard dimension. Dhillon et al (2015) run a laboratory experiment where they can separately assess the effect of moral hazard. The main idea is to use software designed to extract Facebook information on friendships from a subject pool of undergraduate students before they choose to participate in the experiment. In the experiment referrers and workers are kept physically separated and anonymous. The only information referrers are given is on the friendship relationships of potential workers but they cannot see who it is. To rule out inference on ability using friendship infor-

mation, they do not use a real effort task - instead the worker gets a fixed wage and decides how much of it to return in various social proximity settings. In this setting, it is shown that employers use referrals 80% of the time, referrers are willing to accept monetary losses in order to be able to choose workers and workers return about 40% more when referral is used rather than anonymous hiring. One of the main contributions of the paper is the use of Facebook information to measure the strength of ties. Topa (2011) defines social networks as the set of social connections linking individuals. There exist different definitions of strong and weak ties. Links between two individuals A & B in a network are considered to be strong if there is high overlap between the set of nodes directly connected to A and the set of direct contacts of B. Links are defined as "weak" if there is very little overlap between A and B's direct contacts. Dhillon et al (2015) use the number of common friends a pair of agents has as a measure of the strength of ties.

A robust prediction of the theories on screening vs moral hazard is that screening does not require the referrer to be present in the firm when the potential worker is hired, while moral hazard explanations usually imply that the referrer and employee must be in the same firm. Marsden (2001) e.g. finds that for managerial, professional or sales/ service jobs, referrals from outsiders are more common while for lower status jobs insiders are the preferred mode, lending some support for the fact that screening is more important in high level jobs while moral hazard is relevant for lower level jobs. Another important implicit difference is in the types of networks that are important for screening vs moral hazard. Since screening assumes that referrers are more able workers and that they know other able workers, it seems that the types of networks being considered are professional networks such as colleagues from previous jobs while for moral hazard it is more social networks-family and friends that are important, relying on social preferences and repeat interactions. This difference has been ignored in the literature.

To summarize, the main points covered in the theoretical literature on the use of social networks in recruitment are (1) co-ordination problems between workers and employers when they select between different search methods (2) efficiency of formal search vs informal search (3) externalities on market wages due to a lemons effect when referrals are used for screening (4) wage premia and wage dispersion due to the use of referrals (5) the use of strong ties when networks are used to overcome moral hazard (6) the difficulties of empirically identifying the causes for the use of networks

in recruitment.

The ideal dataset to test some of these predictions would include information on networks of potential workers and referrers in firms, method of job search and recruitment by the firm for each worker, as well as information on the worker's tenure, shirking and performance within the firm post recruitment. However, the effect of product market competition on referral outcomes could only be tested if there is data on different types of products or services. The only paper we know of that attempts such a study for peer effects (without social networks) is Cornelissen et al (2013) which considers a representative sample of firms, workers and occupations in a large local labour market for over two decades. They distinguish between two sources for positive peer effects: (a) due to peer pressure and (b) due to knowledge spillovers. The evidence supports peer effects in wages which are much smaller in size when knowledge spillovers are likely to be important and larger in the case of lower skilled occupations when peer pressure is likely to be the driving force. They also find that the magnitude of peer effects (measured by wages) are about half the size found in the existing studies of peer effects on productivity. It is not clear why we would expect peer effects to be smaller when accounting for the whole labour market as opposed to a specific firm or occupation. Kramarz and Skans (2014) use a dataset on Swedish population wide linked employer-employee records with detailed information on family ties, neighbourhoods, schools, class composition, and parents and child's employers covering years of both high and low unemployment together with measures of firms' performance. They find that strong social ties (parents) are an important determinant of where young workers find their first job. The effect is larger if the graduates position is "weak" (i.e. low education, bad grades) during years of high unemployment, and when information on potential openings are likely to be scarce. Firms are more likely to use parents when their position in the firm is "strong" (i.e. high wages and longer tenure), and if the parent's plant is more productive. Workers finding their first job through strong ties have faster access to jobs, higher wage growth and have lower turnover. Both workers and referrers, however, seem to suffer a wage penalty at the time of joining. Firms seem to benefit from referrals. The theoretical model that is most consistent with these findings seems to be one of moral hazard rather than just a story about information on job vacancies. Only a moral hazard explanation is consistent with the fact that strong social ties are important only if the parent is present in the same plant and not other plants of the same firm. For all of the other explanations, this pattern should not be

observed. Moreover they find that strong social ties are important especially for less educated youths and the less specific the training of the youth is, again suggesting that it is not the skill but the reliability of the worker that is in question. They do not, however, address the mechanisms behind their findings.

3 Ex- post outcomes and networks

So far we have concentrated on the research on recruitment of workers using social networks. Once workers are recruited however, there may be other ways in which networks affect productivity - this is covered by the literature on the interaction between networks and peer effects. Once workers are employed in the firm there are different ways in which networks may affect the interaction between workers and thus workers' productivity. Mas and Moretti(2009) use high frequency data on productivity of workers in a large supermarket chain and find that the presence of more productive workers has a positive impact on the productivity of other co-workers. The responsiveness of workers to co-workers presence is higher when they interact more often with them. They use variation in composition of co-workers over the course of a work day. They also find evidence that the relevant channel for productivity spillovers is pressure rather than altruism. On the other hand, experimental evidence from the laboratory (Falk and Ichino (2006)) suggests that the standard deviation of individual productivity is lower when peer effects are possible. Also low productivity workers are much more responsive and overall output increases when peer effects are possible. What happens to these peer effects when mediated through social networks? Bandiera et al. (2009) show that having a more able friend increases worker productivity of lower ability workers by about 10%, the magnitudes are comparable to an increase in monetary rewards. Higher ability friends are willing to give up about 10% of their earnings when they are with friends. They also claim that friendship networks are more salient than e.g. gender or nationality networks. The spillovers in productivity are driven by heterogeneity in ability across workers. Workers try to conform to a norm of productivity when paired with connected workers. Putting the results of the two papers together suggests that peer effects are different when mediated through networks, at least in that productive workers also reduce their production when paired with friends. It seems that directed altruism plays a role rather than altruism per se. A series of papers look at the impact of team incentives vs individual incentives (e.g. Barton et al (2003) find that team

incentives raise productivity by about 14% but most of the increase is due to selection effects and team composition—diverse teams were found to be better). Indeed, as Bandeira et al. (2013) point out - team incentives affect both moral hazard and selection into teams. They study a setting where there is a trade-off between social networks which reduce free riding or otherwise improve effort, and sorting on ability in the team. When team incentives become more high powered then there are incentives for workers to find people of similar ability rather than sort on friendships. They vary the incentive scheme from team incentives to rank incentives and tournaments. They find that rank incentives lower productivity by 24% relative to team piece rates because team composition changes and the power of social networks in reducing free riding is not harnessed. However tournaments have a monetary component which is sufficiently large to induce workers to sort by ability and to respond by increasing effort. The dispersion in pay increases as incentives become more high powered, suggesting possible negative effects on morale. They highlight substitution between monetary and non-monetary (social networks) incentives to work hard. Interestingly, they do not find a positive correlation between ability and friendship which has been a large part of the networks literature (homophily). Apart from the extensive work on individual peer effects and networks, some authors have also investigated the effects of social networks on employees at different levels of the hierarchy, e.g. managers/supervisors and employees. If supervisor and worker are socially connected we might expect some kind of favouritism with its usual negative connotations. On the one hand theory (Dhillon et al. (2013), Kugler (2003), Heath (2015)) suggests that managers may be able to manage better when they are socially connected, thus leading to improved productivity of connected workers relative to unconnected workers. On the other hand, when the manager's incentives are not aligned with the firm's, he may misallocate his managerial effort towards lower ability but more connected workers. Bandeira et al. (2009) test for this in a field experiment where incentives of managers are varied in different treatments to see the effect on allocation of managerial effort to different workers. In particular they investigate the link between managers and workers when managers can choose to allocate their effort between different workers who are differentiated on the basis of their ability and their connectedness to the manager. The design of the experiment is to vary the manager's incentives from fixed wage to performance related pay with a bonus related to the average worker productivity in their line. Workers are paid piece rates so the scope for reducing worker moral hazard is low. However the managers' effort does

affect worker productivity - the technology is such that the two are complementary in production. They find that when the manager is under a fixed wage regime, then the productivity of a worker is 9% higher when he is socially connected to his manager relative to when he is not. However, when managers are paid a bonus related to the average worker productivity, then being socially connected to the manager has no effect on productivity. When pay for performance is used, the productivity of a low ability worker decreases significantly when she is connected to the manager while that of a high ability worker increases when she is not connected. The mechanism is that when managers have incentives to increase worker productivity they switch from helping socially connected workers to helping high ability workers irrespective of social connections. Overall, social networks are detrimental to the productivity of the firm. The results are of course specific to the setting they explore (short term temporary jobs where long term relationships are not observed, piece rate payments to workers, the manager's decisions are perfectly observable to all workers thus restricting the scope for favouritism). As the authors themselves acknowledge, however, the external validity of these results is also limited by the fact that in their setting the managers' and workers' incentive constraints are satisfied. Finally, a new direction seems to be to investigate how identity can play a role. Akerlof and Kranton (2005) argue that "identity" i.e. the sense of self based on belonging to particular groups can affect worker incentives. The laboratory experimental literature has mostly found a positive in-group vs out-group bias (see e.g. Chen and Li (2009)). The challenge here is to be able to separate out the effect of identity as opposed to the network as both depend on membership in the same group. One method of doing so would be to disclose information on networks without disclosing the identity of the player (as in the paper by Dhillon et al. (2015)).

4 Conclusions

In this paper, we carried out a survey of the role of social networks in the labour market. We summarize the main findings here and discuss some open questions. Topa (2011) provides a list of stylised facts about referrals in the empirical literature: A large prevalence of referrals has been documented in both developed and developing countries ranging from 52% to 87% for workers and from 36% to 88% for firms. Workers looking for lower status and blue collar jobs, less educated workers, younger and less experienced workers, those from high poverty neighbourhoods are more likely to use

informal search methods. There is some evidence that use of referrals and productivity of referrals is different for different demographic groups. The productivity of referrals vs formal job search is relatively high in terms of generating a job offer as well as accepting one. The theoretical literature has pointed out a variety of ways in which social networks affect labour markets- they may create inefficiencies in search, inequalities and unemployment persistence, on the other hand they may improve the quality of the match, via screening and reducing moral hazard. Depending on market conditions (market tightness) and the type of job (whether screening or moral hazard is relevant) they may give rise to wage premia or wage penalties. An expansion in network size reduces both market wages and referral wages. Referrers may not always have the right incentives, and the strength of ties between referrer and referred worker may differ depending on why social networks are being used. The literature loosely supports a wage premium for referred workers as well as longer tenure and lower turnover for referred workers. Referrers are generally higher status individuals relative to referred workers. Referrer and referred worker wages may be positively correlated.

The work on peer effects mediated through networks has not been as abundant, except for the series of papers by Bandeira et al. One of the main findings seem to be that social networks have large effects only when monetary incentives do not conflict with social incentives or when such monetary interests are not too high. This suggests that social networks do generate some value to even the person who is on the "giving" side, but the value is bounded.

Most studies are for developed countries where networks are arguably less important. The survey on community networks and development by Munshi (2014) suggests that there are important differences between the use of social networks in developed vs developing countries. Given the lack of well-functioning formal contract enforcement institutions, it seems reasonable to expect that social networks have a much richer role to play in solving labour market problems related to contract enforcement or search frictions in developing countries. However, we have not come across any papers that explicitly carry out this comparison. Data on the market settings, on how and why different firms use networks and what guides their choice of recruitment is still missing. Within firms, the kind of job is also important but not explored much. The question of wage premia or penalties e.g. must be related to market conditions and job type but this has not been studied empirically (Brown et al (2013), however, do carry out a study of a local labour market). What sorts of ties are important for referrals, e.g.

co-worker ties or family ties? Does the answer depend on the type of job- whether ability is more important or the scope for moral hazard is more important. One can also relate the use of networks as an alternative to monetary payments when there is crowding out of intrinsic motivation. Can intrinsic motivation be improved with the use of social networks? The importance of these questions ultimately stems from the bigger questions on whether social networks improve or hamper labour market outcomes. This is particularly relevant for developing countries given the pervasiveness of social networks.

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